Hennepin County Water Governance Project
An Application of Design Thinking to Governance

Commissioned by
Hennepin County, Minnesota

Produced by
Center for Science, Technology and Public Policy- University of Minnesota

NOVEMBER 2011
Table of Contents

Acknowledgements 2

Executive Summary 3

1. Introduction 4

2. Challenges and Desired Outcomes 8

3. Recommendations for Hennepin County 10

4. Observations and Open Questions 15

5. Methods 19

6. Conclusion 25

Appendix 27

Annotated Bibliography of Case Studies 28

Bibliography of Other Sources 35
ACKNOWLEDGEMENTS

The Center for Science, Technology and Public Policy would like to thank the following people who volunteered their time to the efforts of this project:

**Design Team**
- Erin Anderson Wenz
- John Barten
- Kevin Bigalke
- Ginny Black
- Amber Collett
- Eric Evenson
- Rosemary Lavin
- John Linc Stine
- Richard Miller
- Richard Murphy
- Carolyn Sampson
- Joel Settles
- Doug Snyder
- Judy Sventek
- Lisa Whalen

**Other Interviewees**
- Judie Anderson
- John Bilotta
- Jan Callison
- Jo Colleran
- Deanna Cummings
- Mike Eastling
- Jack Frost
- Sam Geer
- Loren Gordon
- John Gunyou
- Jim Haertel
- Angie Hong
- Jeff Johnson
- Judy Johnson
- Gus Karpas
- Len Kremer
- Peter McLaughlin
- Gene Merriam
- Mike Opat
- Rick Packer
- Neil Peterson
- Tina Plant
- Becky Rice
- Liz Stout
- Michael Welch
- Tim Welle

**Academic Advisory Group**
- Christine Baeumler
- Lance Neckar
- Kathryn Quick
- Deb Swackhammer

**Prototype Testers**
- Christine Baeumler
- Sam Geer
- Jim Haertel
- David Kirchner
- Peter Lindstrom
- Lance Neckar
- Nancy Tyra-Lukens
EXECUTIVE SUMMARY

The surface water governance system that exists today in Hennepin County developed piecemeal from an evolution of practices, methods and goals aimed at meeting changing societal values and needs regarding surface water management. Over the past 150 years these issues have included clean drinking water provision, flooding prevention and control, and water quality improvement efforts regarding point-source pollution. Although the system now is equipped to handle these familiar issues, and much of the system currently functions very well, is it properly structured to recognize and address new water management issues in the future? Furthermore, does the system as a whole operate effectively or efficiently within the tension of the hydrological and political forces that affect surface water management, or with the numerous other public service systems that affect surface water flow and quality?

This report captures the efforts of a project led by the University of Minnesota’s Center for Science, Technology and Public Policy (CSTPP) that looked for ways in which the Hennepin County surface water governance system can be updated and strengthened to address these questions. The project utilized an extensive literature review, over 40 interviews with knowledgeable individuals who work in or with the surface water governance system in Hennepin County and elsewhere, and a collaborative design thinking process with a diverse Design Team panel, to find creative but concrete actions that Hennepin County could take to strengthen its surface water governance system. Through this process the Design Team created four desired outcomes that a surface water governance system should achieve. They envisioned a systematic and science-based governance system that sustainably maintains water availability, mobilizes resources and maintains and restores ecosystem quality. These outcomes guided the Design Team’s efforts and the recommendations drawn from the project.

The CSTPP team culled four recommendations that are supported by all aspects of this project. These recommendations are politically and logistically feasible actions Hennepin County can take to strengthen its surface water governance system, do not conflict with Hennepin County’s current restructuring efforts, and increase the capacity and ability to improve impaired bodies of water in the county:

1. Consolidate the number of watershed districts and water management organizations from 11 to 4 based on existing hydrological boundaries within and outside the county.
2. All water organizations in the county need to have taxing authority.
3. Improve water management planning coordination between watershed districts/WMOs and cities.
4. Some level of coordination, oversight or enforcement in between watershed organizations and the state is needed.

In addition to these recommendations, the CSTPP team highlighted several areas that need consideration before significant efforts are made to restructure Hennepin County’s surface water governance system. These issues, including how governing bodies would be chosen, the best source of financial resources for surface water management, and how standards and activities would be coordinated across county boundaries, focus largely on mechanisms for “how” a new system would be implemented and would operate.
1. INTRODUCTION

This report is the product of a contract between Hennepin County, Minnesota and the Center for Science, Technology and Public Policy (CSTPP) at the Humphrey School of Public Affairs, University of Minnesota. Hennepin County asked the CSTPP to conduct a research and design project to evaluate surface water governance in the county and make recommendations for a system of governance that would enable the achievement of public goals for surface water management. With the guidance of a volunteer Design Team drawn from Hennepin County surface water management entities and the broader public, the Center conducted a literature review, interviews and a collaborative decision process using design and systems thinking. Challenges faced by the CSTPP team and the Design Team, and the outcomes used to navigate these challenges are described in part 2. The findings and recommendations from the project are described in part 3. Future questions that need to be addressed are discussed in part 4. The methods used in this project are described in detail in part 5.

Surface Water Management in the United States

Surface water consists of lakes, ponds, rivers, streams, wetlands and water that moves across the surface of the land from rain and snow. Public management of surface water has changed over time to conform to different social needs. The earliest efforts in the United States to manage surface water for the public good revolved around supplying potable drinking water to and removing wastewater from large urban centers. One of the largest examples is the effort by the state of New York to capture, treat and direct water to the highly populated New York City metropolitan area. Beginning in the mid-1800s, New York constructed a large and intricate system of reservoirs, aqueducts and tunnels to divert and capture river flows from upstate New York, treat the captured water, and distribute clean drinking water to New York City residents and visitors. The system increased and expanded to meet growing population needs, culminating in completion of the final reservoir to store water from the headwaters of the Delaware River in 1964. Today the system of 19 reservoirs and 3 controlled lakes has a total storage capacity of roughly 580 billion gallons of water, 95% of which is delivered uninterrupted to New York City consumers solely by gravity. An equally extensive and intricate system of pipes was constructed within New York City’s five boroughs to collect, treat and remove virtually all of the city’s dry-weather wastewater.¹

As the country’s needs for effective distribution of drinking water and removal of wastewater in large urban centers were addressed, surface water management in the United States for most of the 20th century focused on preventing and minimizing damage from stormwater flooding, along with concerns about the effects of soil erosion caused by water and wind. Stormwater runoff from impervious surfaces was managed with the goal of rapid conveyance and discharge into rivers and streams; in a sense the effort was to get the water out of urban areas as fast as possible. In large urban centers the infrastructure built to manage stormwater runoff was combined with wastewater infrastructure, resulting in the treatment of both stormwater and

wastewater before discharge into rivers and streams. However, during large storm events these systems became overwhelmed, allowing untreated storm and wastewater to flow directly into rivers and streams. Furthermore, many smaller communities in the U.S. simply discharged untreated stormwater runoff directly into local streams and rivers. In areas where stormwater runoff regulations did exist, these focused largely on water flow rates rather than treatment or ecosystem degradation prevention.² Developments in hard infrastructure projects throughout the last century have led to significant advancements in preventing and controlling flooding from large storm events throughout the country, and the results of these efforts remain a major part of our surface water system today.

The Clean Water Act (CWA) in 1972 represented a significant paradigm shift in surface water management in the United States. The CWA outlined for the first time regulatory requirements to manage water quality problems, and gave the newly created Environmental Protection Agency (EPA) the authority to regulate pollution discharge through the National Pollution Discharge Elimination System (NPDES) program. In addition, the CWA required states to create lists of water bodies that could not reduce effluent levels to those required by federal mandate, and instituted the Total Maximum Daily Loads (TMDL) system to give state, regional and municipal public agencies greater ability to manage point source pollution in surface water bodies. The 1987 amendments to the CWA resulted in the extension of the NPDES program to stormwater discharge in incorporated areas with populations of 100,000 or more, and the creation of the Municipal Separate Storm Sewer System (MS4) program to address pollution of stormwater runoff throughout the United States.³ ⁴

This historical progression of surface water management in the United States over the last 150 years reflects key paradigm shifts in how water as a resource is viewed by the public managing that resource. In the early stages of providing clean drinking water to American cities, water in large quantities was seen as a precious resource that is required to live in an increasingly urbanized society. As drinking water needs were alleviated, flooding concerns caused water to be viewed as something that needed to be removed as quickly as possible; an unwanted product of natural hydrologic cycles. Once infrastructure was built to alleviate damages from flooding in much of the country, attention was turned towards improving the quality of surface waters in the U.S. Water was again seen as a valuable resource that not only sustained life through human consumption, but has value for recreation, spiritual inspiration, and visual beauty, and is critical to the survival of flora and fauna throughout the country.

These systems built to manage surface water in all parts of the country developed to meet changing societal needs and values regarding water resources. Future societal needs may focus

³ Ibid.
on non-point pollution sources, ecosystem restoration, rising coastal sea levels or water
diversion to extreme arid climates with dense population centers. In part, this project was
intended to consider the question “How should the surface water management system react,
and what new structures are needed, to respond to changes in societal needs and values?”

**Surface Water Management in Minnesota**

The surface water management structure that currently exists in Minnesota is largely the
product of efforts to mitigate soil erosion from intensive farming practices during the Dust Bowl
of the 1930s. Districts were developed in Minnesota, and throughout the country, to
courage farmers to alter their techniques to more effectively use the state’s soil and water
resources. We can see the legacy of these efforts today in the 87 Soil and Water Conservation
Districts (SWCD) that work with private landowners, county and city governments, and
watershed districts regarding soil and water management in agricultural, forested, urban and
lake areas throughout the state. Although SWCDs manage water resources, in 82 of the 87
SWCDs throughout Minnesota the boundaries of the SWCD coincide with county boundaries,
and in 70% of the state’s geographic area water is managed by counties and SWCDs, primarily
on a county basis.

In addition to SWCDs, parts of Minnesota have created watershed districts to manage surface
water issues that cross city and county boundaries. Following federal and state legislation
passed in 1953 and 1955, respectively, citizens or local government units throughout the state
could petition the Board of Water and Soil Resources (BWSR) to create a watershed district to
manage water issues that required multi-city or multi-county coordination, such as mitigating
upstream activities that affect citizens in a downstream jurisdiction. Many of the watershed
districts in Minnesota outside the Twin Cities metropolitan area exist along large rivers to
manage flooding prevention and control efforts. However some watershed districts,
particularly in the Twin Cities metro area, have broader agendas that deal with water quality
issues, conservation and preservation, and public education programs. As discussed below,
joint powers water management organizations also exist in the Twin Cities metro area to
manage surface water.⁵ ⁶

**The Geographic Challenges of Water Governance**

The interaction of surface water and political boundaries creates three challenges in designing a
surface water governance system: a mismatch between hydrological watershed boundaries and
political ones, inevitable cross-boundary effects regardless of the type of boundary, and the
interaction between surface water and built systems like roads and land use planning that are
governed through political entities, not watershed-based ones.

---

⁵ “What is an SCWD?” Minnesota Association of Soil and Water Conservation Districts.

That SWCD’s jurisdictions are determined largely according to political boundaries, and watershed district jurisdictions are determined largely according to hydrological boundaries, creates a unique and crucial tension when considering management of surface water. Most governmental entities such as cities and counties are based on political boundaries created according to federal law, population density, economic activity and other factors unrelated to natural resource management. However, scientific studies of surface water management issues have repeatedly called for strengthening the system of governance based on hydrological boundaries rather than political boundaries. Since city, county and state government entities, with their politically determined boundaries, are not going away anytime soon, the design of any surface water government system has to address the potential for inconsistencies, duplication and other inefficiencies in the interaction of watershed-based entities and other political structures.

The effects of stormwater and water quality issues extend over multiple jurisdictions, and water is not restricted by city, county, state or national boundaries created by humans. In addition to the challenges caused by boundaries that don’t match, cross-boundary effects create new issues in coordinating the policy response across watershed and political boundaries, as many watershed-based entities are downstream from other watersheds. Agricultural runoff from a farm in one city may drain into a valued recreational lake in a neighboring city. Point-source pollution discharged from an industrial complex in a county that is miles upstream may affect the drinking water quality in a downstream county. The challenge of coordinating surface water governance across geographic and functional boundaries is exacerbated by the different ways that we govern systems that have profound effects on surface water.

So it is worth asking, if public governance entities are charged with managing surface water resources in Minnesota, should these entities manage according to political or hydrological boundaries?

**Surface Water Management in Hennepin County**

Surface water governance in Hennepin County is currently managed by four watershed districts and seven joint powers boards, or water management organizations (WMO). Various agencies at the state, regional, county, and city level also have responsibilities that affect surface water management within the county. The emergence of WMOs in the Twin Cities metropolitan area is the result of the Metropolitan Area Surface Water Management Act passed by the Minnesota Legislature in 1982. This bill required all local units of government within the 7-county metro area to prepare and implement surface water management plans through one of three possible water management organizations: 1) a joint powers agreement between the cities and townships within the watershed; 2) a watershed district; or 3) as a function of county government.

In Hennepin County local units of government created joint powers agreements or joined existing watershed districts. Watershed districts in the county have their own property taxing authority within their boundaries. District board members are appointed by the County Board
of Commissioners. Cities that have formed WMOs appoint the members of the WMO boards and approve funding to WMOs from city budgets generally with funds raised from city property tax levies. One WMO has been granted the authority to levy property taxes directly. Cities also have been authorized to charge property owners with storm water management fees, which many Hennepin County cities do.

Not only do numerous government entities impact surface water management in Hennepin County, but other public sector systems, such as transportation, land-use planning and energy production, have enormous impacts on surface water. Methods used in the construction and maintenance of state highways, county roads and city streets, development of rural areas and redevelopment of urban areas, and the massive intake and alteration of water by thermoelectric power plants all affect water quality, flow and ecosystems throughout the state. The ubiquity and concentration of these systems in the Twin Cities metro area makes their impact on surface water even more pronounced in Hennepin County. So how can we manage surface water in Hennepin County in a way that interacts effectively with other government entities and external but connected public service systems?

2. CHALLENGES AND DESIRED OUTCOMES

Historical analysis of surface water management on a series of geographical scales in this way illuminates how the system that we deal with today in Hennepin County came about. The recently released Minnesota Water Sustainability Framework emphasizes how water management throughout the state has evolved piecemeal over many decades by reacting to specific problems and societal concerns as they arose, rather than envisioning good water management and developing policy to meet long-term and overarching goals. This is not to say that the system that exists today is wholly bad or worthy of system-wide overhaul. But through the interviews conducted and discussions at Design Team meetings, it became clear that the current system in Hennepin County is not one that anyone would design from scratch today. While the current system may be built to handle societal values and needs of the past (drinking water provision, wastewater removal, flooding, and point-source pollution), it may not be structured to effectively adapt to and manage societal values and needs we recognize now or may see in the future. It should also be noted that not all parts of the Hennepin County system are in need of redesign. Through interviews, Design Team discussions and several government reports, it became clear that many aspects of surface water management in the county function very well.

How surface water is managed on these different scales highlights the challenges faced when attempting to redesign the surface water governance system here in Hennepin County. The three questions raised in each section above can be rephrased into a succinct yet daunting design challenge: Create a water governance system for Hennepin County that 1) accounts for varying historical, current and future societal needs regarding surface water resources; 2) resolves, or at least mitigates, the tension between hydrological and political realities in surface water governance; and 3) works within the opportunities and constraints of the myriad other government entities and public service systems within the county. In addition to the
provisional goals outlined at the outset of this effort, this is the task that the CSTPP team and the Design Team grappled with throughout this project.

The Design Team developed four key desired outcomes that a surface water governance system should achieve. These goals guided and focused the Team’s efforts throughout the project, are reflected in the prototypes the Design Team created, and helped shape the recommendations drawn from their work.

The four desired outcomes that a surface water governance system should achieve are:

- **Supply, Quantity & Sustainability**

  A governance system that ensures water availability for all uses (drinking, recreation, industry, etc.) given future constraints (population growth, climate change, etc.) through sustainable planning and protection.

- **Ecosystem Quality**

  A governance system that maintains and restores ecosystem integrity and biological diversity through sediment, nutrient, turbidity, contaminant and “hard” infrastructure reduction, and builds these efforts into stormwater management.

- **Systematic and Science-based Governance**

  A governance system that is based on sound science, integrates human-made, constructed infrastructure with the natural environment, incorporates all the inherent complexities of surface water governance including cross-boundary interactions, and has the authority and capacity to effectively implement water management plans.

- **Mobilizing Resources**

  A governance system that effectively mobilizes and manages financial and “people” resources both within and outside government structures, and has a willingness to invest in the natural environment in order to enhance the value of the built environment.

A system design that met all four of these criteria would be flexible and resilient enough to adapt to changing societal needs and values, operate effectively within both hydrological and political boundaries, and would complement other government entities and public service systems. This holistic system would also meet the strict water management standards that Minnesota is known for and has established over decades of water governance efforts.
3. RECOMMENDATIONS FOR HENNEPIN COUNTY

Through an extensive literature review, over 40 interviews with knowledgeable individuals who work in or with the water governance system in Hennepin County and elsewhere, and a collaborative design thinking effort with 15 experts on a Design Team panel, the CSTPP team identified the following recommendations to better enable the surface water governance system in Hennepin County to achieve the four desired outcomes described above. Each recommendation is supported by what the CSTPP team found in the literature, and is reflected in the interviews conducted and the prototypes developed by the Design Team during this project (see Appendix for prototypes). In addition, none of these recommendations conflict with Hennepin County’s current efforts to merge the Hennepin Conservation District into the county government structure. Finally, while these recommendations cannot guarantee immediate improvement of impaired bodies of water in Hennepin County, they represent steps to strengthen the capacity and ability of water governance entities to mobilize resources aimed at recuperating those bodies. The two main themes that are consistent in each of these recommendations were also the main questions that both the CSTPP team and Design Team struggled with throughout the project: 1) at what geographic scales should water management occur in Hennepin County; and 2) how should we construct the relationships across geographic scale, political boundaries and systems, particularly the relationships between water organizations and cities.

While many valuable ideas and opinions were voiced in the interviews and Design Team discussions, and while there are many examples of effective surface water management elsewhere in the U.S. and beyond, these four recommendations meet the provisional goals set out by the county at the outset of this project and account for the realities and constraints that may hinder efforts to change the current system. These recommendations do not represent the position or statement of any organization, agency or individual involved in this project; rather, they are lessons drawn by the CSTPP team from a comprehensive process of literature review, interviews and design thinking exercises. The CSTPP recognizes that implementation of these recommendations will require action by Hennepin County and other levels of government, and that these actions are not entirely within the county’s power.

1. Consolidate the number of watershed districts and water management organizations from 11 to 4 based on existing hydrological boundaries within and outside the County.

Throughout the course of this project, Design Team members struggled with finding the most effective geographic scale for managing surface water in Hennepin County to achieve the four desired outcomes envisioned by the Team. Certain scales yielded positive and negative results depending on which outcome one referred to. One extreme the team considered focused on a very local scale to engage citizens and motivate local communities to manage surface water, and this was seen as a positive step towards achieving the mobilizing resources criteria. We heard many times that citizens relate to specific, usually very local, bodies of water rather than to the watershed.
A real-world example of success at this scale is Contra Costa County, CA, located on the San Francisco Bay just east of Oakland, Berkeley and Marin County, CA. There, volunteer citizen watershed groups associated with specific bodies of water coordinate surface water management efforts with regional nonprofit organizations and government agencies to share experiences and practices to fit the needs of their community watershed. Over the past 30 years this effort has resulted in an overall watershed ethic that is improving the quality of lakes and streams within the county, as well as the larger San Francisco Bay area. However, although Contra Costa County is similar in size and population to Hennepin County, it has only 19 cities in its boundaries compared to 45 cities and one township in Hennepin County. So while beneficial in some respects, moving to a more localized watershed management system in Hennepin County would increase the number of water organizations that cities deal with, and would likely exacerbate other complexities in the system.

Another extreme the Design Team was asked to consider was extending water management responsibilities beyond the county boundaries and to the river subbasin level (see Figure 1). In this case, organizations governing surface water that intersect Hennepin County would represent the South Fork Crow Subbasin, Crow Subbasin, Twin Cities Subbasin and Lower Minnesota Subbasin. This geographic scale was considered positive for a more systematic and science-based governance system, and would allow for effective supply and ecosystem management on a broad, river-based scale. However, team members were concerned the large organizations would lose the connection to local input from citizens and cities, and might struggle with effective implementation on a project or site scale.

The Design Team was also presented with the idea of consolidating the watershed districts and WMOs along political (in this case city) boundaries to reduce the complexity created by one city crossing the boundaries of multiple water organizations, and to address the tension between managing surface water along hydrological or political boundaries. The Design Team, however, rejected this idea and asserted firmly that surface water in Hennepin County be managed along hydrological boundaries. This premise of management on hydrological boundaries is backed up by nearly all the literature the CSTPP team examined, including the Minnesota Water Sustainability Framework, the National Research Council’s report on Urban Stormwater Management, and numerous journal articles, and was voiced in many of the interviews the CSTPP team conducted.

After considering these options, the CSTPP team recommends consolidation of the current structure to the four new water organizations developed by the Design Team outlined in Figure 2. This consolidation is reflected in Prototypes 1 and 2 developed by team members, and takes into account both hydrological and political boundaries: new water organizations 2, 3 and 4 all follow river subbasin boundaries seen in Figure 1; new water organization 1 encompasses several river subbasins, but Pioneer-Sarah Creek and Elm Creek WMOs have

---

Figure 1
River Subbasins Surrounding and Intersecting Hennepin County
Figure 2
Existing and Proposed Water Organizations in Hennepin County

EXISTING WATER SHED ORGANIZATIONS IN HENNEPIN COUNTY

PROPOSED WATER ORGANIZATIONS IN HENNEPIN COUNTY

<table>
<thead>
<tr>
<th>NEW WATER ENTITY</th>
<th>MERGED WATER ENTITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ELM CREEK WMO; PIONEER-SARAH CREEK WMO</td>
</tr>
<tr>
<td>2</td>
<td>SHINGLE CREEK WMO; BASSETT CREEK WMO; MISSISSIPPI WMO; WEST MISSISSIPPI WMO</td>
</tr>
<tr>
<td>3</td>
<td>MINNEHAHA CREEK WD</td>
</tr>
<tr>
<td>4</td>
<td>RILEY-PERGATORY-BLUFF CREEK WD; NINE MILE CREEK WD; RICHFIELD-BLOOMINGTON WMO; LOWER MN RIVER WD</td>
</tr>
</tbody>
</table>
similar water management needs and similar population densities so could merge together relatively easily. In addition, this consolidation simplifies the system by reducing the number of water organizations that most cities will occupy, but without expanding water organizations to the point where they lose connection with citizens and local government units. Finally, implementing this consolidation would require minimal structural changes within Hennepin County, as the boundaries for the new water organizations would follow the hydrological boundaries that already exist.

2. **All water organizations in the county need to have taxing authority**

Hennepin County currently has 46 lakes and 167 miles of streams that are considered impaired bodies of water according to the MPCA. Although federal and state regulations require that water management entities (including counties, watershed districts, WMOs and cities) implement restoration measures to improve impaired waters, many of these water bodies remain below standards for water quality. While there are several factors that affect this ongoing challenge, the most commonly cited reason in interviews and Design Team discussions was the lack of funding capabilities in WMOs. The inability to mobilize financial resources for water management projects that often require capital, technical or public education investments can significantly reduce an organization’s ability to effectively improve surface water resources and restore ecosystem integrity. In joint powers organizations, like nearly all WMOs, the resources available from the member cities are restrained by the funding level approved by the most reticent members. The practical outcome is that, except for the Mississippi WMO, Hennepin County WMOs have significantly fewer resources available to improve outcomes.

Minnesota and the Twin Cities metro area have designated local government entities specifically tasked with managing surface water. However, if these entities do not have the mobilizing authority and capacity to implement effective surface water management plans, Hennepin County will fall short in its efforts to effectively manage surface water resources. Furthermore, the process of giving all water management organizations taxing authority has already been successfully done in recent years. In 2001, the Mississippi Water Management Organization became the first joint powers WMO to receive property tax levy authority. This option would also simplify the water management system in the county by creating one water organization funding mechanism with which all cities can coordinate. Although little literature was found on this issue, themes from the interviews conducted largely support this option.

3. **Improve water management planning coordination between watershed districts/ WMOs and cities.**

A critical area for implementing the four desired outcomes that came up in Design Team discussions was the planning process for water management projects, specifically improved coordination in planning and pre-planning stages between water organizations and cities. Through Design Team discussions, the CSTPP team recognized the potential for implementing good water management practices through better integration of water
management plans and comprehensive land-use plans of all kinds. Effective collaboration in the planning stage before spending funds on intensive capital improvement projects can save valuable resources, provide space for sustainable management methods to be included in comprehensive land-use plans, and allow for participatory processes that incorporate more voices and viewpoints into planning efforts. Two very different examples illustrate this effort to integrate water management and land-use planning:

- Scott County DRT – The Scott County Development Review Team (DRT, pronounced “Dirt”) is an example of how participation and holistic input are integrated into larger private and public land developments within Scott County. This process is intended to provide developers with an advisory review of the development request through a sketch plan without incurring major costs. This review involves representatives from city and county departments so that developers get a whole-system perspective of what their development will entail, and that allows government officials to voice opinions and offer alternative advice on aspects of the development. It was stated in Design Team discussions that this happens very early in the process to minimize the costs of retroactive alterations at later stages in the development.8

- Singapore – This island city-state occupies a land area of roughly 270 square miles, half the size of Hennepin County, with a population of nearly 5 million in 2009, more than three times the population of Hennepin County. To avoid resource reliance on neighboring water supplier Malaysia and to ensure a sustainable and steady domestic water supply in the future, Singapore has made significant strides in recent decades to become completely water self-sufficient. These measures include capturing and using every drop of rainfall that hits the island, recycling and reusing water from domestic and industrial processes, sustainable management of the island’s limited freshwater reservoirs, and some desalination of seawater. To accomplish these goals, the Singapore government aligned all facets of government behind the effort towards water self-sufficiency and integrated sustainable water management planning and practices into all land use developments on the island.9

4. Some level of coordination, oversight or enforcement in between watershed organizations and the state is needed

In trying to resolve the issue of at what scale surface water management should occur, all three prototyping groups in the Design Team included some form of surface water management responsibilities at a level geographically above watershed districts, WMOs and

---


cities. Because water issues are widely different between metro region counties and non-metro counties, the Design Team’s prototypes illustrate the potential for some surface water management role between the state and watershed levels. As shown in the prototypes, one group delegated the roles of groundwater coordination and dispute resolution to counties. Another group placed regulation, monitoring and planning responsibilities with a larger metropolitan regional entity. While the group intentionally left the identity of this organization unspecified, it could be an existing organization (the Metropolitan Council, BWSR regional agency, etc.) or a newly created metropolitan surface water coordination organization. The third group also placed some water management tasks with an unspecified county or regional-level governing body. Although the three groups did not agree on what that governing body should be or at what specific scale it should exist, it was generally thought that some water management issues require a regional perspective that watershed districts, WMOs and cities cannot provide.

Through interviews and discussions with experts in academia and in the field, it became clear that groundwater recharge is one aspect of water resource management that needs to be coordinated on a regional scale of some kind. The Design Team identified water supply as one of its desired outcomes, and although groundwater is not specifically under the purview of surface water management, there is no question that the two systems are interconnected. In addition, nearly all water management plans for watershed districts and WMOs in Hennepin County mention groundwater recharge as part of their water management efforts. However, groundwater recharge can be a complex issue depending on the geographical location of the water, which aquifer is being accessed, and the features of the ground beneath the surface. For some municipalities, for example, the aquifer recharge point is in residents’ backyards. But for some the recharge point might be miles away in another city, county or even watershed. So as groundwater recharge becomes more prominent as a water resource management issue, this is one example where some kind of regional coordinating effort is needed in the metro area.

One example from the literature of a successful regional coordinating body is the Aragon Water Commission created in the Aragon region of northeastern Spain. This commission acts as a coordination, oversight and recommendation committee regarding water management in the territory. This territory covers nearly 20,000 square miles (almost four times the size of the 11-county Twin Cities Metropolitan area) and is home to a diverse range of climate types, including permanent glaciers, verdant pasture and orchard lands, and arid steppe plains. The Commission was created in 2001 in response to over 20 years of protests that municipalities and regions within the territory were not consulted or included in the planning of large water management efforts, such as dams, that had largely negative effects on local communities. The Commission’s purpose was to gain input from a more diverse group of water users to include a wider range of viewpoints and encourage participation among local communities in water management. This “water parliament” now consists of 65 members representing 17 different groups of stakeholders at a variety of geographic scales. Although the Commission does not have significant enforcement or sanction authority, it is largely seen as a respected, regional coordinating and oversight
body that effectively manages a variety of water resource needs throughout the Aragon territory.\textsuperscript{10}

4. OBSERVATIONS AND OPEN QUESTIONS

Although the recommendations described above represent key areas where Hennepin County can make specific and significant strides in strengthening its surface water governance system, there were many issues and ideas raised throughout the project that were not fully discussed, investigated or debated among both the CSTPP Research Team and the Design Team. While both teams made tremendous efforts in the limited time available to critically and objectively examine the surface water governance system in Hennepin County, and developed extensive and constructive suggestions regarding “what” a redesign of the system would look like, there was not sufficient time to develop mechanisms for “how” that system would develop, function or operate. Developing the “how” was the dominant theme from the feedback gathered about the team’s prototypes from knowledgeable people outside of this design process, and should be the primary focus of future efforts beyond the four recommendations listed above.

Several points raised during the project are worth mentioning and discussing briefly as open questions moving forward:

1. \textit{How should the water organization governing bodies be chosen?} During the design process Design Team members did not reach consensus on how the boards of the water organizations in their prototypes should be chosen or on the composition of the boards. Currently in Hennepin County, watershed district board members are citizens appointed by the County Board of Commissioners. WMO board members are citizens and elected officials appointed by member city’s councils. None of the Design Team members favored direct election of water organization board members. The goal of creating a science-based system of governance can be advanced by having the county appoint knowledgeable citizens who are to some degree insulated from the pressures of politics. This degree of insulation can be valuable, for example, when the issue under consideration is a new real estate development with significant employment and other economic benefits. Elected officials, however, can be more tuned to public needs, values and wants, and can be held directly accountable to the public that they serve. In addition, where a government body has the power to levy taxes, some degree of accountability to the taxpayers is important. While there was strong disagreement among Design Team members regarding how governing boards should be chosen, the CSTPP team recognized that a hybrid of both elected officials and appointed citizens may effectively incorporate both features.

Examples of hybrid commissions and boards exist within Hennepin County. Three Rivers Park District consists of a seven-member board of commissioners, five of whom are elected and two of whom are appointed by Hennepin County. The nine-member Bassett Creek Commission also consists of three elected officials and six appointed citizens. If Hennepin County chooses to restructure water organizations within the county, it should investigate this issue further to consider how the boards for these organizations will look.

2. **What should be the source of financial resources for surface water improvement?** The Design Team noted that where water organizations have been seen as successful, they have had sufficient resources to support a professional staff, undertake projects independently or in partnership with other entities, or fund actions by neighborhoods or non-profit organizations. These successful organizations have commonly done this through a property tax. Consequently, the Design Team supported giving similar taxing authority to the new water organizations. At the same time, cities have used surface water management fees not based on property value to raise funds for building and maintaining surface water infrastructure. In some cases, city funding from this source has been combined with watershed district funding to construct joint projects.

The Design Team, however, did not address which of these funding sources was favorable, or the desirability of a hybrid tax-fee funding mechanism. Depending on how the fee structure is designed, fees can create financial, market-based incentives for the property owner to install water management systems, retrofit existing structures, or change behaviors to more effectively manage surface water on private property. If the fees are related to the actual water impact of the property and its structures, the owner could reduce the fee amount by using management practices such as rain gardens, permeable pavements and green roofs. This leverage effect would be increased if both cities and water organizations used the fee method for raising resources. The advantage of taxes based on property value is that they already exist in government funding systems, and they provide reliable income streams against which a city or water organization may borrow to fund large projects.

Hennepin County currently has special levy authority for certain water management projects within county boundaries. If efforts are made to restructure the funding mechanisms for surface water management, and funding resides primarily with water organizations in the county, this levy may no longer be necessary. Depending on the design of a new system, the special levy can be transferred to other governmental units in or outside the county.

3. **How should standards and activities be coordinated across Hennepin County’s boundary?** The Design Team was constrained by the framing of this project within the borders of Hennepin County. As noted above, they looked at using a subbasin level governance system but rejected that idea as involving too large a scale. As several scientific reports have recommended, it would still be desirable to look at ecosystem restoration outcomes at the subbasin level, and further work should explore tools or structures for coordinating work...
throughout a subbasin. Among those tools might be consistent standards (discussed below). Rather than create a whole new subbasin government structure, it might be possible to use information networking as a model for coordinating this work.

The Peer Water Exchange (PWX) is one example of how network technologies can help resolve water management issues. The PWX is a technology platform built for Blue Planet Network that utilizes a network approach to manage diverse solutions to and resources for water crises around the world. It enables users to manage projects before, during and after project implementation, and lets each stakeholder, such as investors, implementers and reviewers, focus on its primary contribution to the project. This transparent and increasingly flexible network system provides tools necessary to handle the specific and largely localized nature of water management issues, and does so without an administering bureaucratic structure.\(^\text{11}\)

4. **How can we integrate the management of other public systems that affect surface water?**

As noted earlier, one of the complexities of designing surface water governance is the strong effect that other systems have on water quality and flow. Highway, road and street design and maintenance, land use planning, wastewater, parks and other systems can have powerful effects on water. However, if given a bigger role in surface water governance, cities present an opportunity to integrate water management methods and practices into the structures that already exist to manage these public systems. The Design Team did not emphasize this possibility because it was unclear whether cities would make the internal changes needed to achieve more integration across their activities to improve water-related outcomes. But, as noted with Scott County’s DRT process, some examples of coordination with local governments do exist. North St. Paul’s “Living Streets” initiative is another example. By extending the “Complete Streets” concept to include storm water management, the city is integrating water quality and flow management measures with their transportation planning and policies. Development of this initiative was done through collaboration between city councilmembers, citizens, city staff and local businesses.

This integration should also be promoted at the metropolitan level. Given the role of the Metropolitan Council in transportation, land use, wastewater, parks and trails management and planning, it may be beneficial to add design features to the water governance system that promote or demand better integration with the work of the Metropolitan Council. However, despite a sense that this was an important issue, the Design Team did not discuss in detail the possibility of adding another system to the many priorities already under the Council’s jurisdiction. The state of Minnesota also has a role to play in the integration of all the systems discussed here. As the county and the state look for ways to improve surface water management, it will be necessary to develop new coordination and integration structures and tools that lead to ecosystem restoration and sustainable water supply.

---

Regardless of what these structures and tools are, they must achieve a balance of consistency and flexibility both within and across jurisdictions.

5. **What new governance tools may be helpful?** During the Design Team discussions, the role of planning and plans arose repeatedly. Five year plans are one way to achieve coordination across levels of government and between government entities of the same type. In theory, a watershed organization could read a neighboring organization’s plan and have some idea how its work might interact with projects upstream or downstream. In some cases, these water management plans are seen as an impediment to governance effectiveness. Cities that overlap several watersheds are frustrated with water organizations that are on different planning schedules, resulting in city staff continually dealing with new planning processes. In other cases, new projects that would benefit surface water arise unexpectedly and cannot be implemented until the governing plan is amended. At the same time, MPCA is developing state-wide Minimum Impact Development Standards (MIDS) which the Design Team saw as a positive step and a useful tool for improving water outcomes. Moreover, state building codes, transportation project design standards and other standards can have a significant effect on surface water. For these reasons, further work on surface water governance should explore how standards and planning could be better utilized to achieve system outcomes.

6. **Where is the citizen?** Design thinking methods focus on the users of a system and the human experience in a process. By including individuals who work every day in or with the water governance system in Hennepin County on the Design Team, this project utilized the experiences and values of these users to examine the current system and construct ways to redesign the system. But government agencies, private companies and developers, and nonprofit organizations are not the only users of Hennepin County’s water governance system. Citizens constantly use the surface water resources and infrastructure that exist in the county for domestic use, recreational enjoyment, flood prevention, spiritual enjoyment, aesthetic value, and ecosystem services. Although numerous Design Team meeting discussions focused on the active roles that citizens can play in a water governance system, time and resource constraints limited the amount of citizen involvement and input that was incorporated into this project. Future efforts to strengthen Hennepin County’s water governance system need to include citizens in this process. \(^\text{12}\)

Citizens not only bring valuable input to planning and development phases of system designs, they can also be a significant resource in implementing effective surface water management practices and methods. This is exemplified in the Contra Costa County example described above, and the mobilizing “people” resources feature in the desired outcomes outlined by the Design Team. Citizens can engage and educate each other to encourage behavior change, implement ground-level water management methods such as

\(^{12}\) We do not mean citizens in a formal or legal sense here. Rather, we intend to emphasize citizens as civic agents with the capacity for civic participation and engagement. The important note here is to ensure that the public has a space in which to voice opinions on, and a role for participation in, water governance in Hennepin County.
rain gardens, and hold elected officials accountable by instigating political change. Citizen communities and neighborhood groups can also effectively deal with some water management issues on a very local scale that government entities may not be equipped to manage efficiently.

7. **What is the role of non-profits and small-scale organizations?** If the responsible actors do move to reduce the number and increase the size of watershed organizations, it will be important to maintain or develop organizations that can work with citizens on the individual or neighborhood scale. Cities can and do play this role; so do non-profit organizations like Metro Blooms. This Twin Cities-based nonprofit organization promotes and implements environmentally sound gardening and landscaping practices to improve the health of our land and water resources. A unique characteristic of Metro Blooms, and other non-profit organizations, is the ability to facilitate and coordinate with numerous government and private entities across jurisdictional boundaries, usually much easier than government entities. One tool available to watershed organizations and cities is grant-making to local-scale entities that can be active in organizing citizens and businesses to play effective roles in restoring ecosystem integrity and ensuring the future of water supply. Existing watershed districts and WMOs have used grant-making and other organizing tools, and they should not be lost in the efforts to change organizational scale. Further thinking about the role of small scale organizations could provide ideas for how to handle the transition to a new system with larger watershed organizations. For example, existing entities might continue to play a local implementation role even as some of their powers are moved to a larger scale organization.

5. **METHODS**

The Hennepin County Department of Environmental Services recognized the issues for surface water governance that have been described earlier and the growing state-level interest in improving water resource management. Consequently, the county hired the University of Minnesota’s CSTPP to conduct a project aimed at designing a new surface water governance system for Hennepin County. The provisional goals of the project were to design a system that 1) produces lakes, ponds, rivers, streams and wetlands that are wholesome, healthy, sustainable and bring delight to Hennepin County residents and visitors; and 2) operates efficiently, transparently and delightfully for all the people who interact with the system. This project was also an opportunity to clarify the roles and responsibilities of the numerous actors at all levels of water governance in Hennepin County.

The CSTPP coordinated all aspects of the project through CSTPP Senior Fellow and Director Steve Kelley, with help from a project manager, design lead, three research assistants and a GIS

---

This group utilized design thinking techniques and approaches, along with a systems modeling perspective, to engage the users of the surface water governance system in Hennepin County. Encouraging a participatory process among system users can bring forth new sources of inspiration and innovation, and foster new system designs that achieve the provisional goals stated above in more holistic and comprehensive ways. Also, applying a systems modeling perspective helped the group find feedback loops of information, collaboration and resources within the current and newly designed systems, and pushed the group to work on a whole-system scale rather than concentrating on individual parts within the system.

Rather than seeking solutions to specific problems aimed at one part of a system, process or product, design thinking methods address a system as a whole and allow specific problems to surface throughout the design thinking process. For this reason the design challenge given to the group remained fairly broad and ambiguous at the outset of the project. Although this can be problematic given time and resource constraints, design thinking methods help teams solve ill-defined problems in complex situations by expanding creative boundaries through divergent thinking, emphasizing the human experience in process and system design, and rationally fitting solutions to the context of the given situation.

THE PROJECT

Design Team

To directly capture the participatory aspect of the design thinking process, this project featured a Design Team composed of knowledgeable individuals from a variety of positions and backgrounds; they brought an array of experiences working both in and with the surface water governance system in Hennepin County. The CSTPP attempted to create a team that fully represented the diverse interests involved in surface water governance, and recruited members from a variety of government levels, from private, public and nonprofit sectors, elected and appointed officials. Due to the significant commitment of volunteered time demanded by the project and the constraint of already busy schedules, not everyone recruited was able to participate. However, the final 15-member Design Team approved by county staff largely captured the many influences that affect surface water governance in Hennepin County.

These members were asked to approach the team as individuals with diverse opinions, backgrounds and experiences, not as representatives of agencies and organizations seeking to push an agenda. Through a series of four four-hour meetings and a fifth two-hour meeting, this Design Team engaged in numerous exercises and conversations designed to consider the value of water to citizens and society, examine the meaning and purpose of governance in water management, think in extremes to tap into new sources of creativity and inspiration, and determine the desired outcomes that a surface water governance system should achieve. In the final meetings the team built prototypes for new water governance system designs that reflected these desired outcomes and highlighted ways that the current system in Hennepin County can be strengthened. In the last stage of the project the Design Team tested out and got feedback on their prototypes from knowledgeable individuals outside this design process, and these comments were incorporated into final discussions among Design Team members.
Research Team

In design thinking processes the Design Team conducts a significant amount of research on the issue at hand prior to diving into the design process. However, due to the nature and size of the Design Team in this project, this would have been ineffective and extremely difficult to coordinate and manage. So, the CSTPP team did a large amount of research prior to and during the first Design Team meetings to familiarize themselves with the current system in Hennepin County, and examine what has been done in other parts of the world to improve water management systems. A portion of the information gathered through the research process was presented directly to the Design Team, but the majority of the research was used to organize the Team meetings and guide the focus and energy of the Design Team members. Given the nature of the project this was an effective, albeit indirect way to connect the research to the efforts and actions of the Design Team.

Academic Advisory Group

CSTPP Senior Fellow and Director Steve Kelley also convened an Academic Advisory Group of University of Minnesota faculty from several fields to provide expert assistance to the Research Team. The Advisory Group highlighted avenues of potential research and resources, raised questions about certain aspects of the project, and offered advice for creative and effective ways to guide the Design Team. Group members were called upon individually for specific questions and advice, and met three times during the project as a group with the Research Team. Academic Advisory Group members: Deb Swackhammer, PhD, Humphrey School of Public Affairs; Kathryn Quick, PhD, Humphrey School of Public Affairs; Lance Neckar, MLA, College of Design - Landscape Architecture; Christine Baeumler, MFA, Department of Art.

THE PROCESS

The design thinking process entails a series of steps aimed at getting designers to expand creative boundaries and “think wrong” in order to tackle complex and ill-defined problems from different angles, always focusing on the human experience in a system. The design thinking concept has been developed and widely used by Stanford University’s Institute of Design (d.school), the international design consulting firm IDEO, independent educator the Nueva School in San Francisco, and many other private sector corporations. However, this success in the private sector has not transferred to the public sector, and there has been little to no application of design thinking to public governance systems. This project is an opportunity to apply these innovative methods to governance structures that can be difficult to navigate and manage, and that can house institutional resistance to change. The CSTPP team tailored the key characteristics of the design thinking process to the circumstances of water governance in Hennepin County (see Appendix for Design Plan).

Step 1: Research, Listen and Observe

The first step in the design thinking process is to research, listen and observe. In the initial stages of this project, the Research Team reviewed the academic literature on water management to study examples of other water governance systems throughout the world.
These case studies ranged from local community-based systems to national and international governance structures. The studies emphasized how the system was constructed and operated, ways the system could be improved, and the successes and failures of efforts to manage surface water in a variety of climates, political arenas and cultural backdrops. The Research Team presented a few of these case studies to the Design Team in a way that described the Roles, Tools, Processes and Spaces (RTPS) categories that were used throughout the project to breakdown and simplify the complex structures and activities that occur within governance systems (see Appendix for RTPS case studies).14 Highlighting examples of effective water governance at a range of scales and in a variety of climates and political environments provided inspiration on how to structure Design Team meetings to most effectively guide the efforts of team members and helped push Design Team members’ thinking to various extremes. The research can provide Hennepin County and other policy making organizations with systems to draw from and possibly emulate in the future.

The Research Team also examined reports and analyses on water management from a variety of sources and at a range of geographic scales. For example, the Minnesota Water Sustainability Framework, commissioned by the 2009 Minnesota Legislature and released in January, 2011 by the University of Minnesota’s Water Resources Center, emphasizes many gaps in water science and policy throughout the state, and includes a wide range of recommended actions for creating a sustainable water future in Minnesota. Also at the state level, the Minnesota Legislative Auditor’s Office released a report on watershed management in Minnesota in January, 2007 that highlighted aspects of the water governance system in the state that were not functioning properly, and recommended that the Board of Water and Soil Resources (BWSR) be restructured and strengthened to play a stronger role in the state’s water management. On a national scale, the National Research Council published a 610-page report on urban stormwater management in the United States recommending greater authority and accountability in stormwater management at the municipal level, and outlined actions to improve the nation’s ability to hold and treat stormwater during and shortly after rainfall. Finally, a 2009 project conducted by the University of Minnesota’s Humphrey School of Public Affairs graduate students examined the surface water governance system in Hennepin County and provided significant background information about the current system for this project.

In addition to an extensive literature review, the Research Team engaged in efforts to observe and listen to the users of the water governance system in Hennepin County to develop a deeper understanding of the values and needs of the people who comprise the system. This is a critical component of design thinking that helps designers shift from engineering solutions to people’s presumed needs, to finding ways to engage them at the level of their actual values and at meaningful points in their lives. A system that is built on the values of those who interact with it can better serve the end users, participants and environment for which it was created. To gain this insight the Research Team interviewed over 40 individuals from a variety of water governance backgrounds and perspectives related to Hennepin County: 8 elected and

---

14 The Roles, Tools, Processes and Spaces categories were based on a presentation by Chris McCarthy, Director of the Innovation Learning Network at Kaiser Permanente.
appointed county-level representatives; 9 current and former board and staff members from watershed districts and water management organizations in Hennepin County; 2 officials from state-level agencies; 2 employees at regional governing bodies; 5 former and current employees at city governments; 7 representatives from private businesses and chambers of commerce; and 4 executive directors from nonprofit and citizen organizations specializing in water issues within Hennepin County. Also, although not formally interviewed, the Research Team had numerous discussions with experts in academia regarding surface water management and governance issues.

The interviewees were asked to describe their role in water governance in the county, what measures they use to value water, what is important to them in a water governance system, how they would measure the success of a water governance system, what works in the current system, and what role, if any, that collaboration, education, ecosystem services and technological tools can play in effective water governance. In addition, interviewees were given a bubble map of the numerous water governance entities and stakeholders that currently exist in Hennepin County, and asked to imagine and draw how they would see the ideal system. The insights from these interviews, discussions and drawing exercises helped the Research Team’s understanding of the current water governance system in Hennepin County, provided guidance for planning the Design Team meetings and exercises, and were used to inform Design Team members during the prototyping phase of this project.

Another tool available to the Research Team was the application of systems modeling to examine and portray the current water governance system in Hennepin County, and to experiment with different ways of designing a new system. Using systems modeling techniques and computer software, the Research Team focused on presenting the relationships and connections between working parts in the system, and feedback loops of information, influence and resources within the current and new systems. Visualizing the ways that certain outputs react to different structural layouts and input variables was beneficial to the Research Team when thinking about where to focus the activities, efforts and functions of a water governance system. Although it has not been used extensively in direct work with the Design Team to this point, there is potential to utilize systems modeling when exploring questions raised by the project on future endeavors for improving surface water governance in Hennepin County.

**Step 2: Generate Ideas**

Following the extensive research stage, designers then engage in divergent thinking through rigorous brainstorming and ideation activities. Through this phase designers expand their thinking to tap into new sources of inspiration and innovation, explore different ways to solve the problem at hand and breakdown the mental barriers that can constrain creativity. By searching for diverse ways of solving problems holistically before grappling with a specific problem at hand, designers can arm themselves with unique and varied solutions before converging on the realities of the context and environment in which they are working.

The first two Design Team meetings encapsulated this phase of the design thinking process. Team members were introduced to the project, its goals and their role in developing a new
design for surface water governance in Hennepin County. In the first meeting, the team engaged in activities and discussions that examined the ideas of governance, management practices, water ecosystems and public engagement on very broad and general terms. The information from these exercises helped identify the level of understanding and consensus among the Design Team regarding the definitions, needs, influences and questions surrounding these ideas. More importantly, large group discussions and the information documented from the first meeting helped Design Team members realize their own understanding of these ideas as a group.

In the second meeting Design Team members were encouraged to think in a variety of extremes to help push their creative boundaries. Members brainstormed ideas in small groups while thinking on temporal and spatial extremes, discussing water problems that existed 50 years ago and water problems that will exist 100 years from now for the whole world, for Minnesota and for their neighborhood. Answers to these questions were then discussed as a large group and grouped together along common themes. By the end of this exercise, Design Team members had what they considered were four detailed desired outcomes that a water governance system should achieve. These outcomes were used throughout the prototype phase of the project to guide Design Team efforts.

Design Team members then dove into thinking in governance extremes. Members were given brief descriptions of an authoritarian and a self-governing prototype example of a water governance system. The authoritarian example was drawn from Singapore’s system of surface water management, a system that is guided, operated and controlled largely by the centralized government. The self-governing example was drawn from a common pool resources governing model at a fishery in Turkey. In this system, the users govern each other based on collective interest in the resource at hand with almost no intervention from an outside entity. Team members took the perspective of citizens and leaders in each example and cooperated to build two general water governance prototypes. This development of ideas from thinking in extremes and attaching those ideas to a tangible prototype helped Design Team members engage in divergent thinking, and opened the door for new ideas before settling into the realities of designing a surface water governance system for Hennepin County.

**Step 3: Prototype and Feedback**

The next phase in design thinking transitions designers from divergent thinking to convergent thinking, and combines the research and ideas from the first two steps into concrete prototype designs that adhere to the constraints that exist in the given environment. Designers also get feedback from the users of the system to ensure that their prototypes account for the values and needs of system users. The prototypes and feedback are used to explain the designer’s ideas regarding how to build a system, determine what will actually work in the given environment, and learn what to do next to implement successful prototypes.

The Design Team spent meetings 3 and 4 engaging in a variety of exercises to construct, define and fine-tune prototypes for a new water governance system in Hennepin County that met the desired outcomes criteria and reflected their own values and experiences regarding water
governance (see Appendix). The prototype matrix represents how one group attempted to go about constructing a prototype, and offers a useful visual perspective of the dimensions in which the Design Team worked as they navigated geographic scales, various governance activities and the desired outcome goals. The other prototype images reflect the progress that three groups of Design Team members made in creating a structure of “what” a new water governance system would look like during these two meetings. Throughout this phase of the process, material from the research and themes gleaned from the interviews conducted were presented to team members to convey opinions and inputs from other sources, and spark new ideas if progress stagnated.

Following the fourth meeting, these prototypes were tested out on knowledgeable individuals who were outside this design process. These testers provided both positive and negative feedback, and highlighted gaps in the prototypes that needed to be addressed. Responses from testers largely revolved around “how” these prototypes would work, and this feedback was taken back to the Design Team in the fifth meeting.

Step 4: Discuss Feedback and Prepare for Implementation

After feedback is incorporated into the prototypes, designers take their ideas out into the real world. They collaborate with stakeholders, include public input to make on-site adjustments, and collect data to track and measure the impact of their proposals.

At the fifth meeting, Design Team members spent two hours examining the feedback from testers and discussing how details in their prototypes might play out in the realities of Hennepin County. Members acknowledged that more work needs to be done before the prototypes are ready for implementation, but were content with the structure of the prototypes at this point.

6. CONCLUSION

This project attempted to redesign Hennepin County’s surface water governance system by utilizing an extensive literature review, interviews with users of the system in Hennepin County, and a design thinking process involving Design Team members with a diverse array of backgrounds and experience in surface water management. During the design process, the Design Team developed a list of desired outcomes that a water governance system should achieve. These outcomes reflected a water management system that would be flexible and resilient enough to cope with past, current and future challenges of all kinds and meets the strict water management standards here in Minnesota.

Drawing from all aspects of this project, the CSTPP team outlined four recommendations that, if implemented, would strengthen the surface water governance system in Hennepin County to better achieve these desired outcomes. Although the Design Team was pushed to think in extremes and expand their creative boundaries, none of the recommendations outlined in part 3 require radical alteration or dismantlement of the current system, nor do they require extreme or widely unpopular political efforts to implement. The CSTPP team also highlighted a
list of observations and open questions moving forward that should be addressed before significant efforts are made towards restructuring Hennepin County’s surface water governance system. These points are intended to complement the recommendations and, depending on the design details of a future system, debating and addressing these questions can facilitate the transition to and implementation of the recommendations.

In short, although the recommendations are a change from how surface water is currently governed in Hennepin County, they are politically and logistically feasible actions to implement. Implementation, however, will require a degree of political leadership at some level of government above the watershed and city scale.
<table>
<thead>
<tr>
<th>ORG. LEVEL</th>
<th>FEDERAL</th>
<th>MULTI-STATE</th>
<th>STATE</th>
<th>WATERSHED/REGIONAL</th>
<th>COUNTY</th>
<th>LOCAL</th>
<th>NEIGHBORHOOD</th>
<th>SYSTEMATIC SCIENCE BASED</th>
<th>ECO SYSTEM QUALITY</th>
<th>SUPPLY QUANTITY SUSTAINABILITY</th>
<th>MOBILIZING RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOALS</td>
<td>FUNDING</td>
<td>PLANNING</td>
<td>REGULATORY</td>
<td>RESEARCH</td>
<td>MONITORING</td>
<td>EDUCATION</td>
<td>IMPLEMENTATION</td>
<td>OVERSIGHT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TASKS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- **X** indicates the presence of a task or goal.
- The matrix represents various organizational levels (Federal, Multi-State, State, Watershed/Regional, County, Local, Neighborhood) and their corresponding tasks or goals.
- The systematic science-based, ecosystem quality, supply quantity sustainability, and mobilizing resources tasks are also depicted in the matrix.
**REGIONAL/WATERSHED ENTITIES**

**STATE OF MINNESOTA**
- Defines roles and aligns goals
- Provides scientific expertise & policy

**Hennepin County**
- Appoints at least one member to each watershed organization

**CITIES**
- Incorporates citizen, local business input or partnerships

**ENGINEERING**

**EDUCATION/ENGAGEMENT**

**REPRESENTATION**

**ROLES**
- Has flexibility to articulate the 'how'

**PLANNING**
- Aligns goals and plans

**IMPLEMENTATION**
- Develops plans to meet state goals
- Ensures the 'what' is accomplished

**DESIRABLE OUTCOMES**
- Mobilize resources
- Ecosystem quality
- Systematic & science-based governance
- Quantity, supply & sustainability

**PROTOTYPE #3**

**GOVERNANCE SYSTEM**
THE DESIGN PLAN
This is a commonly used process in design thinking that CSTPP adapted for the timeline of this project. The first two meetings engaged in divergent thinking to push the Design Team's creative boundaries, work at the extremes and assemble ideas. In the 3rd and 4th meetings the Design Team reverted from divergent to convergent thinking and constructed ideas into workable and tangible prototypes.
Hennepin County Water Governance Project:
A series of case studies in water management and governance practices

Research Team:
Will Nissen
Christopher Jones
Christianne Roach
Nick Swaggert
Gina Hollinday
(GIS mapping)
How to use this packet

WHAT?
This packet outlines some key case studies in water management using a What-How-Why approach. Roles, Processes, Tools and Spaces are also called out within each case study. (See below).

HOW?
Each case study attempts to answer the following questions: What are they doing? How are they doing it? And Why are they doing it?

WHY?
This method of thinking is a way to help sort out the important aspects of a case study without an overwhelming amount of information.

ROLES:
This category is called out and colored if the case study addresses the issue of roles.

PROCESSES:
This category is called out and colored if the case study addresses the issue of processes.

TOOLS:
This category is called out and colored if the case study addresses the issue of tools.

SPACES:
This category is called out and colored if the case study addresses the issue of spaces.
WHAT?
Activities of local volunteer watershed organizations have led to an overall watershed ethic that is improving the quality of lakes and streams within the county, as well as the larger San Francisco Bay. Forums were created as places to share knowledge and insights gained from watershed organizations and volunteer practices.

HOW?
There are 3 basic organization categories in this study: regional nonprofit groups, local volunteer watershed groups associated with specific bodies of water, and governmental agencies. County level coordination enabled local groups to work with the Contra Costa County Department of Conservation and Development to create watershed forums.

WHY?
Citizens became involved because they felt a stronger attachment psychologically to various bodies of water. Volunteer education programs and landscape outcomes perpetuated the desire for citizen activism.

Citizen-level volunteer stewardship was catalyst for county-level change.

County-wide forums lead to the spread of ideas and innovation amongst volunteer groups. Government agencies participate as well.

Small, incremental change increases in scale slowly. Volunteer education programs recruit more citizens to activism as well as informing others of water quality issues.

Multiple scales: project/site, creek (immediate in-stream and riparian), watershed, county, and San Francisco Bay.
Sub-watershed Organization | San Juan Creek Watershed, CA

WHAT?
Five water districts came together to manage wastewater (SERRA) and all other water resource issues (SJBA), except water importation.

HOW?
Two Joint Power Agreements were developed between the five districts. One went well, one did not.

WHY?
Each district had different needs. Overall precipitation was low, ground water quality was degrading and population was increasing.

Residents organized by subwatershed to communicate with elected officials where as the elected officials communicated between districts.

Zoning and development regulation remained district-based.

Joint Powers Agreements coordinated the districts, though law suits settled disputes.

Streams within each district remained under its control. Geographic actions are correlated with geographic responses.
WHAT?
To create a water resource management plan, the government needed to respond to the needs of indigenous populations, and various private stakeholders’ needs. The result was 4 national plans: 1. Improve conditions in the poorest municipalities 2. Foster economic growth 3. Improve competitiveness and 4. Protect the environment.

HOW?
The 4 national plans were created as part of a 2 step approach. Step 1 was to develop an overall water strategy with the help of INWAP (IDB-Netherlands Water Partnership). Step 2 was to create the water management plan through the National Water Commission (CONAGUA). CONAGUA represents many institutions that deal with water.

WHY?
To create a water resource management plan, the government needed to respond to the needs of indigenous groups and various private stakeholders. A participatory approach was key to creating several plans that each address different needs of private sector stakeholders and citizens.

Partnership with INWAP on a national level to create policy. Several disciplines are represented in CONAGUA, which also creates and implements policy.

Different values and goals of stakeholders are addressed through 4 different plans. A 2-step approach led to a water management structure first and then a more specific water plan.

Participatory approach is planned as water policy continues to be implemented. Private stakeholders and civil society representatives will be consulted.
Government & Hydrological | Singapore

**WHAT?**
Connecting the entire human and hydrological system into one system for human use.

**HOW?**

**WHY?**
To eliminate dependence on neighbors and achieve water independence.

---

Government institutions are the predominant role with all other stakeholders complying with the changes.

Streamlining processes for end users such as developers by instituting a permitting one-stop entity.

All water movement connected to a system using technology to monitor and improve water quality and protect users. Legislation developed to maximize and ensure goal is met.

The entire country’s space was identified as able to capture water that fell on or touched its land. Scale was not relevant.
Create a Water Commission | Aragon, Spain

WHAT?
Aragon created a participatory “Water Commission” to act as an oversight and recommendation committee. Infrastructure was financed through a succinct Water Plan. Reconciliation of the water between the mountainous arid region and the fertile lowland was done.

HOW?
By including 65 members representing 17 groups of stakeholders. By creating and publishing a capital improvement plan, Aragon was able to gain feedback to ensure buy in. Utilize spatial planning in order to achieve a balance of water within the region.

WHY?
To gain more participation among diverse levels of water users, Aragon published publicly a cohesive water treatment plan to encourage participatory actions to take place.

The Aragon Water Commission was created consisting of 65 members and 17 groups of stakeholders which represented a “water parliament” greatly improving the debate and inclusion within the Aragon region.

The Aragon Water Commission was created for oversight of all water projects in the region. The plan was created and published using feedback coupled with scientific data to ensure the citizens of Aragon’s concerns were taken into account.

New infrastructure was financed to create new jobs and tools for monitoring water quality.

Water is thought of as a global resource instead of a local resource. Spatial planning necessary to ensure reconciliation between governing bodies, infrastructure and water consumption.
WHAT?
The fragmentation and diversification of water governance structures in Canada have led to inconsistent water policies throughout the country. Because water is a resource that transcends geographical boundaries, there is a need to review and reform the water governance structure to make it more consistent and unified.

HOW?
Each province has its own governance structure that was created piecemeal as Canada’s population and government expanded. One example cited is Lake Ontario, where 15 different government stakeholders have a vested interest in how the lake is governed and regulated.

WHY?
Canada needs to reform its governance structure to facilitate communication and coordination across municipal, provincial and federal boundaries.

In 2009 the Canadian Council of Ministers on the Environment was created to act as a recommendation body for water improvement. Consensus is required to set standards.
ANOTATED BIBLIOGRAPHY OF CASE STUDIES


A concept of co-evolution is argued to complement Integrated Water Resource Management's gap in administrative integration. Co-evolution's complement to Integrated Water Resource Management is explored through issues surrounding joint water management arrangements between the Israelis and Palestinians in the late 1990s and early 21st century. How co-evolution contributes to such a water management approach highlights how we might think about what it means to encourage innovation. Conclusions of the article suggest co-evolution provides the language and description for the changing interactions and political environment, and therefore provides a sharper conceptualization for administrative integration.


This article follows the Aragon Water Commission from inception to publication of white papers and policies. The commission was created in 2001 and in 2004 the 65 members were appointed to develop the organization and begin the commission’s duties. Once appointed, the commission broke up into smaller groups to tackle the five most pressing issues and write proposals to be voted on by the plenum. These issues were: Plan for Infrastructure, The Principles of Water Policy, Water Quality, Projects Falling within the Aragon Water Pact, and Regulation of the Commission itself. The commission attempted to balance each sub-committee with stakeholders from all groups. It is also significant that each policy was adopted with at least 3/5 of the vote. The commission has been highly regarded as having a strong level of community input, which is a result of the high number of members as well as the deliberate approach to each objective. Though not outwardly stated, it should be noted that one of the major reasons why the water commission was formed was due to outdated infrastructure plans, particularly dams that were formed with little to no input from the populace. Also of note is that the president of the Aragon Water Commission is the Aragon Environmental Minister.


A look at Canada's decentralized approach to water governance with four levels: municipal, provincial, federal and First Nations (indigenous). Water supply is usually municipally managed and is subject to jurisdictional, territorial and scalar fragmentation creating a series of governance gaps, overlays and challenges. There is continued tension in Canada regarding harmonization (standardization of laws, rules, and norms) vs subsidiarity (delegation of decision-making and policy implementation to the lowest appropriate scale). The case-study used examines Lake Ontario and the 15 different government actors that have a vested interest in the regulation of the lake. At the 1998 Canada-Wide Accord on Environmental Harmonization, an attempt to solve the harmonization versus subsidiary issue occurred. Consensus was required to set standards that merely reiterated the status quo and were rarely innovative. The Accord only had the power to make recommendations and did not retain the ability to mandate changes to the federal or provincial governments on water regulation.


Over a period of 20 years, different aspects of co-management (the sharing of power and responsibility between the government and local resource users) have come to the forefront. This paper focuses on a selection of these: knowledge generation, bridging organizations, social learning, and the emergence of adaptive co-management. Co-management can be considered a knowledge partnership. Different levels of organization, from local to international, have comparative advantages in the generation and mobilization of knowledge acquired at different scales. Bridging organizations provide a forum for the interaction of these different kinds of knowledge, and the coordination of other tasks that enable co-operation: accessing
resources, bringing together different actors, building trust, resolving conflict, and networking. Social learning is one of these tasks, essential both for the co-operation of partners and an outcome of the co-operation of partners. It occurs most efficiently though joint problem solving, leaning networks can incorporate new knowledge to deal with problems at increasingly larger scales, resulting in maturing co-management arrangements that became adaptive co-management in time.


This paper reviews the current instruments in Colombian legislation for water management, including planning, economic and administrative instruments. In particular, it reviews the Watershed Management and Ordering Plans, administrative permits for water use and pollution, as well as water use and water pollution charges. It analyzes how they could interact and be implemented in order to undertake comprehensive and integrated water management by the regional environmental authorities. The paper then reviews how these instruments are currently being implemented by the regional environmental authorities, concluding that IWRM goals are not being achieved.


Integrated watershed management, preferably under the direction of a watershed or basin management body, has been prescribed in the water policy literature and from other quarters for decades. Few instances may be found where this recommendation has been implemented. This gap between prescription and practice is sometimes attributed to politics, as a sort of nuisance to be overcome or avoided through rational, comprehensive, consensus-based decision making. Fundamental political considerations are inherent in water resources management, however, and are unavoidable even if the desire for watershed-scale decision-making bodies were realized. Boundary definition, choices about decision-making arrangements, and issues of accountability will arise in any watershed and may help to explain why watershed management has more often taken polycentric organizational forms composed of subwatershed communities of interest. An example of a small Southern California watershed is used to highlight the political issues inherent in attempts at watershed management.


Water policies involve very wide-ranging problems. The paper considers the possibility, or the capability, of arriving at agreements that can sustain water management policies at various decision-making levels and regarding a range of issues relating to water. Different types of problems and obstacles that the model attempts to overcome, as well as the main conditioning factors that are likely to be encountered, are analyzed. The proposed model of consultative participation is based on the experience of the Aragon Water Commission.


The Laurentian Vision Partnership is a collaborative planning and design initiative that explores local and regional redevelopment opportunities for depleted iron ore mine lands on Minnesota’s Mesabi iron range. The initiative involves an ad hoc coalition of local, regional, and state representatives from industry, business, communities, education, and government dedicated to advancing the long-term vitality of the region. The initiative is also a land-based case study in the development of transdisciplinary action research. The initiative has employed participatory design tools to promote and maintain collaboration, discourse, and knowledge building across diverse knowledge bases, within a land design framework that considers how changes in active mining processes can regenerate the region’s future ecological and economic environment. This paper outlines the initiative and its projects and methods. It reflects on the partnership’s results and challenges through a review of project documentation, capacity building case studies, and the authors’ professional practice in regional landscape planning, site design, and participatory decision making, as managing members of the partnership since 1999.

This paper examined how in Contra Costa County, CA, the activities of local volunteer watershed organizations have led to an overall watershed ethic that is improving the quality of lakes and streams within the county, as well as the larger San Francisco Bay. Forums were created as places to share knowledge and insights gained from watershed organizations and volunteer practices. The method used to examine this case study was the Transdisciplinary Action Research (TDAR) method. TDAR has 4 primary approaches: participation, collaboration, management, and physical signs of care and ownership. Other methodologies might focus on organization, motivations, activities, and values. In the case of Contra Costa County, TDAR focused on comprehensive, transdisciplinary studies that elucidated the evolution of watershed stewardship as ethic, practice, and physical outcome in the landscape. Watershed stewardship in the California county address various scales such as the project/site, creek (immediate in-stream and riparian), watershed, county, and San Francisco Bay. There are 3 basic organization categories in this study: regional nonprofit groups, local volunteer watershed groups associated with specific bodies of water, and governmental agencies. County level coordination enabled local groups to work with the Contra Costa County Department of Conservation and Development to create watershed forums. Citizens became involved because they felt a stronger attachment psychologically to various bodies of water. Small, incremental change increased in scale slowly. Volunteer education programs and landscape outcomes perpetuated the desire for citizen activism.


Integrated water resource management (IWRM) and water sharing concepts are described. Various definitions of IWRM are presented. It can be described as a facilitated stakeholder process to promote coordinated activities in pursuit of common goals for multiple objective development and management of water founded in sustainable water resource systems. Sustainable water resource systems support social objectives into the indefinite future without undermining hydrologic and ecological integrity. IWRM is comprised of objectives, institutions, implementation, and adaptation, reflecting merging of top-down and bottom-up approaches. It can assume many institutional forms, and is best implemented at the river basin or subbasin scales. Several water sharing models and principles are introduced. Examples of mature yet different IWRM governance structures in California and France are presented. Wide-scale adoption of IWRM remains elusive. Changing societal values, increasing water demands, growing water use conflicts, and link to poverty reduction and economic development provide impetus to adopt IWRM; it remains a promising mechanism to better use and share water to balance economic, environmental, and social aspects that underpin sustainable development.


This paper examines the concept of Integrated Water Resources Management (IWRM) through the lens of several South American case studies. The most common definition of IWRM is “a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.” The goal of IWRM is to reap maximum benefits for the system overall, and not just for the components.

In the Caribbean, the Inter-American Development Bank (IDB) was created decades ago and provided 18% of its lending portfolio to water-related projects and activities. Later, the IDB-8 was created to emphasize socio-economic water-related issues as well as infrastructure ones. In 1998, an IDB-8 IWRM strategy was created that focused action towards 3 levels: constitutional (policies and strategies), associative (river basin / watershed approach) and operational (financing/project-based). The main hurdle the Caribbean must now face with the IDB-8 IWRM strategy is that almost all effort is placed on the constitutional and associative levels, with very little effort placed on the operational level. Other hurdles include the need for the collection of large amounts of basin-wide reliable data, a greater availability of reliable predictive water quality models, investments to obtain benefits from water quality improvements basin-wide.
In Mexico, IWRM appears 37 times in the 2004 National Water Law (LAN). Mexico is currently in the process of developing regional action plans that focus on economic efficiency, including social and environmental considerations as stipulations in an optimization set of equations. Overall, despite collecting data basin-wide, policies have stayed at a paper level and have not been implemented.

In order to achieve IWRM, with support from IDB-Netherlands Water Partnership (INWAP), Costa Rica is developing an IWRM Plan in 2 stages. Stage 1 is to gather information from a highly participatory approach. Stage 2 is to develop the Master Plan itself. Stage 2 put the Ministry of Environment (MINAE) in charge of water allocation, conservation and parts of provision. Smaller groups that represent private sector and public sector interests are the Costa Rican Electricity Institute (ICE), Water Supply and Sewage Institute (AyA), and National Irrigation and Drainage Service (SENARA). These groups were left in charge of respective social and productive water uses, and regulated by a single body. To summarize, MINAE implements the IWRM Plan in conjunction with ICE, AyA, and SENARA, which are regulated under a different body.

Guatemala decided to take a different approach because of different population needs. In order to respond to both indigenous population and private sector needs, a participatory approach was used to create several plans to address those needs. To create a water resource management plan, the government partnered with INWAP to create 4 national plans: 1. Improve conditions in the poorest municipalities 2. Foster economic growth 3. Improve competitiveness and 4. Protect the environment. These 4 national plans were created as part of a 2 step approach. While the Costa Rican government worked with INWAP during Step 1, Step 2 created the water management plans through the National Water Commission (CONAGUA). CONAGUA represents a variety of institutions that deal with water.


The joint management of shared water resources in the Southern African Development Community (SADC) is contributing to regional integration, socio-economic development, poverty alleviation and the protection of vital ecosystems. The SADC Protocol on Shared Watercourses is an instrument of international water law that entered into force in 2003. The overall objective of the Protocol is to foster closer cooperation between the SADC states for the coordinated management, protection and utilization of shared watercourses through the establishment of river basin organizations. Therefore, it is playing a pivotal role in guiding the establishment of institutional structures capable of jointly managing the scarce water resources in Southern Africa. The Orange River is one of the international watercourse systems in the SADC and of strategic importance to South Africa, Lesotho, Namibia and Botswana, making it an excellent case study in the evolution of joint river management and international water law.


A discussion of the Water Plan of Aragon that includes an analysis of the infrastructure created. There is also a detailed section on how the system was financed, and promoted the increase in jobs resulting from the plan. Does more waste water treatment create better water or does reduction of pollution create a more sustainable water network? If we make more and bigger freeways does it solve our traffic problem or create more traffic? The article ends with a call for an interdisciplinary water manager that has knowledge and experience in engineering, chemistry, biology, medicine, politics, sociology, law and financial management.


A paper on the importance of water quality as a metric, not simply using the delivery of water as a stand-alone benchmark, that utilizes numerous graphs and equations to illustrate the authors' point. In India the
government rates utilities solely on the delivery that has created a “low cost-low quality” system of water delivery and the subsequent health problems associated with low quality water. The authors conclude that further research into the Indian water situation needs to be conducted.


An island county, Fiji has the largest fresh water resources per capita in East Asia and the Pacific, but access to fresh water and the amount of water available to each island is not equitably distributed. A study found that apart from climatological and geological constraints, this inequity is mainly due to water-use practices (for example, rainwater harvesting systems are heavily underutilized). Surface water in Fiji is used for several purposes: hydropower, agriculture, tourism. Overall, the largest surface water withdrawal is from the hydropower and agriculture sectors. In urban areas, the majority of the water supply relies on surface water. The government structure of Fiji has a Cabinet that oversees the Minister of Lands and Mineral Resources. There are 6 departments within this: Mineral Resources Department, Public Works Department, Ministry of Environment, Ministry of Health, Ministry of Agriculture, Town Country Planning. The Public Works department oversees urban water supply, sanitation, drainage, and quality. The Water Supply Department sits within the Public Works Department. The Water Supply Department operates and maintains 32 public water supply systems that include city and town regional supplies. Water pricing is tri-band and funds generated by this pricing funds wastewater practices. Critics note that the monetary cost of water do not reflect the true costs of fresh water. The main hurdles that Fiji faces are water losses through leaky pipes, unmetered use, the small size of storage tanks (future use is not taken into account), quarterly water use meter reading schedules that conflict with monthly billing schedules, old infrastructure, an overbearing water bottling industry, and not seeing surface and ground water as part of a unified cycle.


The sustainability of regional development can be usefully explored through several different lenses. In situations in which uncertainties and change are key features of the ecological landscape and social organization, critical factors for sustainability are resilience, the capacity to cope and adapt, and the conservation of sources of innovation and renewal. However, interventions in social-ecological systems with the aim of altering resilience immediately confront issues of governance. Who decides what should be made resilient to what? For whom is resilience to be managed, and for what purpose? In this paper we draw on the insights from a diverse set of case studies from around the world in which members of the Resilience Alliance have observed or engaged with sustainability problems at regional scales. Our central question is: How do certain attributes of governance function in society to enhance the capacity to manage resilience? Three specific propositions were explored: (1) participation builds trust, and deliberation leads to the shared understanding needed to mobilize and self-organize; (2) polycentric and multilayered institutions improve the fit between knowledge, action, and social-ecological contexts in ways that allow societies to respond more adaptively at appropriate levels; and (3) accountable authorities that also pursue just distributions of benefits and involuntary risks enhance the adaptive capacity of vulnerable groups and society as a whole. Some support was found for parts of all three propositions. In exploring the sustainability of regional social-ecological systems, we are usually faced with a set of ecosystem goods and services that interact with a collection of users with different technologies, interests, and levels of power. In this situation in our roles as analysts, facilitators, change agents, or stakeholders, we not only need to ask: The resilience of what, to what? We must also ask: For whom?


This paper explains the holistic approach and effective governance on water management in Singapore. Since gaining independence, an enabling environment which includes a strong political will has pushed the country successfully to achieve self-sufficiency in water. There are also legal/regulatory and institutional frameworks put in place to ensure effective implementation of its water management policies. The
institutional framework has facilitated an integrated 'whole-of-government' approach to land-use planning, water management, a sound built environment and pollution control. Lastly, the technical framework that comes under its national water agency has effectively managed the entire water cycle as a single system for the whole country.


Before the democratic Spanish Constitution of 1978, federal technocrats made little attempt to consult municipalities on regulations and programs using water. The result was conflicting policies, i.e. dams built that wiped out cities, and waves of water governance-related protests. The culmination of these frustrations led to the Aragon Law on Planning and Participation in Water Management of 2001. Hydrographic water confederations were created that included representatives of the national government, relevant autonomous communities, local authorities and few environmental interests. The authors note that end-users (or consumers) had the most powerful voice and environmentalists were outnumbered 50:1. The councils created acted as a water parliament that sends the central government its proposals in order to ensure coordination. For example the Ebro Council had 7 technical reps, 14 from the central government, 34 from autonomous communities, 27 end-users and four farming and environmental organizations. The Aragon Water Institute has a total of 65 voting members and they associate their success with the creation of a ways and means of promoting debate within society that allowed for the expression of all views.


The aim of this paper is to analyze the coverage of the principles of transboundary water resources management in two key bilateral treaties in the Ganges Basin. The treaties are the 1996 Mahakali Treaty between Nepal and India and the 1996 Ganges Water Treaty between India and Bangladesh. The study reveals that both treaties incorporate several internationally recognized transboundary water resources management principles, e.g. the principle of equitable and reasonable utilization, an obligation not to cause significant harm, principles of cooperation, information exchange, notification, consultation and the peaceful settlement of disputes. The presence of these internationally accepted principles in these two treaties offer plenty of common ground, which could serve as guidelines to promote sustainable water resources management throughout the region.


In light of significant interest by scholars in environmental geography and in studies of social-ecological systems in the multi-scalar, multi-stakeholder aspects of environmental decision-making, we focus this review on multilevel systems of environmental governance in which multiple actors exercise different levels of power, authority, and action to determine 'who gets what' and 'who gets to decide'. We describe literature documenting how new geographies of governance have emerged as state functions have been dispersed upwards, downwards, and outwards to non-state actors. We consider 'What is the role of the state in this reconfiguration of scale and environmental governance?' We focus on how scale and spatiality is being reconceptualized and how borders are reformed materially and socially through new governance practices, and consider the implications for advancing geographic theory and sound public policy.


Integrated Water Resource Management (IWRM) emerged as a popular concept in the water sector in the 20th century. From a highly techno-centric approach in the past, it has taken a new turn embracing Habermasian communicative rationality as a place-based nexus for multiple actors to consensually and communicatively integrate decisions in a hydrological unit. The ‘how to integrate’ approach had remarkable appeal worldwide in promoting authentic participation of all stakeholders. However, critics argue that the domain of water resource management is a political process of contestation and negotiation; the emphasis is on complexities, contextuality, power dynamics and the importance of analysing real world situations.
They demonstrate ‘how integration cannot be achieved’ given the power dynamics in social interactions. These apparently contradictory discourses draw on different theoretical paradigms and polarise the discourse on IWRM, without offering constructive alternatives. To this end, this paper offers an option to complement this polarised discourse by examining ‘how integration actually does take place’ in a strategic context thereby facilitating consensual decisions to integrate water management for a sustainable future.


The national and international level paper predominately uses broad policies, i.e. promote efficient water use, increase efficiency of regulation and distribution of water resources, regulate water use in industry, etc. to describe how water usage is increasing and becoming an important issue in population and pollution. The paper evaluates water quality by using three indicators: five-day biochemical oxygen demand (BOD₅), chemical oxygen demand (COD) and total suspended solids (TSS).


There are no “side effects”, just effects; they are the unintended consequences of our actions. There are three reasons why we do not institute changes: the complexity problem, learning failures, and the implementation challenges. The complexity problem occurs when people do not understand why an outcome occurs. Compartmentalizing evidence into a group of experts conducting a “manhattan project” can result in people who are unwilling to change. Due to the complex nature of a problem, humans divide the issue into cause-effect instead of systems with continuous feedbacks. For example, one is unhappy with his/her current financial situation and strives for more money, only to earn more money and become unhappy they don’t have more. Learning failures occur from our inability to look at the system holistically, with incorrect or limited information and scapegoating others. For example, we confuse military budget with security, GDP per capita with happiness and blame the atrocities at Abu Ghraib as a few bad apples out of line. Implementation failures occur due to a desire to avoid failure, or inability to test systems. A pilot will not test the maximum dive of a plane with passengers on board and most people do not want to appear having made a mistake, thus stifling innovation. The best way to avoid most of these pitfalls is through the utilization of virtual worlds to test the changes to systems. Most policy makers lack training in the scientific method and design of experiments, and thus are unable or unwilling to successfully participate in virtual modeling.


The watersheds in which we live are comprised of a complex set of physical and social systems that interact over a range of spatial and temporal scales. These systems are continually evolving in response to changing climatic patterns, land use practices and the increasing intervention of humans. Management of these watersheds benefits from the development and application of models that offer a comprehensive and integrated view of these complex systems and the demands placed upon them. The utility of these models is greatly enhanced if they are developed in a participatory process that incorporates the views and knowledge of relevant stakeholders. System dynamics provides a unique mathematical framework for integrating the physical and social processes important to watershed management, and for providing an interactive interface for engaging the public. We have employed system dynamics modeling to assist in community-based water planning for a three-county region in north-central New Mexico. The planning region is centered on a ~165-km reach of the Rio Grande that includes the greater Albuquerque metropolitan area. The challenge, which is common to other arid/semi-arid environments, is to balance a highly variable water supply among the demands posed by urban development, irrigated agriculture, river/reservoir evaporation and riparian/in-stream uses. A description of the model and the planning process are given along with results and perspectives drawn from both.


This article analyzes urban growth through the lens of water resources, particularly in Asia and Africa. Demographic change is bigger in today's world than any other change that human history has recorded.
Whereas in 1975, only 190 million people lived in cities with more than 5 million people, the figure had gone up to 394 million by the year 2000. The UN forecasts that in 2015, over 600 million people are expected to live in a megacity. About 60% of megacity inhabitants live in coastal areas (about 30% live on deltas of major rivers), while by 2025, almost 25% of a billion people are expected to live in inland-megacities. 63% of megacity inhabitants are not located in a major river delta that would afford them the lowest water scarcity limit. This paper examines global demographic trends and prospects and relates them to the water sector challenges of large urban areas in developing countries. The conclusion is that the potential problem is vast and that countries and cities have yet to develop a working strategy.

BIBLIOGRAPHY OF OTHER SOURCES


