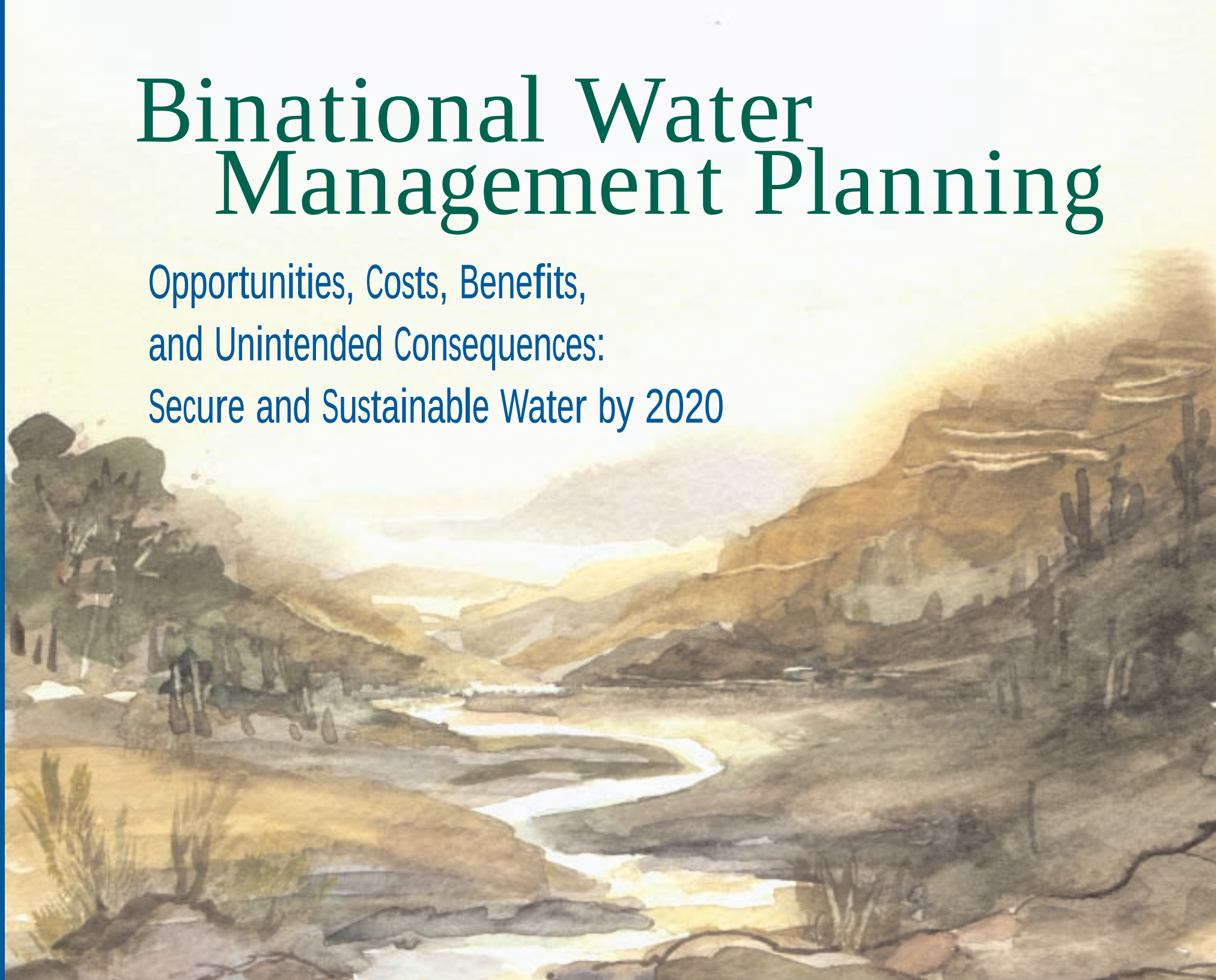
Binational Water Management Planning

Opportunities, Costs, Benefits, and Unintended Consequences: Secure and Sustainable Water by 2020



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Opportunities, Costs, Benefits, and Unintended Consequences: Secure and Sustainable Water by 2020

Conclusions and Recommendations
of the U.S.-Mexican Border Institute IV

Rio Rico, Arizona - May 6–8, 2002

Co-sponsored by:
Southwest Center for Environmental Research and Policy (SCERP)
U.S. Environmental Protection Agency, Office of International Affairs
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Border Trade Alliance

CENTRO DE INVESTIGACION Y POLITICA AMBIENTAL DEL SUROESTE
SOUTHWEST CENTER FOR ENVIRONMENTAL RESEARCH & POLICY

Introduction

Water has emerged as a first-tier issue between the United States and Mexico, a situation that has potentially serious implications for the bilateral relationship. Border Institute IV, held in Rio Rico, Arizona, from May 6–8, 2002, successfully initiated another level of binational dialogue on border water issues, a necessary first step toward long-term planning and regional sharing of water and water-related resources.

"Water management in many ways exemplifies the challenge of sustainable development," Víctor Urquidi said (see page 19 for affiliation) in his introductory remarks at the Border Institute. As population explodes in the border region, the demand for large quantities of clean water increases. This increased demand intensifies competition among water users, including the economy, communities, and the environment itself. The challenge is to balance the needs of natural resources — which represent the future — with current demands from the two nations' economies and citizens. Jesús Román Calleros succinctly summed up the challenge of planning while faced with dwindling resources: "As time, populations, economies, and affluence change, only the flow of water remains the same."

Because border rivers and aquifers are inherently binational and because the institutional capacity to address groundwater issues is lacking, the Institute participants generally agreed that **the federal governments of the United States and Mexico should take more proactive roles in addressing border water issues.** Even top-level decision makers recognize the need for long-term planning. As the *New York Times* reported on May 24, 2002: "President Fox says Mexico has spent decades squandering what it has 'without planning, without sense.'" Similarly, according to Gedi Cibas, water use and distribution are less-than-optimally distributed in the United States because water policy is based more upon precedent than principle.

Some efforts by the federal governments to implement river basin planning have been successful at integrating economic development, environmental quality, and social welfare. The U.S.-Canadian International Joint Commission (IJC), for example, monitors and regulates water drawn from the Great Lakes. However, long-term planning to meet demand in the United States is confounded by states' rights over groundwater and some surface water, while in Mexico water is wholly a federal matter. These institutional and jurisdictional "mismatches" clearly necessitate a carefully constructed, high-level resolution by the two nations.

Border Institute IV Plenary Session *(Left to Right) Daniel Craig McCool, University of Utah; Benjamin I. Muskovitz, United States Department of State; Mary E. Kelly, Texas Center for Policy Studies, University of Texas; Jorge C. Garcés, North American Development Bank; and Denise Moreno Ducheny, San Diego State University.*

Objectives and Focus of the Border Institute Series

The Southwest Center for Environmental Research and Policy (SCERP) created the Border Institute Series in 1998 because it recognized the need for a binational forum that would facilitate environmental policy discussions within the complex framework of Border XXI. SCERP foresaw the potential value of translating the results of scientific investigation into solid environmental policy. Hence, the purpose of the Border Institute series is to convene academics, policymakers, industry leaders, and other border stakeholders in a collegial yet highly work-intensive atmosphere in order to formulate policy recommendations and devise potential solutions to pressing environmental border problems. Participants are encouraged to focus on the **region as a whole and on "the current year plus twenty" horizon, a conceptual two-decade window and landscape scale that foster the development of long-term policy recommendations.**

Each Border Institute addresses the policy implications of selected border environmental issues. It must be emphasized, however, that the Institutes are not a series of isolated conferences. Rather, the thematic focus of the Institutes seeks to address border environmental policy problems in a programmatic way. Border Institutes I through III investigated:

- Demographics and economic development asymmetry across the border
- Environmental infrastructure, natural capitalism, and environmental accounting
- Energy and its interdependencies in the border region

Recommendations from the Border Institute, in the form of executive summaries and a volume in the SCERP Monograph Series, are widely disseminated to decision makers and other border stakeholders. **Presentations from Border Institute IV are available online at www.scerp.org.**

Overview of Water Issues

Stephen Mumme opened the conference with the statement:"There is no more important issue [than water]." He then presented, in a paper written with Ismael Aguilar Barajas, key features of border water issues. He explained that few substances are as vital to the border's future as water and no subject has dominated the past decades' headlines as the scarcity of water and its human dimensions. Furthermore, water capital on the border to the year 2020 is shaped by two fundamental factors: first, the variable supply of naturally occurring water and, second, the steadily rising water demand.The sources of conflict stem from competition among user groups, as summarized in the matrix below:

Competition among Water User Groups

Upstream Users	Downstream Users
Surface Sources	Ground Sources
Urban Inhabitants	Rural Inhabitants
Economic Engine	Environment and Ecology
Irrigation	Cities and Industry
Drought Years	Normal Years

Non traditional users — including tribal nations, ecological resources, and rural communities — now compete for water of which they were once the sole user. **Water is becoming such a major, international issue that many foresee serious conflicts emerging from worsening tensions and conflicts over this resource.**

Water along the International Boundary

Although water in the arid U.S.-Mexican border region has a long history of negotiation and engineering, it remains a highly contentious issue. Mumme delimited the discussion by declaring "Water is locked up by treaties, pipes, and channels." The 1944 Treaty for Utilization of Waters of the Colorado River, the Tijuana River, and the Rio Grande still serves as the principal point of reference for the two nations on questions of boundary waters. However, many consider it to be too limited in today's context of demographic growth and drastically shrinking supply.

> *"Water has risen to the importance of drugs and immigration on the binational agenda, which begs the question of whether any agency (as currently configured) has the ability to address water as a first-tier issue." – Mary Kelly*

Pete Silva was even more succinct; "The current binational appropriation structure is a hopeless anachronism," he said, referring to the allotments to reservoirs on the Rio Grande. While all recognize the difficulty of changing the Treaty, most also realize that "it has greater flexibility than many realize and can be used to deal with current and emerging problems," as Mumme insisted.

Major Events in the Evolution of U.S.-Mexican Water Management

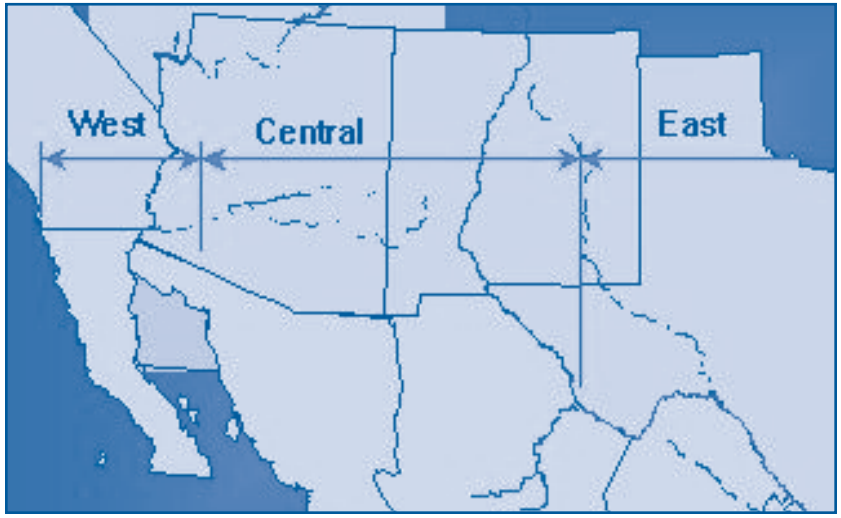
Year	Event	Objectives
1848	Treaty of Guadalupe Hidalgo	Definition of the international boundary.
1889	Convention that created the International Boundary and Water Commission (IBWC)	Observance of the rules of the Boundary Treaties and the Convention in relation to the changes of course in the international rivers.
1944	Treaty for "Utilization of waters of the Colorado and Tijuana Rivers and of the Rio Grande"	Allocated waters of the international rivers between the two countries and extended the functions of the Commission.
1983	Agreement for the Protection and Improvement of the Environment in the Border Area (La Paz Agreement)	Provided formal guidelines for the binational participation of various government levels in the design and implementation of transboundary environmental solutions by specific work groups.
1992	Release of the Integrated Environmental Plan for the U.S.-Mexican Border Area (IBEP)	Strengthened enforcement of environmental laws, increased cooperative planning, completed the expansion of wastewater treatment facilities.
1992	Creation of the Good Neighbor Environmental Board (GNEB)	Advises the President and Congress on environmental and infrastructure issues.
1993	Creation of the Border Environment Cooperation Commission (BECC) and the North American Development Bank (NADBank)	Assist communities on both sides of the border in coordinating and carrying out environmental infrastructure projects.
1996	Release of Border XXI program	Promotes sustainable development in the border region.

(Christopher P. Brown et al 2002; Stephen Mumme 1993; Mark Spalding 1999)

For water planning purposes, the border region can be divided into three subregions: the western region, which is dominated by the Colorado River watershed (the Californias, western Arizona, and western Sonora); the central region, dominated by no large or single river system (Sonora, Arizona, New Mexico, and western Texas); and the Rio Grande/Río Bravo drainage (eastern New Mexico, Texas, and the four eastern Mexican border states).

It is important to point out that many tribal nations are also in the border region and they face important water issues. For example, the very existence of the Cocopah or "People of the River," who once had flourishing communities along the lower Colorado River and delta, is now threatened because of decreasing river flows.

U.S.-Mexican Border Subregions



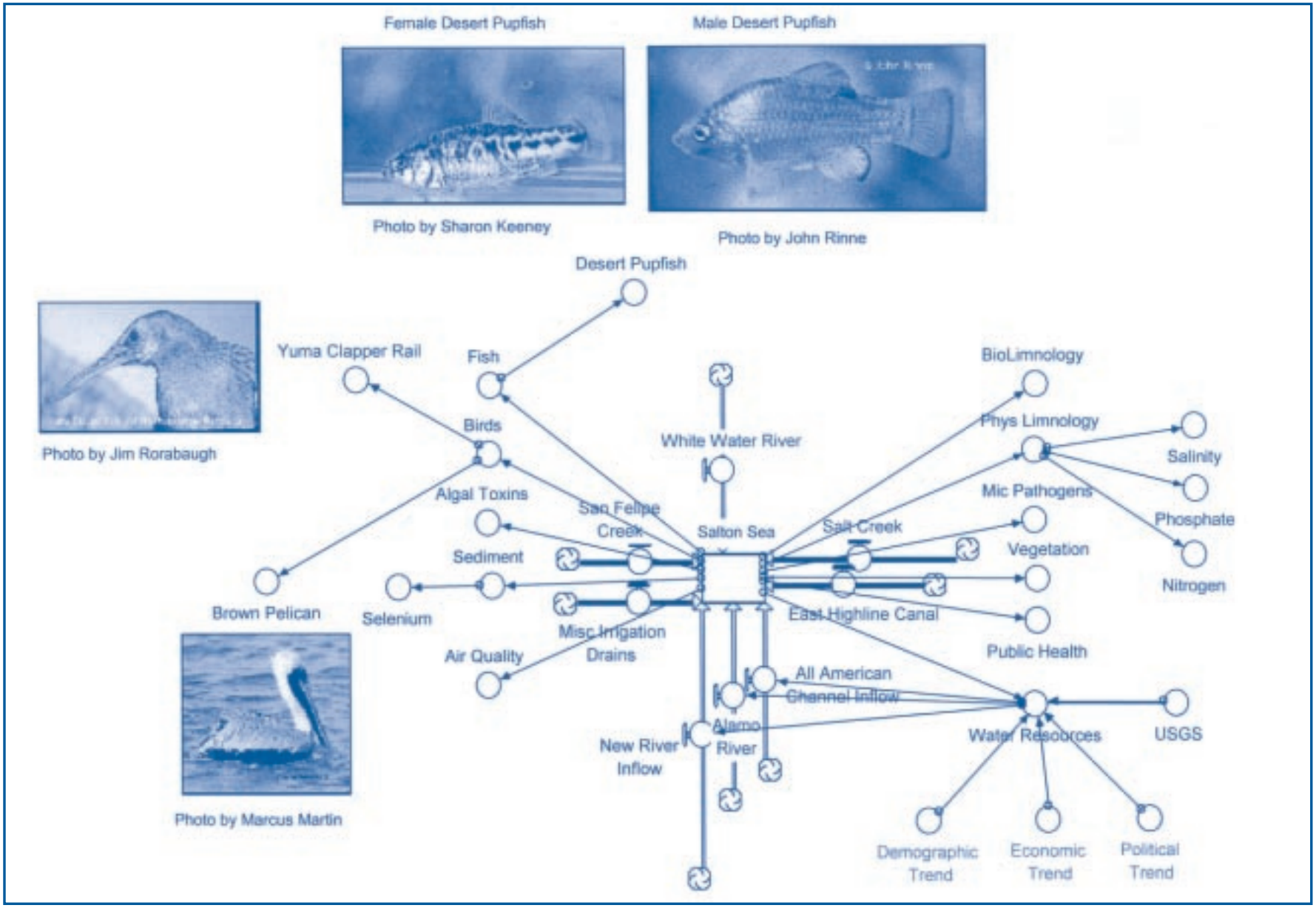
(Ed Hamlyn 2002)

Interdependencies and Discontinuities

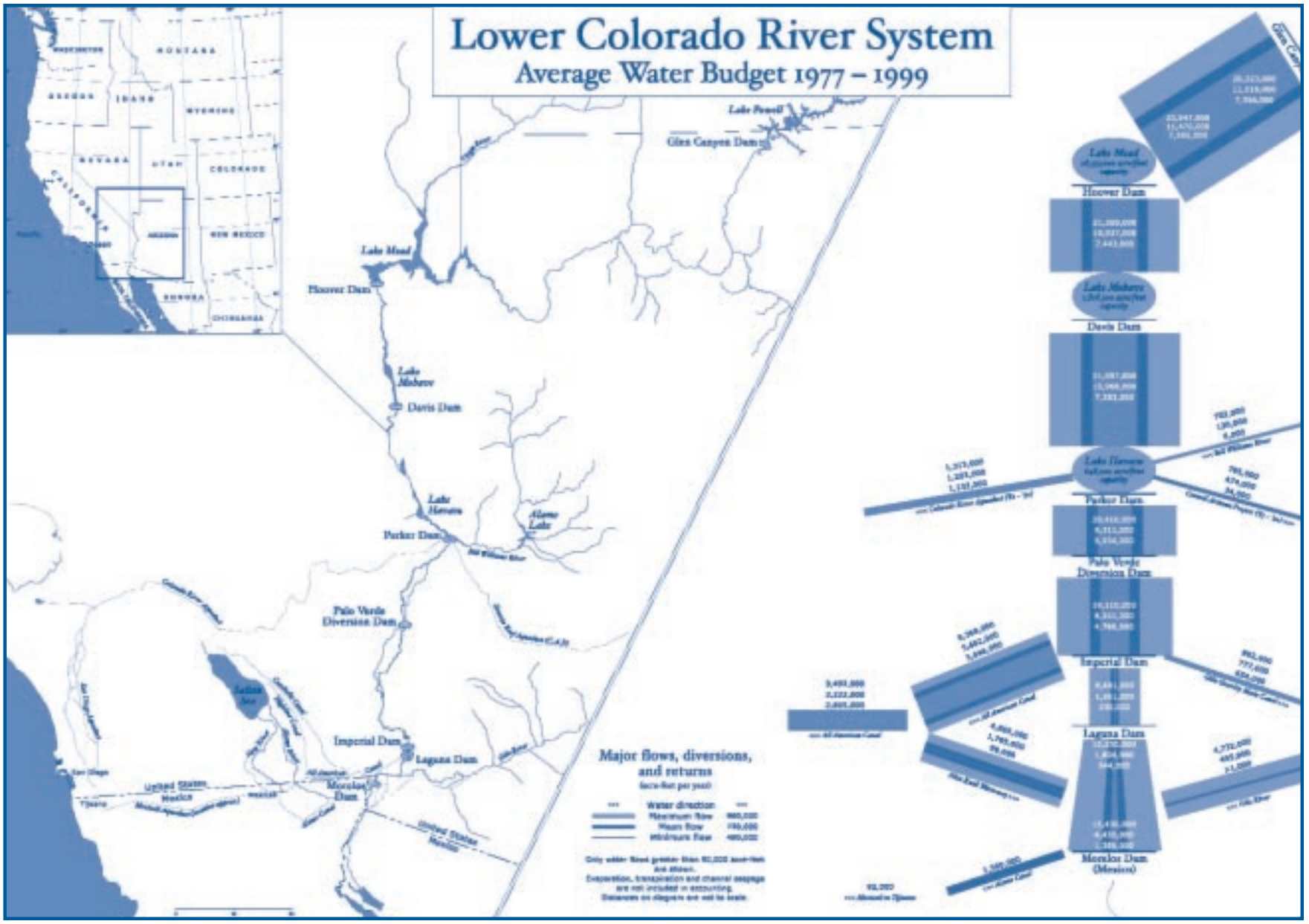
Water is connected to nearly all measures of quality of life (human health, environmental processes, ecological integrity, and economic vitality), yet is subject to control by disparate agencies and competing interests. Water **quality** cannot be divorced even slightly from water **quantity**, nor can groundwater issues be separated from surface water concerns. Flows of water underneath the border, for example, not only replenish aquifers but can also transport contaminants. Additionally, water is intimately linked with energy, air quality, and economic development issues.

"What we have on the border is a kaleidoscope of jurisdictions that often conflict with each other, rather than any form of cooperation to address these complex water issues," said Bill Nitze in his keynote address. These include hydrological, jurisdictional, and competing sector discontinuities, as well as mismatches between the two governments, among the levels of governments, and even within governments. For example, the water supply, water treatment, wastewater treatment, and public health agencies are often separate organizations with different organizational cultures operating in different locations. Institute participants concluded that **strategic planning is necessary to get disconnected agencies to connect and march together.**

Transboundary Water Model



(Michel E. Kjelland 2002)

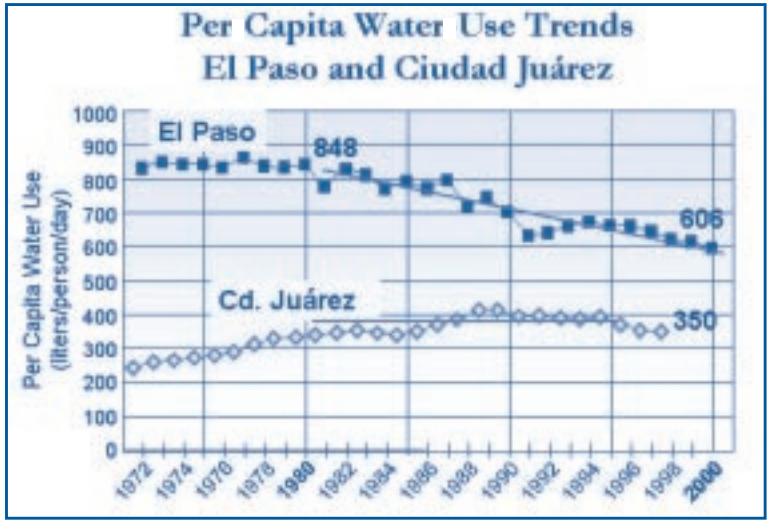


(Jessica Swartz Amezcua and Harry Johnson 2002)

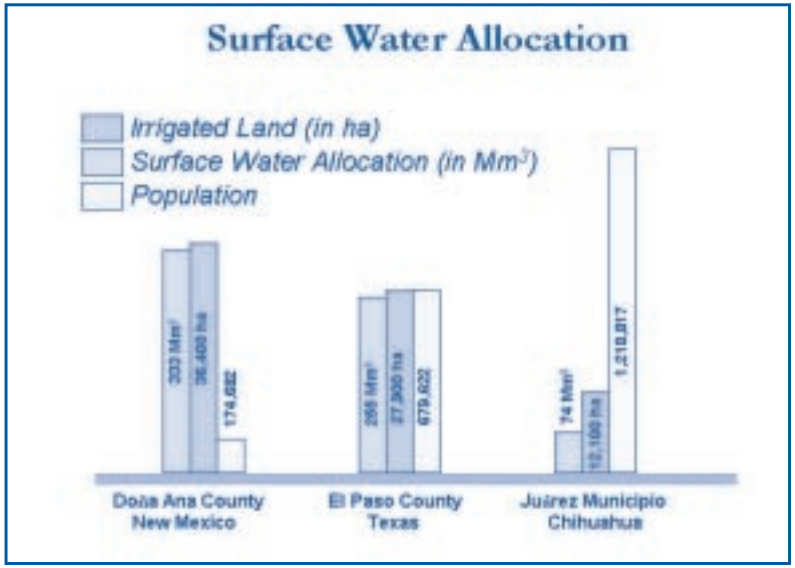
There are also unnecessary and potentially damaging linkages in the treaty addressing border water issues. The Colorado River and Rio Grande, for example, are linked by mention in the same treaty, yet each possesses grossly different issues and has diverse mechanisms to resolve problems. Furthermore, groundwater is not included in the bilateral treaties between Mexico and the United States.

Past, Present, and Future Trends

While the region has been water scarce for decades, extreme shortages and higher costs are looming; probably approaching one side of the border more rapidly than the other. **Historic and current usage patterns reflect the asymmetry in availability and price.** Ed Hamlyn, Oscar Ibáñez, and Charles Turner observed that agricultural use is relatively constant, (using 60 to more than 80 percent of surface waters while municipal withdrawals range from 10 to 30 percent, depending on location) and that increased demand for water is being driven by urban growth. Furthermore, per capita use is higher in the U.S. border cities than Mexican border cities. Likewise, information quality, institutional capacity, and budget size are better on the U.S. side.



(Ed Hamlyn 2002)



(Ed Hamlyn 2002)

Although Ciudad Juárez relies almost solely on groundwater, the allocation of 74 million m^3/year of surface waters from the Rio Grande is especially critical. Water demands in Ciudad Juárez are increasing and its source of groundwater, the Hueco Bolsón aquifer, is overly extracted and declining in quality. The impact of increasing water shortages — on many dimensions of quality of life — will be felt on both sides of the border.

Of course, all water availability is threatened by global climate change. Already the warmer temperatures have caused greater evapotranspiration and there is some indication that less precipitation occurs regionally.

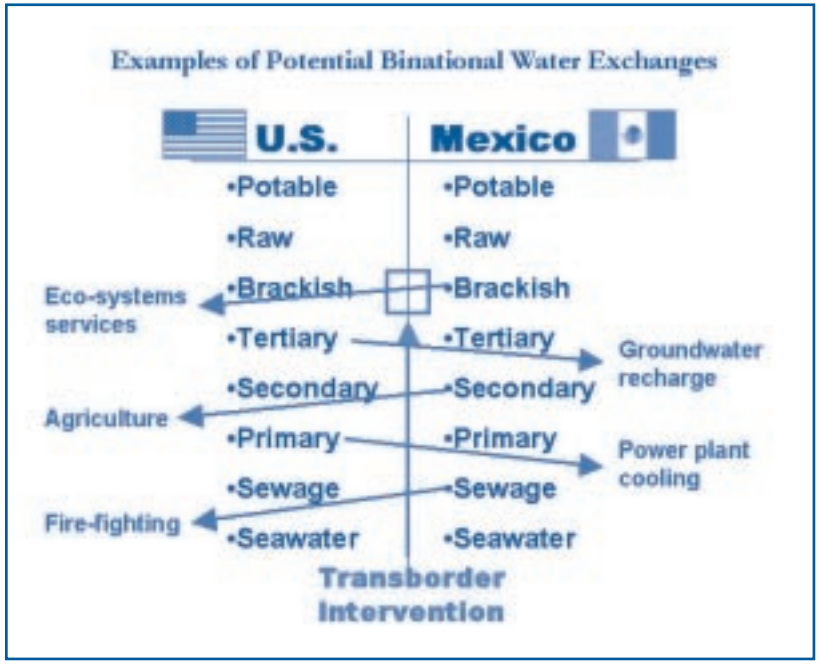
Current Solutions

Many engineering and technology solutions to water crises exist. Satellite, or decentralized, facilities, for example, save money by more effectively addressing local needs, replacing extensive lengths of pipes with less expensive systems, and reducing flow rate fluctuation. Another scenario involves reuse of water within a single community. This option entails re-treating water within a twin-city pair, rather than transferring water over long distances, which often implies high energy and infrastructure costs.

Additionally, current water loss could be saved on the order of 50 percent if efficient irrigation practices were applied. Low efficiency in agricultural water management results primarily from the use of gravity irrigation systems, where evaporation and infiltration losses through open and unlined channels occur. The main challenge for the region is to increase irrigation efficiency. The solution is in the introduction of high technology irrigation infrastructure and practices coupled with rational management of water resources under sustainability criteria.

Yet another point of view recognizes that demand for water is absolute and growing, that water availability is flexible but shrinking, that water prices are variable but related to supply, and that water use be prioritized according to grades (see figure that follows), ultimately providing more and cheaper water to various users. Currently, partial, traditional, and additional treatment of wastewater makes it available for use for groundwater recharge, industry, agriculture, landscaping, and parks. Soon, wastewater will probably be used for cooling new power plants. Any number of grades of water can safely and economically be used for additional purposes. For example, brackish groundwater may soon be used directly to irrigate some salt-tolerant crops; it may also be treated less expensively than ocean water for general irrigation purposes.

It is clear that the opportunity exists to match and trade across the border. The challenge is to motivate current users to make the different grades available for trade. For example, a Mexican farmer should be compensated for saving water (or perhaps temporarily fallowing) and "delivering" the saved water to a broker. The broker, in turn, could sell the water to a farmer in Texas, or to a fish and wildlife agency that wants to restore a habitat. In the year 2000, for example, agencies paid US$61 million for slightly over 397 million m^3 of water for habitat restoration. Clearly, the possibilities of moving water across the border are many and, as Barbara Bradley observed, "wasted, reclaimed water can be engineered to serve either side without topographical hindrances and associated costs."



As SCERP researcher John Mexal stated in a preparatory Border Institute IV meeting, "Ideally, wastewater should be primary- or no more than secondary-treated wastewater as this maximizes the fertilizer content while minimizing the concentration of salts. However, the water should be applied through a drip irrigation system for maximum safety. Although the farmer should bear some of the costs because drip irrigation alone will increase yields, this is a cost that should not be borne by the farmer alone." Mexal also explained that the current situation should actually be reversed. Instead of the farmer receiving and using the water first, which then gets treated and passed on to the city, clean water from rivers or aquifers should be run through the city, partially treated, and then applied to farmland. Currently, shared aquifer storage and reuse of recycled water represent largely untapped, yet valuable, options. Through injection of aquifers — which are accessible from both sides of the border — recycled water could overcome some of the transport barriers caused by urban development.

Since three existing plants and four future plants in the San Diego-Tijuana region are potential sources of recycled water, several alternatives may emerge for large-scale aquifer storage and reuse. One possibility, according to Emilio de la Fuente, is to combine plants for "conjunctive use resulting in transboundary sharing and multiple benefits." Conjunctive use is the coordinated management of surface, reclaimed, and groundwater supplies. In addition to trades of agricultural drainage and fresh, brackish, ground, and reclaimed water, other potential options for water sharing include binational facilities such as aqueducts, treatment plants, storage facilities, recharge and extraction systems, desalination plants, and recycling/reclamation plants.

Co-located: San Diego's South Bay Reclamation Plant and International Wastewater Treatment Plant

(Barbara Bradley 2002)

Furthermore, a geographic information system (GIS) can act as a decision-support tool by showing spatial water data and temporal projections. Currently, one GIS map is being developed for the Paso del Norte; a preliminary map already exists for the many water flows across the California-Baja California border.

GIS Map of the Rio Grande/Río Bravo in El Paso/Ciudad Juárez

(John Kennedy and Bobby Creel 2000)

Institutional and Funding Framework

The current institutional framework and financial mechanisms are inadequate for long-term solutions. To illustrate this, Hamlyn and others cited not a water scarcity but an "institutional scarcity." While all agree that revisiting the binational treaties is either unlikely or counterproductive, most agree with Arturo Herrera when he explained that, "We can extrapolate the existing agency model to include these tasks."

Although existing institutions can be catalysts for change, they are not yet allowed to be. "The IBWC can incrementally expand its activities to become a process convener and the NADBank has the financial instruments in its low-interest fund to build the necessary conservation projects," Nitze proposed. Many others agree, sharing the sentiment that this is a good opportunity for the NADBank to be relevant. However, the problem is that so few organizations, such as irrigation districts or watershed councils, can handle the scope of the challenge of water management planning, much of which entails promoting conservation. "Eleven conservation projects have been proposed but they need sponsors. The bank can only do half," said Jorge Garcés, NADBank Deputy Managing Director.

There was a clear consensus among many of the participants that, while states and local entities have important roles to play, much more federal attention is needed to help resolve pressing transboundary water issues. A more comprehensive approach to addressing border water issues appears necessary to meet current and future challenges.

- *"The feds need to lead." – Steve Mumme*
- *"The leadership, talent, and support are not forthcoming from the Bush administration." – Bill Nitze*
- *"The feds need to stick their necks out." – Mary Kelly*
- *"No agency, however competent, can do what needs to be done without federal support." – Pete Silva*
- *"The federal government is abdicating its responsibility and politicians are engaged in mere political grandstanding." – Greg Thomas*
- *"There will be no change without federal government commitment... It is not sufficient to create water management plans on a state-by-state basis when critical water resources are shared between states and between nations. The two countries must create binational mechanisms in which integrated regional management plans and budgets for both sides of the border can be developed.... Binational public institutions should have the authority to coordinate the activities of existing institutions at all levels of government." – Bill Nitze*

The following reasons define a clear role for the federal governments in binational water management planning:

1. Compacts and treaties allocate the existing interstate surface waters while the International Boundary and Water Commission/Comisión Internacional de Límites y Aguas (IBWC/CILA) allocates international surface waters. As surface waters are committed, used, degraded, and evaporated, prospective users increasingly look to groundwater as new and permanent sources of less-brackish water. Furthermore, water is drawn from subsurface sources at increasing rates without knowing how much, understanding the consequences, or even developing binational or watershed agreements about use. Additionally, there is no movement toward limitations on wells, a necessity if dry or salinated wells are to be averted.

2. The 1944 Treaty did not discuss groundwater, and there has been little progress since. The U.S. section of the IBWC, however, is proposing a comprehensive program to assess trans-boundary aquifers. Additionally, the Border XXI Program has a framework for assessing contamination of groundwater resources. Since many groundwater basins are rapidly being depleted or contaminated, the two nations cannot afford to wait for detailed studies.

3. It is particularly difficult to negotiate groundwater use because groundwater is a property right and a **state** issue in the United States, while a **federal** matter in Mexico. To further complicate matters, there is a disincentive to establish serious dialogue between U.S. and Mexican states, or between the U.S. and Mexican federal governments, since many U.S. and Mexican states compete for water resources.

4. The IBWC/CILA has recently shown its adaptability to new challenges and is encouraged to continue to evolve in the near future. Minute 306 on binational technical committees and ecosystems in the lower Rio Colorado is seen by many as a sign of this new direction.

5. The IBWC/CILA has recently demonstrated its interest and capacity for dealing with groundwater issues by approaching each of the U.S. states to encourage them to begin their conversations with the Mexican federal government about groundwater agreements. The Mexican Commissioner of CILA, Arturo Herrera, and the U.S. Commissioner of the IBWC, Carlos Ramírez, agree that the respective sections of IBWC/CILA can "extrapolate" from existing models to include assessment, testing, use, and recharge of groundwater as part of their regular activities.

6. Commissioner Herrera recommends that the Mexican federal government:

- Reduce state-state competition by allocating groundwaters
- Provide grants to fix water infrastructure leaks and inefficiencies
- Facilitate fee structures as revenue streams to finance bonds

7. Additionally, and significantly, the United States Geological Survey has promoted groundwater issues by proposing the development of a groundwater inventory in conjunction with the IBWC/CILA. However, other federal agencies should step up to their roles as binational water management facilitators and leaders.

Interestingly, the federal governments had agreed to do exactly what they have been called to do. At the March 2001 summit of the two new presidents, they proposed a binational summit on border water issues. This has not yet materialized.

While many traditional water subsidies are perverse and counterproductive, conservation depends upon a series of positive and negative incentives to occur. "An overabundance of overly subsidized, overly water-intense irrigation projects are wasting water," Dan McCool said. Water is grossly underpriced. In many cases the price merely constitutes the cost needed to move the water to the user. "The Comisión Nacional del Agua estimates 60 percent of agricultural use is wasted and between 35 percent and 53 percent of municipal use in Mexico is lost," Nitze pointed out.

Water pricing should be revised to encourage conservation. New development can pay the higher true cost of water while allowing current users to pay only incrementally more immediately, easing the transition to full pricing. **"Water is too cheap to conserve,"** was a refrain heard frequently at Border Institute IV.

Risks of the Status Quo

Significant risk exists if the current situation continues. Indeed, the cost of implementing remedies is significantly less than addressing the long-term consequences of business as usual. Due to the acceleration of water degradation and scarcity, the U.S.-Mexican border region suffers tangible economic costs. It is estimated that:

- Greater than $1 billion are accrued in health costs
- Nearly $1 billion are lost due to water pollution
- About $1 billion are lost due to decreased recreational and leisure use of water
- Estimated billions of dollars of biodiversity are lost due to habitat destruction

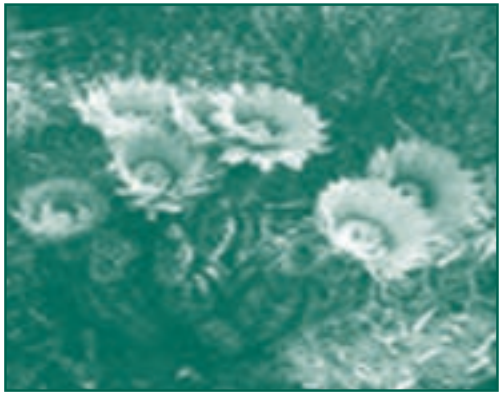
There are 450 native species and 700 migratory species found in the border region. Thirty-one percent of all species in the United States listed as threatened or endangered by the Department of Interior are found in the borderlands. On the Mexican side of the border, 85 species of plants and animals are in danger of extinction. Additionally, the border region's many parks and wildlife refuges need protection from water transfers.

All of the aforementioned adds up to serious problems for the region's "bottom line"; if left unaddressed, these multiple environmental stresses will ultimately have dire consequences for the region's economic health.

The risks are not just for Mexico, which is running out of water faster than across the border. "Water issues in Mexico will 'boomerang' back to the United States if they are not addressed, resolved, and indeed, shared," said Mumme. Few want to guess the full extent of transboundary effects if water becomes too expensive or limited for one sector or country to provide an adequate supply for its buyers. If negotiations for the Transboundary Environmental Impact Assessment (TEIA) for the U.S.-Mexican border region were not stalled in Mexico City and Washington, D.C., it would be timely to expand the scope of TEIA to address such questions as water supply and to mitigate and minimize impacts. The TEIA is an agreement among Canada, Mexico, and the United States on transboundary environmental impact assessment that will include provisions for the evaluation of transboundary environmental impacts.

Threatened or Endangered Species in the U.S.-Mexican Border Region

Reddish Egret



Black Lace Cactus

Green Sea Turtle

(Photos courtesy of Texas Parks Wildlife © 2002, Black Lace Cactus photo by Paul M. Montgomery)

Scenarios for Settlement

"Solutions mean addressing the asymmetries and differences across the border," José Luis Castro challenged the group. The cultural and socio-economic impacts of water availability and price must be studied and appreciated for both the U.S. and Mexican sides of the border.

Assumimg that the federal governments play active roles, then "solution scenarios" (Greg Thomas's term) are possible. An examination of binational case studies reveals both obstructions to successful water management planning as well as guiding principles. Numerous factors that impede cooperation include inflexible water allocation systems; dissimilar legal systems; different economic pressures and financial capabilities; centralized versus decentralized institutional structures; history of water disputes; cultural differences that influence water use; different perspectives; and lack of comprehensive information regarding the water resources of the region. Christopher Brown emphasized "principles of binational cooperation on water issues" and recommended building upon the success of local watershed councils and encouraging their capacity through small grants. Water sharing agreements can be supported by providing a broker and a database of potential buyers and sellers.

The principles leading to binational coordination and cooperation on water use are:

- Exchange of information, technology, and equipment
- Joint use of transfer and storage projects
- Local water exchange and trade
- Emergency transfers across the border
- Binational watershed approach to management;
- Cooperative transborder groundwater recharge
- Protection of transboundary riparian habitat;
- Understanding the differences (economic, perspectives, capacity) on both sides of the border
- Binational restoration of natural hydrology and flows
- Joint U.S. and Mexican flood control

Success stories discussed at the Border Institute include the following features:

- Local coordinating mechanisms, such as the Border Liaison Mechanism, that enable local and state officials in the border region to talk directly about binational issues
- Joint university initiatives such as SCERP projects on water quality, watershed, and water atlas
- Creation of the Committee on Binational Regional Opportunities (COBRO), a public advisory committee that addresses cross-border planning in areas such as environmental management and water supply within the San Diego Association of Governments (SANDAG)
- Binational environmental infrastructure such as the international wastewater treatment and reclamation plants at some twin cities
- Recognition that surface and groundwaters are connected
- The creation of transborder Consejos de Cuencas or Watershed Councils
- Increased conjunctive use planning
- Alternative negotiation, such as the New Mexico-Texas Water Commission (which was formed as a result of a litigation settlement between El Paso and several New Mexico entities), which managed to avoid long, expensive, and polarizing lawsuits
- Expansion of bi-state task forces to binational task forces such as the Paso del Norte Water Task Force which unites water managers, water users, experts, and citizens to work cooperatively to promote a tri-state, binational perspective on water issues that impact the future prosperity and long-term sustainability of the region
- Evolving role of NGOs such as the Río Bravo/Rio Grande Coalition whose purpose is to support and strengthen grassroots groups of citizens working to sustain the Rio Grande/Río Bravo Basin
- Implementation of Promagua, a program in Mexico designed to attract private investment to water projects via federal subsidies
- Open and transparent process such as the Citizen Forums program which was recently implemented by the IBWC
- Recognition of states' rights issues by beginning sub-regional, state-state negotiations

Recommendations

I. Binational Water Management Planning

For far too long there have been calls on both sides of the border for planning that is binational, with transparent and transdisciplinary public participation. This also includes the call for comprehensive planning that addresses all of the competing sectors in the matrix on page two, and that is wasteland-based in scale and scope. However, this has not been the reality.

Many non governmental organizations, including academia as independent and science-based facilitators, have tried to catalyze water discussions or agreements among users. The process itself is straightforward. The steps necessary to implement the plan — authorizing the process, convening respective stakeholders, approving the findings, and funding the bulk of the recommendations — are confounded by jurisdictional mismatches. This underscores the urgent and immense need for the federal governments to play an active, facilitative and supportive role. Ideally, the two nations should grant joint planning authority to an existing commission. Repeatedly, at Rio Rico and elsewhere, the IJC is cited as a potential model to emulate for reaching consensus about groundwater, water quality, and ecosystem services, among other contentious issues. Already the BECC/COCEF (whose mandate expansion includes water conservation) is investigating such a mechanism at the local level. Ultimately, a binational water bank could be created that:

- Provides storage capacity during excess years
- Allots those reserves during short years
- Adjudicates among potential buyers
- Allocates proportions for natural systems and services
- Facilitates the mix and match trade schemes as illustrated on page eight

In the area of water quality, lagoons, wetlands, and other SCERP-developed techniques hold promise in the border region as alternative wastewater treatment technologies. These alternatives, which require relatively cheap land and labor costs, should be recognized as viable options, planned, funded, and promoted for small-scale applications as well as for rural and remote settings.

II. Sourcing, Transfers, and Storage

Local water should be used first because transferring water over long distances from traditional users often has unintended consequences. Michael Cohen, for example, pointed out that the proposal to fallow fields in the Imperial Valley in order to send water to San Diego threatens the health and even the existence of the inland sea because "the Salton Sea relies upon agricultural drainage flows from Imperial Valley agriculture." Since many cities are depleting their water sources, however, **water transfers are seen as viable options. However, water transfers should only be authorized for "saved" water** and only if all parties, including natural systems, are not harmed.

Additionally, groundwater recharge standards are needed in order to take advantage of reclaimed water. For example, **groundwater planning must begin with the understanding that an incurred debt to aquifers must be paid before renewed pumping may begin.**

Suzanne Michel wrote, "...throughout the U.S.-Mexican border region, water agencies are focusing upon conjunctive use of groundwater as a cost-effective source of water, even in times of drought. Numerous municipalities are extending their local water supplies by improving groundwater quality, and by blending surface and groundwater supplies." Michel also noted that water agencies are examining the possibility of desalinating groundwater resources with elevated salt levels due to the increasing costs and uncertainties associated with water transfers (particularly from the Colorado River). Since groundwater does not evaporate, groundwater storage is emerging as a vital water banking option to store water during wet years to utilize during times of drought.

Recommendations about binational water sourcing include:

- Reducing physical losses to the system through seepage, evaporation, and transpiration
- Avoiding contamination of sources that renders them unusable
- Planting less water-intensive and more salt-tolerant crops
- Improving storage, particularly subsurface storage
- Re-plumbing infrastructure to benefit the environmental and ecological systems
- Managing the intensities and durations of droughts

III. Drought Management

All Border Institute participants agreed that droughts are an opportunity and a call for action for both short-term solutions and long-term strategies. "This drought is not an aberration," Thomas warned. Mumme offered that "drought is both a hydrological as well as a social phenomenon," indicating that solutions are available within the context of current and anticipated climate and weather patterns. Mumme expanded on this, asserting that **"water management also requires drought management."** Drought management includes setting up municipal reserves in anticipation and recognition of the severity and the duration of dry spells. Additionally, mandatory conservation measures should be established during droughts and post-drought assessments should be conducted.

IV. Conservation

Conservation must be a priority for all border planning organizations. "The priority has to be water conservation, but that is not currently a mission of existing border institutions," Ben Muskowitz said. Savings clearly start with agriculture. "On average, agriculture uses 78 percent of all the water in the region," Ed Hamlyn reminded the participants, "but all sectors can save." The Mexican government is drafting legislation to "productively reorganize irrigation districts and units based on the criteria of efficient water usage and productive competition."

"Irrigation districts can make tremendous savings, but these will have their costs," Arturo Herrera said. In the border region, most water conservation projects must focus on irrigation systems and that priority should be placed back on natural systems, **all of which require significant amounts of money and must be funded partially by grants**. It is estimated that the cost of irrigation system improvements is $400 million for Texas and $100 million for the Lower Rio Grande Valley.

V. Equity Issues

The existing framework is inadequate to define or assure equitable distribution of water. Existing water resources are inequitably distributed across the border and among sectors. Because many groups lack sufficient access to information and institutions, institutions should incorporate various mechanisms to ensure their flexibility and accessibility. In addition, a diversity of cultural values associated with water and its use exists in the U.S.-Mexican border region.

Solutions to equity issues that should be taken into account to promote sustainable use of resources should include flexible and inclusive binational planning mechanisms; *regulated* market mechanisms, including creative and flexible water pricing schemes; the reallocation of subsidies; water education; and leveling the playing field through capacity building. The recognition that "equitable use" needs rigorous attention to integrate science, environmental justice, and social welfare theory is a significant research challenge for SCERP and others.

VI. Ecosystems

Transferring water away from natural communities and processes today reduces water quality and quantity for human uses tomorrow. Ecological use is recognized by the 1983 La Paz Agreement and later by IBWC/CILA minutes, such as 306 Lower Colorado River Delta. Advantages offered by natural systems and ecosystem services include flood control, navigation, fisheries and other natural habitats for economically important species, pollution abatement, and climate buffering. The numerous benefits associated with allocating water to the environment include:

- Increased wildlife habitat and biodiversity
- Increased groundwater recharge
- Increased surface and groundwater storage
- Increased economic development potential for communities
- Increased water quality
- Decreased storm water peak discharge rate
- Decreased stream channel erosion
- Decreased frequency of local flooding
- Decreased pollution through cleaning action of riparian vegetation

"The real scarcity is intact river systems," observed McCool. Perhaps the environment can be better understood as an "in-between" user to store, filter, and move water. Additionally, the public perception of wastewater needs to shift from that of "waste" to "recyclable."

VII. Database/Knowledge Sharing, Monitoring, and Indicators

"We need to quantify the issues to understand and resolve them," Vince Tidwell began. Indeed, there is as much disinformation as misinformation about water," Aguilar expanded. "No consistent long-term data sets, paired with a need for comparable methods of data analysis, means *data stress*," John Klein lamented. Indeed, the "harmonization" of protocols would improve the process of collecting, analyzing, and distributing water data.

Water use indicators are needed to determine how to direct funding for this experimental work as well as to encourage appropriate sourcing, conservation, sequential reuse, and sharing. Academia is especially good at data quality, gaining access to governmental or proprietary data, and aggregating up or disaggregating down in scales, both temporal and spatial. Better presentation of existing data is necessary to support border water policy decisions. Although existing data needs to be improved and more data collected, Institute participants agreed that decisions should not be delayed due to lack of complete, perfect, or symmetric databases.

VIII. Water Education

Water, which has been considered sacred since time immemorial by traditional cultures, has become transformed into a mere utility. As such, drought education is crucial to sensitize and prepare people to deal with the frightening reality of water scarcity. As competition for water continues to increase (and the cost of exploiting new water resources is often prohibitively expensive) **it is imperative to institute water education programs to promote a more realistic and appreciative water-conscious "culture."** These programs should involve schools, communities, and the media. Additionally, it is necessary to ensure that conservation measures are shared among all people, including the wealthy, and that water for all sectors — especially for the most vulnerable including the poor, tribal nations, and the environment — is distributed sensibly and equitably. **In essence, water's sanctity needs to be re-discovered .**

Conclusion

Water issues along the border are infinitely complex and include incessantly rising demands; a finite, depleting, and degrading supply; competing sectors; and, in some cases, cumbersome and antiquated regulating institutions on both sides of the border. Additionally, because of the interconnectivities and interdependencies of water and other concerns, a solution for one issue becomes a problem for another. As a result, the U.S.-Mexican border faces unprecedented sustainability challenges. It is time for policymakers on both sides of the border to accept proactively the reality that water scarcity is the norm rather than an anomaly. These challenges underscore the importance of tackling these solutions collectively, which is the primary purpose of the Border Institute — to bring together academics, policymakers, industry leaders and other border stakeholders from both sides of the border to address key issues. Solutions were formulated during Border Institute IV and many of the possible outcomes were elucidated and dissected to avoid unintended consequences.

Due to the sheer complexity of these problems, however, solutions will have to emanate from compromise. At best, solutions should work for all sectors; at worst, they should not harm any. Interdisciplinary and sustainability science — SCERP's aim and mantra — should be at the forefront to ensure long-term solutions.

Whether or not these proposed solutions are implemented — however imperfect — the United States and Mexico will face consequences. If no action is taken, certain (if not all) sectors will be affected; institutions and individuals will have to change their habits and large sums of money will have to be invested. In short, everyone and all institutions will have to conserve. If however, no action is taken the situation — already in crisis mode — will degenerate even further. The 1998 reportings of the first Border Institute were clear. Even if migration to the border region ceases, by the year 2020 the border population will increase naturally by about five million. As it stands, the border population will likely increase by 14 million people. Unless most of the recommendations from Border Institute IV are followed, the burgeoning population will necessarily lead to increased demand for water —water that is already inadequate in terms of quantity and quality. The current situation is simply unsustainable. All sectors face untold and irreversible ramifications if border water scarcity is not addressed now. Put simply, the U.S. and Mexican federal governments must take proactive roles and competing sectors must work together to avert environmental, economic, and social disaster.

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About SCERP

The Southwest Center for Environmental Research and Policy (SCERP), a consortium of five U.S. and five Mexican universities, serves U.S.-Mexican border residents by applying research information, insights, and innovations to environmental challenges in the region. SCERP was created in 1989 to initiate a comprehensive analysis of possible solutions to acute air, water, and hazardous waste problems that plague the U.S.-Mexican border region.

The consortium works closely with the Border XXI Program and other environmental agencies in the United States and Mexico. It has the multifold mission of conducting applied research on the environment, outreach, education, policy development, and regional capacity building for the communities, its ultimate customers. SCERP addresses issues that pertain to the rapidly deteriorating border environment, strives to protect and enhance the quality of life of border residents, and works to support the educational mission of its universities.

SCERP's unique approach to transborder issues is to integrate and focus transdisciplinary academic expertise; binational, state, tribal, and local policy-making; non governmental organization advocacy capacity; and private industry attention. The consortium's vision is of a vital region with a dynamic and diverse economy, sustainable environmental quality, intact ecological systems, and a more equitable quality of life.

The SCERP consortium is comprised of the following universities in the United States and Mexico:

- Arizona State University
- New Mexico State University
- San Diego State University
- University of Texas at El Paso
- University of Utah
- El Colegio de la Frontera Norte
- Instituto Tecnológico de Ciudad Juárez
- Instituto Tecnológico y de Estudios Superiores de Monterrey
- Universidad Autónoma de Baja California
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