PLACE, POWER AND WATER POLLUTION IN THE CALIFORNIAS: A GEOGRAPHICAL ANALYSIS OF WATER QUALITY POLITICS IN THE TIJUANA-SAN DIEGO METROPOLITAN REGION

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Place, Power and Water Pollution in the Californias: A Geographical Analysis of Water Quality Politics in the Tijuana-San Diego Metropolitan Region

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The U.S.-Mexico border region is probably one of the most environmentally stressed areas in the world. Due to an increased emphasis upon free trade, export-oriented industry clusters now dominate the landscape of the U.S.-Mexico border. Given the attraction of increased employment opportunities provided by export-oriented industries, urban populations along the border have increased dramatically resulting in first an increased demand for urban water, and second increased flows of aguas negras. Aguas negras is the borderland nickname for the dark, murky water composed of untreated fecal matter mixed with chemical wastes and nonpoint source pollution. The dissertation project examines the *range of choice of water quality governance alternatives* present within the Tijuana-San Diego metropolitan region. Four case studies which correspond to four place-based water quality governance approaches are evaluated. These approaches are: point source, watershed, metropolitan region, and hydrocommons in U.S. and Mexico. In this dissertation, I answer the four research questions: (1) What are the laws, governance structures, and decisionmaking procedures associated with each place-based approach? (2) For each case study what are the governance structures and decisionmaking procedures present? (3) In each case study what is the range of

choice among technical and governance alternatives? and (4) How do representations of place and the geographic concept of *scale* shape water quality governance? Results of this study include a delineation of water quality governance for the four place based approaches in the United States and Mexico. Each of the four case studies are detailed and analyzed using theories of place and range of choice. Geographical theories of scale and scope of conflict are applied to examine power relations in each case study. Drawing upon the concept of natural capitalism, a redefined, sustainable, and democratic urban water paradigm for the U.S.-Mexico border is suggested. The improved vision of urban water resources governance involves an incorporation of a sense of place, an expanded range of choice, and an expanded scope of conflict in water quality governance.

TABLE OF CONTENTS

CHAPTER PAGE

CHAPTER PAGE

CHAPTER PAGE

CHAPTER PAGE

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURE PAGE

FIGURE PAGE

CHAPTER 1

INTRODUCTION

Introduction

Over the past two decades scientific studies of water quality in the U.S.-Mexico border region have brought the problem of border water quality to public attention. However, as noted by water resources scholars such as Donald Worster (1985), Robert Gottlieb (1988), and Vivienne Bennett (1995), water quality is not simply a scientific problem to be addressed by scientific studies and technical solutions. Water quality is a political problem to be examined by studies of water resources governance, law, and democracy. Examining and evaluating border water quality laws and the policy decision-making process is significant because we can: (1) educate researchers about the types of scientific studies that should be conducted to assist decisionmakers in water policy development; (2) educate stakeholders (industry, government, public interest groups, U.S. and Mexican citizens) involved in the development and implementation of the binational water quality political process; (3) illuminate the range of choice available within existing legal and governance structures; and (4) evaluate current legal and governance structures with the assumption that changes can be made to permit alternative legal and policy structures (Wescoat 1987).

Ingram, Laney, and Gillilan's (1995) water quality policy analysis of Nogales Arizona/Sonora and the Texas Natural Resource Conservation Commission's (1996) *Regional Assessment of Water Quality in the Rio Grande Basin* are two studies which describe in detail water quality political processes in Arizona and Texas. This dissertation presents a geographical interpretation of water quality politics in the Baja California-California border region—a region which to this date has been overlooked by border water researchers. This geographical analysis is based upon a case study of water quality politics in the Tijuana-San Diego metropolitan region. For this dissertation, I detail and evaluate water quality governance in four place-based water quality management approaches. These place-based approaches are: point source, watershed, metropolitan region, and hydrocommons. An evaluation of the politics present in the four place-based approaches enables us to examine the range of choice available among current governance structures and decisionmaking processes regulating U.S.-Mexico border water quality.

Urban Geography and Water Quality in the Tijuana-San Diego Metropolitan Region

The Tijuana-San Diego metropolitan region is located on the westernmost section of the United States-Mexico border. It is a binational urban center which enjoys a Mediterranean climate with precipitation ranging from approximately ten to fifteen inches per year (McKnight 1999). This urban region is the most densely populated and economically prosperous region along the U.S.-Mexico border

(Ganster 1998b). However, the metropolitan region's unplanned urban and economic growth has resulted in increasing flows of *aguas negras*. Aguas negras is the borderland nickname for the dark, murky water composed of untreated fecal matter mixed with chemical wastes from manufacturing plants and urban storm water runoff.[1] Each year, millions of gallons of aguas negras enter gullies within the Tijuana-San Diego metropolitan region, and eventually pollute watersheds, estuaries and coastal waters in the U.S. and Mexico. Figure 1.1 details the metropolitan region and its water resources infrastructure.

The Tijuana-San Diego binational metropolitan region is home to approximately four million residents, and it is considered one of the largest binational metropolitan regions in the world. The highly urbanized core is concentrated "near the coasts, in the valleys, terraces and low hills that transition to the coastal mountain range" (Ganster 1998b, 5). Most of the population is concentrated within fifteen miles of the Pacific Ocean and twenty miles on each side of the U.S.-Mexico Border (Ganster 1998b). Due to domestic and international migration both cities have sustained high growth rates. Between 1930 and 2000, San Diego's population has increased from 210,000 to 2,896,900. Tijuana's population has increased from 11,000 in 1930 to an estimate of 1,125, 200 in 2,000 (Ganster 1998b).[2] Tijuana's annual population growth rate is estimated at

[1]In Mexico, aguas negras is defined for the most part as raw sewage flows. For this dissertation, I define aguas negras as all types of water quality degradation including nonpoint source pollution, and contamination from agricultural runoff, and industrial waste by-products.

[2]Specific population figures for Tijuana are often the source of disputes due to the problem of counting migrant and low income populations.

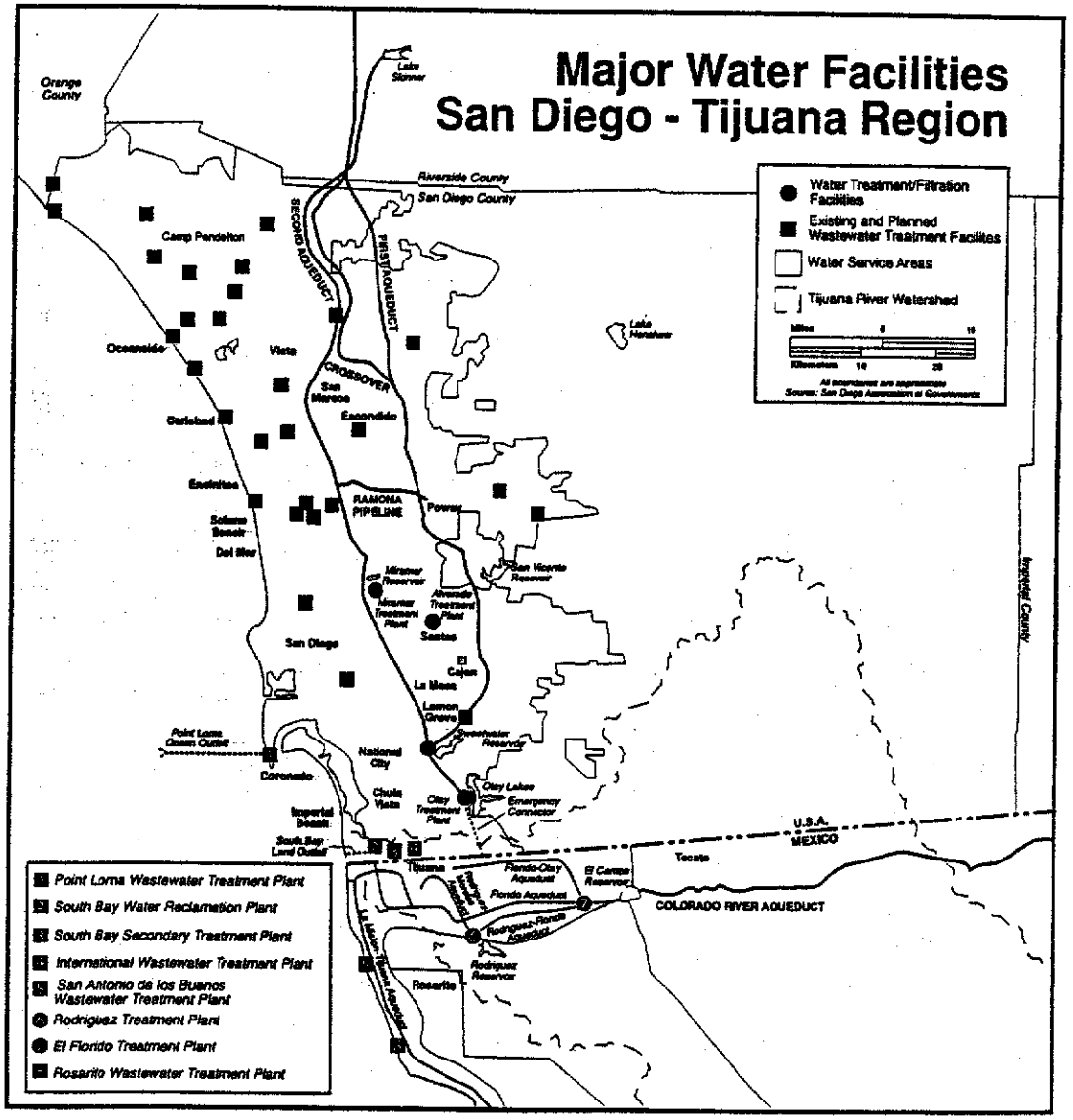

Figure 1.1. Major Water Facilities: San Diego -Tijuana Region

5.8 percent (Comisión Estatal del Agua [CNA] 1999), twice that of San Diego's (Ganster 1998b).

In terms of economy, San Diego is the wealthiest urban center along the U.S.-Mexico border with a regional economy of approximately eighty billion dollars per year (Ganster 1998b). However, this "robust economy" is a recent occurrence. During the latter part of the 1980s and early 1990s, San Diego encountered the worst economic recession in fifty years (San Diego Association of Governments [SANDAG] 1999). Between 1990 and 1993, San Diego's local economy encountered a 2.6 percent decline in employment, as thousands of jobs left the region. This recession was a result of the economic crises caused by downsizing of the aerospace and defense industries throughout Southern California following the end of the Cold War (Ganster 1998b). The defense industry downsizing resulted first in a decrease of regional jobs. Subsequently average household incomes declined dramatically (SANDAG 1999). In addition, because much of the local capital was generated by the region's defense industry, there was less capital available to invest in San Diego's capital improvement projects (water and wastewater infrastructure to name a few). Ironically, a drought, between 1987 and 1992, severely limited water availability throughout the entire state of California. Proposed cutbacks in San Diego's imported water supplies ranged from twenty-five to fifty percent (City of San Diego, Metropolitan Wastewater Department [MWWD] 1998b). However, stringent conservation programs and high precipitation levels in March 1992 prevented the imported water reductions. As a

result of this drought, City planning documents cite "assuring an adequate water supply" as essential for economic stability in the region (SANDAG 1999).

In response to the recession, local governments, the private sector, and community-based organizations are now working together to reduce the its effects, take advantage of economic restructuring within an export-oriented global economy, and create a framework to manage growth in the region (SANDAG 1999). This framework, known as the "Prosperity Strategy" is aimed at developing "export-oriented clusters" throughout San Diego County. San Diego Association of Governments defines export oriented clusters as "geographic concentrations of interdependent, internationally competitive firms in related industries" (SANDAG 1999, 7). A listing of export-oriented clusters established in the San Diego region is delineated in Table 1.1.

Table 1.1

San Diego's Export-Oriented Clusters

Biomedical Products	Financial Services
Biotech & Pharmaceuticals	Fruits & Vegetables
Communications	Horticulture
Business Services	Medical Services
Computer & Electronics Manufacturing	Recreational Goods Manufacturing
Defense & Transportation Manufacturing	Entertainment & Amusement
Uniformed Military	Environmental Technology
Visitor Industry Services	Software

Source: SANDAG (1999, 9).

By financing and developing export-oriented clusters, local politicians assert that new jobs have been created to replace those lost during the recession. Some of the jobs are high-paying, such as employment in biotech or software engineering; however, many jobs are low-paying, entry-level jobs in the service sector (especially those supporting entertainment and visitor/tourism industries) (Marcelli and Joassert 1998). The significant increase of low-paying jobs has exacerbated the inequitable income distribution in the region. According to a study conducted by economists Enrico Marcelli and Pascale Joassert (1998), between 1980 and 1997 the income disparity between the highest and lowest income earners increased by twenty-two percent. Since 1990, San Diego County experienced an acceleration of poverty (Marcelli and Joassert 1998). In 1997, 507,378 persons or nineteen percent of San Diego's population lived in poverty. In addition, one in three children live at or below the poverty level (the federal government poverty level is $16,276 for a family of four) (Marcelli and Joassert 1998; *San Diego Union-Tribune* 4 February 1999).

In this new millennium, with an expanding economy and a growing population, a shortage in affordable housing has become a problem in the San Diego region. According to the San Diego Association of Governments (SANDAG 1999), the region will not have sufficient urban land to accommodate its housing needs beyond 2005. Local leaders and the building industry have responded with large-scale developments (3,000 to 10,000 residential units), but these developments provide low-density single-family dwellings for upper-income homebuyers (Marcelli

and Joassert 1998) (Figure 1.2). In addition, export-oriented clusters and retail centers serving these developments result in a dramatic increase of urban expansion or, to restate, urban consumption of land. San Diego's local political leaders recognize the problem of urban expansion, but there is little coordination between the cities for regional solutions to the affordable housing shortage or other problems associated with urban expansion (i.e., increased traffic and air pollution for example).

From a water resources perspective, urban expansion in San Diego first has resulted in a demand to increase imported water supplies. Local water resources agencies and political leaders believe that local surface water runoff cannot support San Diego's 2.8 million residents and local economy. Hence, as with most of Southern California, the emphasis has been to import water, rather than protect local water resources. Depending upon water demand, San Diego imports between seventy-five and ninety percent of its water supply from the Sacramento and San Joaquin Rivers in Northern California and the Colorado River to the east (Laru pers. com. 2000). In addition to increased water importation, urban expansion results in the destruction of native habitat (coastal sage scrub, grasslands, chaparral, oak woodlands, and wetlands habitat). Native habitat destruction, in part, causes rising levels of pollution in San Diego's urban storm water runoff and surface waters.

Between 1950 and 1999, Tijuana's urban economy has dramatically changed. During the 1950s, Tijuana relied on tourist dollars from the United

States, and income from the Caliente Race Track (MWWD 1998b). However, in 1965 Mexico's Border Industrialization Program initiated foreign investment and industry operations in the U.S.-Mexico border region (Carter 1999). This program allows foreign-owned industries to own and operate manufacturing and assembly plants in Mexico. Mexican citizens provide the labor for assembling imported parts and materials (Carter 1999, 6). These assembly plants are known as maquiladoras or maquilas. The number of maquiladoras in Tijuana has rapidly increased from 100 in 1974 to 560 in 1996, employing over 50,000 workers (Sánchez 1998). At present, estimates cite that Tijuana is home to 800 maquiladoras employing over 100,000 workers (MWWD 1998b). The maquiladora industry sector is a major contributor to Tijuana's five billion dollar annual economy (Ganster 1998a).

According to Williams (1995), the Mexican economic crises of 1982 helped fuel the burgeoning growth of the maquiladora industry. During the mid-1980s, the maquilas expanded at a rate of more than twenty percent per year, and economic analyses are showing an increase of the maquila economic activity after Mexico's 1994 economic crises (Carter 1999; Williams 1995).[3] This increase of maquila economic activity resulted in a significant alteration of Mexico's borderland economies and politics. Until recently, political leaders in Mexico depicted maquilas as a necessary evil designed to assist Mexico's borderland economy (Williams 1995). However, now the maquila industry has become a "priority sector" of Mexico's economy (Williams 1995). Maquilas bring in

[3]Maquiladoras are a source of growth due to low labor costs, lack of environmental enforcement in Mexico, and the ease of shipment of goods to the United States.

twenty-five percent of the nation's employment, and earn sixteen billion dollars in foreign capital, second only to petroleum exports (Liverman et al. 1999; Williams 1995). Hence state and federal governments nurture and protect the maquiladora industry, often at the expense of Tijuana's human and environmental resources.

The expansion of the maquiladora industry in Tijuana, along with the prospect to earn higher wages in the United States, has resulted in ever increasing domestic and international migration flows to Tijuana. This increase in migration flows results in rapidly growing border urban populations, urban expansion, motor vehicle use and congestion, generation of waste and air pollution, and rapid depletion of natural resources. Like San Diego, Tijuana's rapidly growing low-income population generates an increased demand for low income housing. Lack of affordable housing in urban centers has resulted in the creation of urban squatter settlements outside the city limits, called "colonias" (Figure 1.3). Colonias do not have adequate water and wastewater collection and disposal services (Carter 1999, 7).

Like many of Mexico's borderland cities, the rapid urban growth has led to an increase in the demand for water and wastewater services. Border cities and states have little money to spend on water and wastewater projects because the federal government provides little financial resources to municipal or state water districts (Carter 1999). At present, Tijuana's wastewater collection provides service to approximately seventy percent of Tijuana's residents (Guzman 1998), as

have to start rationing water for its growing population. One solution to increased shown in Figure 1.4. The water supply outlook is grim. By 2004 Tijuana may water demand is to increase water imports from the Colorado River, as San Diego is proposing.

The problem of aguas negras is present in both Tijuana and San Diego. The most publicized event concerning aguas negras is that of "renegade raw sewage flows" which originate in Tijuana and flow into the Tijuana River, which then transports uncontained wastewater flows across the border to coastal wetlands and beaches in San Diego and Imperial Beach (see Figure 1.5). These uncontained wastewater flows are the result of Tijuana's wastewater collector system which is overburdened and in need of maintenance and repair. Cross border sewage flows have actually increased during the past decade, resulting in U.S. citizens demanding immediate action to stop the raw sewage flows. These demands for immediate action resulted in short-term, often expensive solutions while ignoring the need to find a sustainable and low cost solution to managing Tijuana's urban growth and infrastructure. San Diego's own urban expansion has resulted in thousands of miles of water and wastewater pipes. Many of San Diego's existing water and wastewater pipes are at least thirty years old, in poor structural condition, and are prone to leak and overflow, especially during storm events. Aging pipes are not monitored on a regular basis for leaks and spills, resulting in sewer spills which may continue unnoticed for days.[4]

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[4]On 21 February 2000, one of the largest sewage spills in San Diego history occurred. During a storm event, a tree fell and split open a raised manhole, causing raw sewage to enter the

However, raw sewage flows are not the only cause of water quality degradation in the Tijuana-San Diego metropolitan region. Both cities do apply finances and technologies to contain and treat wastewater flows. But both cities have yet to adequately address the problem of nonpoint source pollution. Various diffuse sources throughout the urban landscape cause nonpoint source pollution. In all urban centers, water from rain, car washes, and lawn irrigation flows through streets, parking lots, and into urban creeks and storm water conveyance systems. The water flows known as "urban polluted runoff" carry nonpoint source pollution— oil and grease from cars, pesticides, fertilizers, and even raw sewage from leaking and overflowing sewer lines. Every day in Tijuana and San Diego, urban polluted runoff flows into creeks and rivers and is discharged in concentrated amounts on the beaches. The result is a public health risk to those who recreate on beaches of Baja California and California. In addition, urban polluted runoff threatens local drinking water sources (reservoirs and aquifers) throughout Tijuana and San Diego. As will be documented in this dissertation, as urban populations and urban regions increase, so do the levels of urban polluted runoff flows.

As one can surmise from the above and other descriptions of the Tijuana-San Diego metropolitan region, the region is characterized by dynamism in a demographic, economic (Ganster 1998a), biogeographic (Michel 1994; Ojeda 2000), and even a water quality sense. This dissertation will address the dynamic

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San Diego River. The raw sewage flowed unnoticed for one week, resulting in thirty-six million gallons of raw sewage entering the San Diego River and contaminating Ocean Beach. The spill exposed the weakness of the city's ability to detect sewage flows within its sewer lines (*San Diego Union-Tribune* 9 March 2000).

and wide range of water quality problems in the Tijuana-San Diego metropolitan region—from uncontained wastewater flows to urban polluted runoff, coastal water contamination, and degradation of local drinking water sources. In addition, the dissertation examines the range of choice of water quality governance alternatives present in the Tijuana-San Diego metropolitan region. It In the next section I introduce and discuss the concept of range of choice in water resources geography.

Range of Choice in Water Quality Politics?

"Range of choice in water resources management" is a phrase formulated by geographer Gilbert White over forty years ago. According to White, the range of choice principle is significant because "[unwise water resources] decisions often result from misperception or unawareness of potentially good alternatives" (Wescoat 1987, 41). The range of choice principle, in part, is similar to the alternatives analysis required by the National Environmental Policy Act of 1969 (NEPA) environmental impact assessment. Under NEPA, the range of choice entails examining alternative means of completing the proposed project or action (Plater, Abrams, and Goldfarb 1992). For the most part, NEPA alternatives are listed as engineering, location, timing, and size alternatives associated with the proposed project. However, in water resources geography literature the range of choice encompasses more than a NEPA style technical alternatives analysis. Range of choice also is associated with analyses of economic appraisals, spatial linkages, social guides and water institutions (Wescoat 1987).

Hence, for geographers range of choice entails not only technical and scientific alternatives, but also an examination of social scientific, and even cultural, alternatives in water resources management. Wescoat (1987) cites two reasons for geographers recognizing a wide variety of range of choice studies. First, unlike engineer-driven water institutions such as the International Boundary and Water Commission,[5] geographers have maintained a commitment to a breadth of alternatives analysis. Second, water resources geographers generally adhere to the pragmatic tradition which encourages pluralism, democracy, education, and public participation (Wescoat 1987). For water resources scholars, range of choice analyses are significant because they reveal the institutional, political-economic, and cultural context in which water resources decisions are made (see Bates et al. 1993; Hundley 1992; Ingram, Laney, and Gillilan 1995).[6]

What is the range of choice in water quality? To this date there have been a few general attempts on the topic (see Davis 1968) including, to some extent, a National Academy of Sciences (1968) report on the Colorado River. The latter report examined the range of choice concerning alternative water management objectives (efficiency, political equity, income distribution, environmental control),

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[5]The International Boundary and Water Commission (IBWC) and its Mexican counterpart, Comisión Internacional de Limites y Aguas (CILA), is an institution which facilitates joint action for U.S.-Mexico border water policy while protecting national sovereignty. According to Ingram, Laney, and Gillilan (1995), the commission has been criticized for its exclusion of outsiders (the public) in water policy planning and decisionmaking and its engineering-only based approaches to resolving water supply and water quality problems along the U.S.-Mexico border.

[6]However, according to Wescoat (1987, 52), besides encouraging democracy in water quality governance via range of choice, water resources geographers must also consider the basic question, "Why and when is expanding the range of choice . . . a 'good' idea?" This particular question can only be answered by examining case studies which encourage, and case studies which do not encourage, range of choice analysis (see Chapter Two for one such analysis).

and even evaluated state water laws and public attitudes (Wescoat 1987). In California, a range of choice analysis addressing the water quality degradation problem and wetland restoration of Northern California's Sacramento and San Joaquin Rivers Bay-Delta region is currently under way (Rieke 1998). The Bay-Delta restoration range of choice analysis proposed by the CALFED Bay-Delta Program (a joint powers authority with management and regulatory responsibility in the Bay-Delta system) currently addresses watershed ecosystem restoration, technical and financing alternatives (CALFED 1998). In the current public deliberation process of the CALFED analysis, even the "style" of technical analysis is under scrutiny. Critics of CALFED cite that present analysis gives too much emphasis to "structural" engineering solutions, and not enough to nonstructural solutions such as demand management and local watershed protection within regions dependent upon imported water from the Bay-Delta region. Such strategies would reduce these regions' (particularly Southern California's) dependence upon imported Bay-Delta water, and possibly decrease water diversions. Less water diversions entail more water in the Bay-Delta ecosystem which would improve water quality and wetlands habitat for aquatic, avian and terrestrial species (Environmental Water Caucus 1999).

However, there is one element which is neglected in water quality (and water resources in general) range of choice studies, and this element is the analysis of political alternatives available to water users, their elected representatives, water organizations, and other nongovernmental stakeholders involved in water quality

politics. Even the director of the CALFED program, Lester Snow, has stated that "once you have laid out your strategy [to resolve the Bay-Delta water quality problem], there is still the issue of governance, or 'who is in charge' which has yet to be resolved" (CALFED Public Workshop on Proposed Draft Alternative 28 January 1998, San Diego, CA). In terms of U.S.-Mexico border water quality, studies have focused primarily upon the scientific, public health, spatial, and development context of water quality (Ingram, Laney, and Gillilan 1995; Texas Natural Resource Commission 1996). Certain case study papers describe particular river basin monitoring and/or clean up projects, which may include a listing of organizations involved in these projects (Texas Natural Resource Commission 1996). Finally, there exist a few historical and political analyses of water quality case studies along the U.S.-Mexico border (see, for example, Hundley 1966; Ingram, Laney, and Gillilan 1995; Mumme 1982, 1994), but none have explicitly attempted to address the range of choice among water quality politics along the U.S.-Mexico border.

One reason why political range of choice may be neglected is due to the complexity of the water quality problem (point versus nonpoint source pollution for example), and the fragmented, complex regulatory and institutional system involved in managing water quality. In the U.S. and Mexico, no comprehensive water quality law or regulatory agency governs all elements of water quality. Instead water quality politics encompasses the laws and political institutions associated with water resources management, pollution management and species habitat (terrestrial

and aquatic) protection.

There do exist numerous analyses of the numerous institutions which govern and regulate water quality, but few are comprehensive, and even fewer examine the range of choice among political alternatives. Analysis of government institutions may clarify, even explain, the institution's motives and actions in the water quality process, but such an analysis rarely provides a comprehensive picture of how all the political actors and organizations interact (an exception would be Ingram, Laney, and Gillilan 1995). Case study analysis of water quality politics provides us with rich detail and evaluation of one type of water quality governance approach, but rarely is there an attempt to examine alternative water quality governance approaches in these case study analyses. To remedy this problem, and to clarify the border water quality political process, this dissertation moves the focus of study from the institutional/case study perspective to a geographic perspective of water quality politics. I do this by making place, not the institution, the central focus of water quality politics. If we shift our perspective to place, then the central question one must ask is, does place shape water quality politics?

A Place-Based Framework for Range of Choice Studies in Water Quality Politics

Along the U.S.-Mexico borderlands researchers, community activists, and governmental policy makers now focus upon the concept of *place* as a context for resolving water supply and quality problems (Brown and Placchi 1998; U.S.-Mexico Border XXI Program 1997). In water quality political deliberations within

the Tijuana-San Diego metropolitan region, this research identifies four place-based approaches in managing water quality. These approaches are: point source, watershed, metropolitan region, and hydrocommons. This examination of the range of choice in water quality politics is an analysis of four water quality case studies which correspond to each place-based approach. These case studies are listed in Table 1.2.

For my range of choice analysis of water quality governance, I answer the following research questions:

1. In the U.S. and Mexico, what are the laws, governance structures, and decisionmaking procedures associated with each place based approach?

2. For each case study what are the governance structures and decisionmaking procedures present?

3. How do representations of place and the geographic concept *scale* shape water quality governance and power relations?

4. In each case study, what is the range of choice among technical and governance alternatives?

To develop the theory and rationale which clarifies the range of choice study and the above research questions, I proceed as follows. First, I draw from literature in geography and water resources management to examine the role place plays in water quality politics, or more specifically, how and why different players in the water quality process use the four representations of place to frame the water

Table 1.2

Water Politics in Tijuana-San Diego Metropolitan Region:
Projects for Evaluation

South Bay International Wastewater Treatment Plant (point source): A binational wastewater treatment plant located just north of the U.S.-Mexico Border which currently treats twenty-five million gallons per day (mgd) of Tijuana's sewage. The International Boundary and Water Commission has applied for a discharge permit. The State of California Regional Water Quality Control Board has yet to approve the discharge permit. The plant continues to operate and discharges twenty-five mgd of primary treated effluent into the Pacific Ocean. Secondary treatment of municipal wastewater is required by U.S. federal law.
Tijuana River Watershed GIS (watershed): Sponsored by the National Oceanic Atmospheric Administration (NOAA), San Diego State University, and El Colegio de la Frontera Norte (Tijuana). This GIS is designed to integrate binational multi-media ecological and socio-demographic data for this binational watershed. The *Tijuana River National Estuarine Research Reserve (TRNERR) Community Watershed Monitoring Program* uses the GIS to conduct community based watershed education and research projects in the Tijuana River Watershed.
Border Water Council (metropolitan region): The Border Water Council was initiated by the San Diego Association of Governments and the San Diego County Water Authority on 13 January 1998. This council is still in its planning stages and has representation from water agencies in U.S. and Mexico. The council's mission is to assist in the planning, coordination, and implementation of cross-border water infrastructure improvements and water resources management in the San Diego-Tijuana metropolitan region.
CALFED on the Border (hydrocommons): Within the past decade certain experts have linked transbasin diversions with water quality degradation. This linkage between transbasin diversions and water quality is present in the *hydrocommons* place based approach in resolving water quality degradation. In California, a hydrocommons based water quality management program (known as the CALFED process) is currently underway to address water quality degradation and wetland restoration of Northern California's Sacramento River Delta region. A hydrocommons based management program which would link Baja California and Southern California with the Colorado River has not been implemented, but certain organizations are examining such an option.

quality problem. Second, I draw from water policy and environmental justice literature to develop my framework for a political mapping of water quality governance structures and decisionmaking structures. Finally, I draw upon the literature from natural resources management and political geography to examine a prevalent political strategy in water politics, which is to manage *the scale of political conflict*. Hence, this dissertation explores the intersection of three disciplines and provides a geographical, or place-based analysis of water quality politics in California and Baja California.

Politics and Place in the Water Quality Process

How Geographers Define Place

> The assignment of place within some socio-spatial structure indicates distinctive roles, capacities for action and access to power. . . . *Placing* and *making of place* are essential to social development, social control and empowerment in any social order. (Harvey 1997, 265)

Place plays an integral role in defining organizational roles, power relations and types of action in political conflicts. However, what do we mean by the term place? For geographers, the concept of place has numerous meanings. Place can be understood as an object, i.e., as a geo-referenced (via latitude or longitude, for example) location, border, or physical landscape. This type of place is referred to in geography as place-as-object. Place is also understood existentially as a subject, in the sense that we feel we belong somewhere and attach emotional, spiritual, or experiential meanings to place (Till 1996, 5). This type of place is often referred to as place-as-subject, or sense of place. For Agnew (1987) and Routledge (1993),

place also entails locale. Place-as-locale is the areal and social setting of events and social relations (Till 1996). Until recently, geographers have tended to emphasize one particular conceptualization of place. However, as Till (1996, 5) and Agnew and Duncan (1989) argue, the "power of place" lies in its ability to integrate diverse meanings. Hence the term "place" as referred to in this dissertation is a holistic concept which incorporates varying extents of the meanings discussed above.

Let us explore briefly how the concept of place is utilized in water quality politics. In terms of place-as-object, the link is clear in that each approach listed in Table 1.2 is delineated by a geo-referenced location or region. In fact, the actual location of a coastal storm drain or ocean sewage outfall (the point source of water pollution discharge) is of great concern to residents in the Tijuana-San Diego metropolitan region, because at locations near storm drains or outfalls, swimming or other coastal recreational uses may become unheathful due to pollutants emanating from these point sources. The concept of place-as-subject is integral to watershed-based politics, in that community based watershed movements incorporate experiential, emotional, and spiritual attachments to a watershed, or sense of place in their governance strategy. As this dissertation will demonstrate, invoking sense-of-place images (e.g., our polluted watershed is a health risk to our children who recreate in it, or our watershed can become a source of community pride, even neighborhood restoration) could be necessary to foster public participation of urban watershed residents in water quality politics.

However, I must stress that place is not the only, or possibly even the primary, factor which shapes water quality political action. Institutional history and culture play a significant role, and the concept of place as locale (the areal and social setting which events and social relations are constituted) supports the integration place and social processes (e.g., institutions) in water quality governance. As we will see in this dissertation, the relationship between water quality governance and place is a reflexive one. Water quality governance is not only shaped by the "places" they encompass or even the sense of place images invoked, but also by social relations between organizations who attempt to manage and govern water quality in these places.

Place and Water Quality in the Tijuana-San Diego Metropolitan Region

Place is the current "site" of conflict in water quality politics as various organizations and scholars defend different place-based approaches to govern and regulate water quality. Within the San Diego-Tijuana metropolitan region there exist four placed-based strategies for regulating and/or restoring water quality (point source, watershed, metropolitan region, hydrocommons). Each of these place-based approaches entails first, different definitions of the water quality problem; second, different styles of water quality governance; and third, different types of power relationships between organizations. This dissertation evaluates and compares these three components of water quality governance in each of the four place-based approaches discussed below.

At present, U.S. and Mexican governmental regulation of water quality remains focused on point source control of water pollution. Point source control of water pollution entails that wastes from industry and households are deposited into a sewage conveyance system. This wastewater travels via the sewage conveyance system to a treatment facility, where it is treated at one point source (i.e., one place), a publicly owned treatment plant (POTW) (Adler, Landman, and Cameron 1993).[7] The South Bay International Wastewater Treatment Plant is an example of point source control. The plant is located just north of the U.S.-Mexico border, where it currently treats twenty-five million gallons per day (mgd) of Tijuana's sewage. This plant has been the focus of much criticism from U.S. and Mexican organizations, in part because the wastewater is treated at one point (a POTW), thus resulting in expensive wastewater treatment costs (costs are approaching $400 million dollars). At present, the effluent receives primary treatment (secondary treatment is required under the U.S. Clean Water Act), and is deposited in the Pacific Ocean via a 3.5 mile long outfall on the U.S. side of the border (the full capacity of this outfall is 300 mgd). Critics assert that the deposition of large amounts of partially treated effluent at one point or place, could result in coastal ecosystem damage, even beach closures. Plant sponsors state that some treatment of Tijuana's uncontained raw sewage flows is better than no treatment.

Within the last decade federal organizations (such as the U.S. Environmental Protection Agency [EPA], U.S. Fish and Wildlife, Mexico's Comisión Nacional del

[7]In the U.S. industrial waste is pretreated before entering the POTW. Pre-treatment of industrial waste is a rare occurrence in Mexico.

Agua [CNA]), California's State Water Resources Control Board, and environmental activists have shifted their efforts from point source management (as defined above), and are focusing once again on the concept of watershed as a context for water quality regulation (CNA 1996, 1998; EPA 1996; Natural Resources Law Center 1996; Wescoat 2000). Wescoat (2000) and CNA (1998) define the term watershed as a geographic region in which storm water runoff flows through a stream network, which finally drains to a common outlet. Within the context of U.S. water history the term watershed has evolved to "connote small scale management of land use and water, while river basin connotes large-scale interstate multiple-purpose development of the sort advanced by the U.S. Army Corps of Engineers and Bureau of Reclamation" (Wescoat 2000, 147). In Mexico, the term *cuenca* or watershed connotes both large river basins and smaller watersheds. To date land use has not been integrated in Mexican government sponsored watershed management plans (Zúñiga pers. com. 1999).

The watershed concept is of particular relevance in the Tijuana-San Diego metropolitan region, because the region contains a binational watershed, the Tijuana River watershed. As with many border watersheds, the Tijuana River watershed is plagued with binational flows of aguas negras (see Figure 1.1). Many organizations' place-based communications and subsequent politics promote watershed-based activities, such as watershed education, watershed-based water quality testing, and a geographic information system (GIS) watershed database In fact, the watershed is a recurring place representation which organizations in

Mexico and the United States use to promote binational cooperation in solving the binational water quality pollution problem. One increasingly persuasive place representation which links watershed with binational cooperation is the Tijuana River Watershed GIS and subsequent mapping efforts resulting from this GIS. This GIS (along with other border watershed mapping efforts) defines the U.S.-Mexico border as a region of shared watersheds and/or river basins, and thus of shared water pollution problems (Brown and Placchi 1998). This representation of the border as a region of shared watersheds has led academics and various organizational leaders to initiate binational watershed research, education and water quality testing.

In addition to point source and watershed approaches, certain organizations in San Diego and Tijuana view the water quality problem as one bounded by the metropolitan region. These organizations (primarily water supply, urban wastewater agencies, and economic development agencies) propose to implement a binational regional metropolitan water plan for water supply, wastewater treatment, and wastewater reclamation. In January 1998, the Border Water Council was formed to assist in planning, coordination, and implementation of cross border water infrastructure improvements and water resources management in San Diego and Tijuana. Unlike watershed-based groups who are interested in integrating and ultimately preventing point and nonpoint source pollution management, Border Water Council focuses primarily on water supply management, wastewater reclamation, and economic development. In addition, Border Water Council is

organized around the place-based approach of a binational metropolitan region. Most stakeholders involved in Tijuana's and San Diego's water quality politics see much potential in the Border Water Council's efforts in binational water resources planning (in terms of both water supply and water quality) (Brown 1998).

Finally, a few organizations assert that long distance transbasin water transfers degrade water quality. In California and Baja California, two major transbasin diversions from the Sacramento and Colorado Rivers provide water to the Tijuana-San Diego metropolitan region (Bates et al. 1993). Policy makers which link water quality with transbasin diversions support a *hydrocommons* place-based approach for resolving water quality degradation (Weatherford 1990). A hydrocommons is a large geographic entity which incorporates water supply and water quality issues within a region which is suffering from water pollution and subsequent aquatic ecosystem distress. What differentiates the hydrocommons approach from watershed and regional approaches to water quality management is that the hydrocommons recognizes the environmental linkages between the exporting basin and the receiving region of transbasin diversions. In addition, a hydrocommons approach recognizes the linkages between water pollution, aquatic ecosystems degradation and drinking water quality.

In California, a hydrocommons-based water quality management program is currently underway to address the water quality degradation problem and wetland restoration of Northern California's Sacramento River Delta region (Rieke 1998). This hydrocommons project known as the CALFED process attempts to link the

politics of water quality, the politics of water supply, and the politics of endangered species management. A hydrocommons management program for the border region between Baja California and California has not been implemented, but certain organizations have initiated working groups and conferences to examine such an option. For these organizations, hydrocommons-based management makes sense because in this western part of the U.S.-Mexico border region, the region's primary waterways are not large river basins (such as the Rio Grande River in the eastern borderlands). Instead the primary waterways are a network of man-made canals and aqueducts which divert Colorado River water to agricultural and urban water uses in Southern and Baja California. These transbasin diversions cause, in part, numerous water and land-based environmental degradation problems along the California and Baja California border. In the Tijuana-San Diego metropolitan region, water supply agencies in both cities seek to increase their water supplies via transbasin diversions from the Colorado River.

One way to understand the geography of water quality is to examine how these different place-based water quality management approaches shape the definition of the water quality problem and water quality governance (Harvey 1997). To answer research questions one and three, I recorded various governmental and nongovernmental representatives' perceptions of the water quality problem. My goal was not only to understand the "scientific" perspective of the water quality problem, but also to understand how all participants in water quality politics (decisionmakers, government officials, and representatives from the

environmental and public health communities) perceive the geographic diversity of water quality. In addition, I determined why participants supported a particular place-based approach, documented representations of place, and identified perceived advantages and disadvantages of each place-based approach. Finally, via document analysis and interviews of stakeholders in the water quality political process, I investigated for both the U.S. and Mexico the historical, legal, and institutional rationale (or place-as-locale) for each place-based approach to water quality governance (research question one).

Examining the institutional and historical context of each place-based approach is the first step in analyzing place-based water quality politics. To evaluate and compare the types of water quality governance (research questions two and three), one must understand the political processes and power relations present in water governance. It requires a mapping of the water quality political process itself (in the U.S., Mexico, and borderlands) and a review of theories of scale in political geography.

A Political Mapping of the Water Quality Political Process

Water quality politics encompass the laws and political institutions associated with water resources management, pollution management, and as indicated in the CALFED process, even aquatic habitat and wetland restoration. In the United States, especially California, water quality politics are highly decentralized, giving states and municipalities formal sovereignty in water related

matters (Mumme 1982). In addition, there is little integration in the U.S. between water supply agencies and water quality regulatory governmental organizations. Finally, despite what is being preached by U.S. politicians, and even some EPA officials, U.S. cities are not in complete compliance with federal water pollution regulations such as the Clean Water Act. In San Diego, certain point sources are well regulated and enforced, but other facets of federal regulation (such as requiring secondary treatment of wastewater, control of cumulative wastewater loads in water bodies, nonpoint source pollution, or even providing effective water quality assessment reports) are ignored. Mexico, on the other hand, has a highly centralized system water law and administration which does incorporate water quality and quantity. As the EPA has indicated in its appraisal of Mexican environmental laws, Mexico does have excellent environmental laws, but rarely are these laws enforced. In addition, for Mexico (and border municipalities such as Tijuana), the primary concern of water governance is providing and financing water and wastewater infrastructure (Carter 1999). Other important water quality issues, such as the degradation of aquatic ecosystems, the problem of nonpoint source pollution, storm water flows and environmental impacts of transbasin diversions have yet to be addressed by the public and the government.

The current post-North American Free Trade Agreement (NAFTA) environment has fostered numerous border organizations and working groups which encourage binational public participation. Within the last ten years, governance of border environmental conflicts has become even more complex with the

involvement of organizations from economic development, environmental, and public health sectors. The main problem associated with federal and binational water quality management is that there is a lack of comprehensive legal and institutional authority in resolving the water quality problem. There are numerous organizations involved in dealing with water pollution. Each of these organizations have their own decision making structures, their own mandates and jurisdictions. In addition, transbasin water transfers are exacerbating the problem, because water transfers can have negative impacts upon environments from not only the source of transfer, but also at destination sites as well. In the borderlands between Baja California and California, there are no real comprehensive laws or regional political entities which resolve aquatic and terrestrial habitat degradation associated with current patterns of water resources management.

Shifting the analytical focus away from organizations or institutions to that of place may be one approach with which to clarify and better comprehend the confusing, highly fragmented matrix of water quality politics. Research questions two and three address the political mapping project of water quality politics in the Tijuana-San Diego metropolitan region. This project draws upon Latin American geographer Peter Ward's comparative works on municipal governance (U.S. and Mexico),[8] and Iris Marion Young's (1990) incorporation of political decisionmaking structures and procedures in the definition and evaluation of environmental justice.

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[8]Ward (1996) states that an examination of how cities govern tells us much about the nature of intergovernmental processes, power relations, and the opportunities afforded for citizen based participation. Ward's research focused on executive and general representative forms of municipal governance (mayor's office and city council, for example) in the U.S. and Mexico.

According to Young (1990), justice movement politics and literature put too much emphasis on evaluating material distributions of environmental benefits and burdens.[9] Subsequently, there is little or no attention given to the political processes which create equitable or inequitable distributions of pollution. Hence, for Young (1990), justice studies should be expanded to incorporate the government structures and decisionmaking processes in which environmental benefits and burdens (such as water pollution) are reproduced.

My mapping project examines water quality political structures and decision making processes within two municipalities, Tijuana and San Diego, and addresses multiple scales of governance from the local water district to the international scale water resources management organizations such as the International Boundary and Water Commission. The first task of the mapping project was to find out who the major players are in the region's water quality politics. After two years of participant observation of the region's water quality politics, I created a list of significant organizations which participate in water quality politics in the Tijuana-

[9]Environmental justice activism evolved in response to governments', multinational private sector corporations', and mainstream environmentalism's ignorance of "environmentalism of the poor" in both developed countries and underdeveloped countries (Di Chiro 1996; Pulido 1994, 1996). Environmental justice community organizations in the United States have typically been located in low income, working class communities dealing with urban environmental concerns such as lead and asbestos poisoning, substandard housing, toxic waste incineration and dumping, and widespread unemployment. According to Young (1990), the concept of justice as used or analyzed within mainstream state politics and development policies is one primarily devoted to distributive justice. The distributive paradigm defines social justice as the morally proper distribution of social benefits and burdens arising from a particular project and/or a developmental path (Young 1990, 18). In geography, distributive environmental justice studies result in maps portraying spatial distributions of pollution and material explanations of environmental degradation (Kasperson and Dow 1991). Other notions of distributive justice are present in the environment and development literature that examines how uneven patterns of development result in environmental degradation (Sánchez 1994). Yet, what is missing from these analyses is a vision of political action to reclaim and recreate cleaner water for impacted communities.

San Diego metropolitan region. This list is provided in Table 1.3. Second, via phone interviews, document analysis, and intensive personal interviews, I answered research question two by detailing and analyzing the governance structure and decisionmaking procedures of the four case studies associated with each place-based approach. The governance analysis entailed answering the following questions:

1. Structure of the governing authority: Is it a single authority, such as a general manager of a water district, and/or a joint authority consisting of a board of representatives?

2. Legitimacy of each authority: Are governing members elected, appointed or hired?

3. What are the goals of this authority?

After answering these questions, I embarked upon the second component of the mapping process which is a delineation of decisionmaking procedures and citizen participation in each place-based approach. Throughout the entire mapping process I paid special attention towards representations of place associated with each case study decisionmaking process.

However, the "political mapping" to this point is missing a *geographical analysis of power relations* in the water quality political process. To address the power component of water quality governance, I examine one type of political strategy which produces power relations in environmental conflicts. This strategy, which I label the politics of scale, is aimed at examining the relationship between the geographical concept of scale and power relations in water quality politics, or

Table 1.3

Listing of Organizations

U.S. Non-Governmental Organizations	Sierra Club, Southwest Wetlands Interpretive Association, Surfrider Foundation, Environmental Health Coalition, Surfers Tired of Pollution, San Diego BayKeeper, San Diego Dialogue, AguaClara, Citizens Revolting Against Pollution, San Diego Natural History Museum, Audubon Society, Environmental Water Caucus, Citizens Against Recreational Eviction
U.S. Governmental Organizations	Environmental Protection Agency , Cal-EPA, California Coastal Conservancy, U.S. Fish and Wildlife Service, Tijuana River National Estuary Research Reserve, San Diego County Office of Environmental Health, California State Assembly and U.S. Congress Representatives, San Diego State University, California Regional Water Quality Control Board, City of San Diego Metropolitan Wastewater Department, City of Imperial Beach, San Diego Association of Governments
U.S. Water Supply Organizations	Bureau of Reclamation, California Department of Water Resources, Metropolitan Water District of Southern California, Otay Water District, Tia Juana Valley County Water District, San Diego County Water Authority, Imperial Irrigation District
Mexico Non-Governmental Organizations	Las Gaviotas, ECO-SOL, Colonia Landowners Associations, Imagen Tijuana, Ecoparque, Green Party, Amas de Casa, Comité Ciudadano Pro-Restauración del Canon del Padre, Grupo Factor X
Mexico Governmental Organizations	Colegio de la Frontera Norte, Comisión de Servicios de Agua del Estado, Ayunamiento de Tijuana, Comisión Estatal de Servicios Públicos de Tijuana, Comisión Nacional del Agua, Secretaria de Asentamientos Humanos y Obras Publicas, Secretaria del Medio Ambiente, Dirección General de Ecología del Estado Baja California, Procuraduría Federal de Protección al Ambiente, Comisión Estatal del Agua—Baja California, Instituto Municipal de Planeación
International Organizations	International Boundary and Water Commission, Border21 Water Work Group, Border Environmental Cooperation Commission, California Border Environmental Cooperation Commissin, Environmental Committee of the Tijuana-San Diego Region, Proyecto Bio-regional de Educación Ambiental, Western Association of Maquiladora Owners, Pacific Institute for Studies in Development, Environment and Security

research question three. Politics of scale is a political strategy often invoked by players in water quality conflicts, be they powerful water agencies, municipalities, government agencies at the state/federal level, private economic development organizations (agriculture, mining, real estate, construction, etc.), or environmental organizations.

Using Scale to Control Water Quality Politics

Political geographers use the term "scale" to delineate how political-economic processes order and produce space. For most political geographers, the primary political institution which defines politics is the state. This state-centric focus has lead to the three tier organization of political geography scale analyses which encompass: "the state itself at the national scale, relations between states at the international scale and the politics of parts of states at the intra-national scale" (Taylor 1984, 2). Political geographer Peter Taylor (1981, 1985) asserts that this delineation of scale is incomplete because it ignores integration of the world capitalist economy which incorporates politics at all scales. To fill this gap, Taylor proposed a three tier "political economy of scale." Unlike the previous state-centric definition of scale, the central focus of Taylor's scale definition (or model) is capital accumulation (Gregory 1996). In this emphasis upon capital accumulation, Taylor (1985) asserts that all political conflicts are experienced at the local level, justified through national ideology at the national level, and organized via the world economy at the global level.

Taylor's definition of scale reflects a world systems approach which implies cause and effect in one direction (usually from the global to the local). Little attention is given to the production of space as a dialectical process (Gregory 1996; Haraway 1991; Harvey 1997) between local and global processes and vice versa.[10] For certain human geographers, any account of complex interactions at different scales must be situated within the "local-global dialectic in which events at one pole may have countervailing effects at another" (Gregory 1996, 544; Haraway 1991). This type of dialectical account which feminist Donna Haraway (1991) labels as situated knowledges resonates with the environmental movement slogan "think globally, act locally" (Gregory 1996), and the feminist mantra "the personal is political."[11]

It is at this juncture that I introduce a type of scale analysis which is centered around the "scope" of a conflict. According to Schattschneider (1960), the outcome of any political conflict is determined by the extent to which the public becomes involved in a conflict. The extent to which an audience or the public is involved in a political conflict is known as the scope of a political conflict. From Schattschneider (1960) and Taylor (1984, 4), the theory of scope is summarized by the three following propositions: (1) all political outcomes are defined by the scope;

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[10]Using different terminology, Taylor does make a similar critique (lack of recognition of dialectical processes) of political geography works, in that by the delineation of three separate scales there is little regard for inter-relations between the scales.

[11]A second critique of Taylor's approach is that one cannot attribute the production of space solely to the globalization of capitalism. According to other human geographers, there are other institutional and cultural dimensions of our world (such as military power, science, patriarchy) which impact the production of space (Gregory 1996).

(2) every change in the scope of conflict has a spatial bias, and this bias will change the balance of power in the conflict; and (3) weaker political organizations attempt to change the balance of power in the conflict by broadening the scope. From Schattschneider's propositions, we can infer that organizations can control a conflict by keeping the scope limited to a particular scale(s). For example, localized habitat conservation plans,[12] such as San Diego's Multiple Species Conservation Program (MSCP), are desired by the development community because the scope associated with habitat planning remains limited to a local region. Representatives from national level political institutions such as EPA are not warmly received (at least by developers and city councils) at these habitat planning proceedings. Opponents to "outside" intervention cite that federal intervention is unwelcome because their presence will squelch local voices and slow down the consensus building process. However, given Schattschneider's propositions, it is my assertion that federal representatives are not welcome at these proceedings because their presence broadens the scope of conflict and can change the balance of power in the habitat planning process.

Hence, the question following this scenario is: Do organizations and individuals involved in water quality conflicts control power relations by managing the scope of conflict? This question entails a type of political strategy which I label as the politics of scale. Politics of scale is a strategy which organizations use to

[12]Habitat conservation plans (HCPs) are land use planning efforts to preserve threatened habitats. According to Ingram, Laney, and Gillilan (1995), land use planning is linked to water quality, because planning controls urbanization. Increased urbanization increases urban polluted runoff in watersheds, estuaries, and coastal waters.

assert power by limiting or expanding the scope of an environmental conflict. Scale[13] is inherent in this political strategy because managing the scope of conflict entails first determining which organizations and hence, which political scales or jurisdictions are involved in the conflict. Second, this dissertation confronts the local-global dialectic by detailing the actions, strategies, even motivations utilized by players and organizations to manage the scope of conflict within the local-global dialectical continuum (hierarchy) of politics. In essence the research invokes the concept of agency in the production of scale in environmental conflicts.

To answer scale component of research question three, I determined what scales of environmental regulation are represented in the four place-based case studies. In addition, I attempted to answer the following questions: (1) Which organizations limit or expand the scope of conflict, and how is this done? (2) Why does an organization expand or limit the scope? and (3) What is the role place plays (if any) in expanding or limiting the scope of conflict?

Besides place and scale, I paid special attention to the concept of "expanding the range of choice" in each of the four case studies (research question four). My central question concerning this topic is: Does an expanded scope of conflict encourage an expanded range of choice among alternatives (and vice versa does an expanded range of choice encourage an expanded scope of conflict), and hence a more pluralistic democratic approach towards water resources management? The

[13]The use of the term scale in this research is similar to "jurisdiction" which is defined as the geographic region over which a political institution's legislative and judicial power extends (Gilbert Law Summaries 1994).

primary goal of the dissertation is to expand the range of choice of water quality governance alternatives. In addition, the range of choice theme present throughout this dissertation examines the relationship between scope of conflict and range of choice in water quality politics.

Methodology and Organization of the Dissertation

To answer the four research questions posed on page 22, I utilized a case study methodology employing three phases of research: (1) participant-observation research, (2) oral and written communication analysis, and (3) in-depth interviews (Yin 1994). For Phase One participant-observation research, I have served as an intern with the Tijuana River National Estuarine Research Reserve (TRNERR) and the Southwest Wetlands Interpretive Association (SWIA) to research and coordinate a community watershed monitoring program for the Tijuana River Watershed. Besides participation in the internship, Phase One also included observations of meetings, public forums (educational events, conferences, public hearings), and work groups sponsored by organizations involved in the four case study projects listed in Table 1.2, for a period of at least two years. For Phase Two of this research, I reviewed four categories of organizational communications: organizational by-laws, public forums, persuasive communications,[14] and organizational water quality reports/water quality plans. Finally, for Phase Three,

[14]Examples of persuasive communications are maps and geographic information systems (GIS) utilized to persuade other organizations or the public, lawsuits, organizational comments made at stakeholder proceedings, and organizational press releases to the media.

the interview process, I conducted fifty-two focused, open ended formal interviews of informants who participate in the four place-based case studies, or have been identified as key players in water quality governance in the binational metropolitan region. Informants were provided with a summary of the four place-based approaches (see Table 1.2). Interview question templates and release forms are provided in the Appendix.

I have written this dissertation as a place-based range of choice analysis among water quality governance alternatives. Hence the dissertation is "framed" around four chapters which correlate to each place based approach. In Chapters Two to Five, when applicable, I answer the four research questions associated with each place-based approach (point source, metropolitan region, watershed, and hydrocommons). For each of these chapters, I discuss for the U.S. the historical/institutional context (or place-as-locale perspective) for each place-based approach. Subsequently, I do the same for Mexico (research question one). After introducing the place-based approach in each country, I turn to the binational case study associated with each place-based approach. I provide a brief history of the case study, and delineate the governance structure and decision making process associated with each case study (research question two).

Throughout my analysis, I pay special attention to the role place plays in each case study. I examine how the incorporation of different types of place shapes range of choice among alternatives, and the expansion or limitation of scope of conflict (research question three). I evaluate when and why the scope of conflict is

expanded or limited and how this expansion or limitation of the scope of conflict both shapes power relations in water quality conflicts and influences range of choice among alternatives present. In certain cases, such as watershed and hydrocommons, a governance structure may not exist. In watershed case study, I explain why there is no official political action is present. For the hydrocommons case study, I evaluate existing legal and policy structure with the assumption that changes can be made to permit hydrocommons management along the California and Baja California border. Finally, I detail the expansion and limitation of range of choice of technical and governance alternatives present in each case study, and how and why such an expansion or limitation occurs (research question four).

In Chapter Six, the conclusion, my focus shifts to redefining a sustainable and democratic urban water paradigm for the U.S.-Mexico border. I discuss how we can manage water resources in a more sustainable manner. In addition, I introduce a template for water quality governance for the U.S. and Mexico which encourages more pluralistic and even equitable governance. This improved vision of water resources governance involves an incorporation of a sense of place, an expanded range of choice, and an expanded scope of conflict in water quality governance. However, there are limitations associated with expanded range of choice and scope of conflict, and I briefly discuss those limitations.

Conclusion

Examining the range of choice in water resources management and governance is a phrase which resonates strong within geography. Geographical range of choice studies have a history of examining and ultimately integrating scientific, technical, social scientific, and even cultural components of water resources management and governance. Within this perspective, all known components of water resources (to include the social components) are considered.

Due to the complexity of water quality problems, and the consequent fragmented, complex regulatory and institutional system involved in managing water quality, range of choice studies have been limited to technical and financial studies—and the political aspect of the range of choice has been ignored. By shifting the focus of political analysis from that of institutions and case study to *place,* it is possible to examine both the range of choice in water quality management, and the manner which geographical concepts such as place and scale shape water quality governance structures, decisionmaking processes, and power relations. This chapter has introduced the theoretical background (defining range of choice, place, political mapping, and politics of scale), research tasks, and methodology utilized in implementing a place-based range of choice study of U.S.-Mexico border water quality politics. Analyzing data from four place-based approaches present in the Tijuana-San Diego border region provides us with four distinct water quality governance approaches rooted in different perceptions of the water quality problem and governance styles. The question I encourage the reader

to ask throughout this dissertation is: what do we want to encourage in future water resources governance in the Californias? Examining different political alternatives, including political experiments such as the Border Water Council and CALFED, in range of choice studies is one way to evaluate the democracy process present (or not present) in water quality politics. As this research will demonstrate, an incorporation of sense of place, and a commitment to expanding the range of choice (among technical and governance alternatives) and scope of conflict, may support a more democratic approach toward water resources governance in that it encourages diverse options and, hopefully, more pluralistic and diverse representation in water resources governance and decisionmaking.

CHAPTER 5

WATER QUALITY AND HYDROCOMMONS GOVERNANCE ALONG THE BORDER OF THE CALIFORNIAS

Introduction: What Is a Hydrocommons?

The three place based approaches introduced in the previous chapters do exist and are evolving in the Tijuana-San Diego metropolitan region. However, as indicated by Wescoat (1987), range of choice analysis should include alternatives which do not exist presently, but which may evolve given changes in water resources institutional and legal structures. One such place based opportunity on the horizon of U.S.-Mexico border water quality management is the hydrocommons approach.

Policy makers which stress the connections between water quality, watershed ecosystem health with transbasin diversions, support a hydrocommons place based approach. Hydrocommons based water quality management is a regional approach towards water quality management and governance. What differentiates the hydrocommons approach from watershed based approaches to water quality management is that the hydrocommons governance recognizes the environmental links between the region which sends or exports water and the region which receives water imports. In addition, a hydrocommons approach recognizes

the environmental links between water transfers, water pollution of surface/ground waters and aquatic ecosystems degradation.

Before we can evaluate hydrocommons governance it is important to understand transbasin water transfers. A transbasin water transfer or diversion occurs when water is diverted from one watershed or river basin and sent to another region beyond the divide or the limits of the watershed. An early transbasin water transfer in the Western U.S. occurred in the early 1900s, when the City of Los Angeles Department of Water Resources was successful in diverting water from the Owens River (located East of California's Sierra Nevadas) via a 260 mile long aqueduct to the City of Los Angeles. In this case, the City of Los Angeles purchased thousands of acres of land within the Owens River watershed to obtain water rights so that Owens River water could be diverted and transferred to Los Angeles (Water Education Foundation 1996a).

Today water transfers are defined in the U.S. as the process of moving water supplies through a complex of water storage and distribution systems from areas of lesser need to areas of greater need (City of San Diego Manager's Report 24 March 1999; Water Education Foundation 1996a). Water transfers may occur within a watershed or water transfers may result in diverting water beyond the natural watershed boundaries (transbasin diversions). Water transfers can occur between agricultural interests or firms, or from agricultural to urban users. Water supply agencies and politicians in Tijuana and San Diego cite that transbasin water

transfers are advantageous because the transfers assure a long term, reliable water supply to meet growing demands of this growing urban binational economy.

Figure 5.1 entails a map of transbasin diversions which support urban water demands in Southern California and Baja California. San Diego imports between seventy five and ninety percent of its water from the Sacramento River Basin, 600 miles north, and from the Colorado River, approximately 240 miles to the east (Laru pers. com. 2000). The City is negotiating to increase its current supply of water through agricultural to urban transbasin water transfers from Imperial Valley, California (City of San Diego Manager's Report 24 March 1999). During times of drought, Tijuana exports up to ninety percent of its water supply from the Colorado River, and is seeking to increase its allocation of Colorado River water. At present, both cities are working together to investigate the possibility of constructing a binational Colorado River aqueduct to accommodate increasing needs for water for the rapidly growing industrial and residential needs of the Tijuana-San Diego Metropolitan region.

According to Weatherford (1990), once a transbasin diversion or transfer is made, the sending and receiving basins/watersheds are linked. This link (made via the transfer) erases the natural boundaries of both sending and receiving basins. When transbasin water transfers are established by conveyance systems such as storage reservoirs and aqueducts, the receiving basin becomes dependent upon the sending basin for water. In addition, the sending basin is no longer self contained because water is diverted beyond its natural basin boundaries. Areas downstream

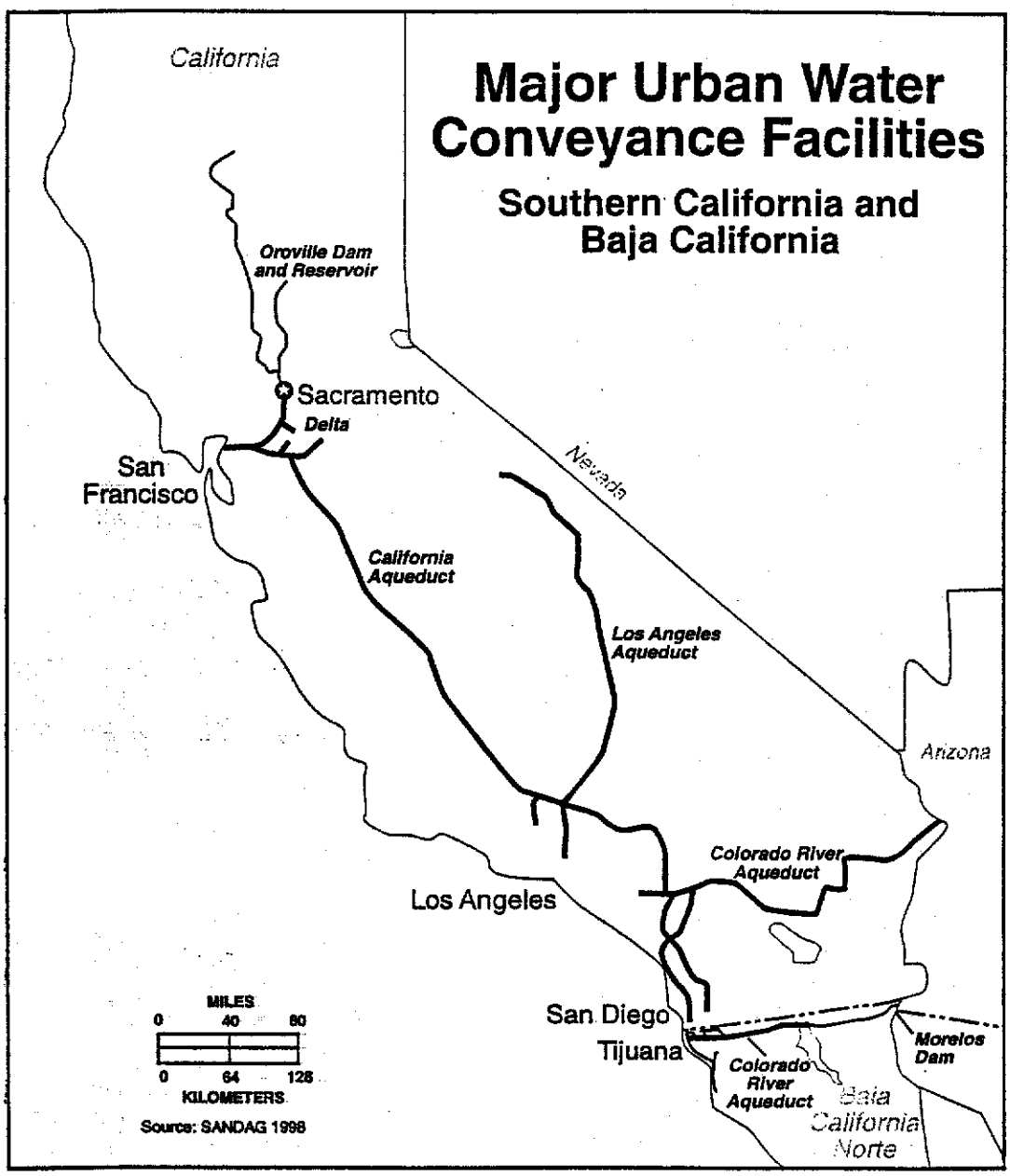

Figure 5.1. Major Urban Water Conveyance Facilities: Southern California and Baja California

of the diversion now receive less water. Consequently, the sending region's water quality and aquatic ecosystems downstream of the diversion are altered. In essence, transbasin diversions "cause hydrologic basins to be reshaped, breached and bonded by hydraulics resulting in hybrid basins" (Weatherford 1990, 3).

These hybrid basins, which are tied together by man-made plumbing, are known as hydrocommons. What is important to understand is that the creation of the hydrocommons results in altered hydrology, water quality, ecosystems, economies, even land use patterns in both the sending and receiving watersheds/ basins. Consequently, for regions which rely on transbasin diversions such as the Tijuana-San Diego metropolitan region, Weatherford and other hydrocommons proponents argue that watershed or basin management should be viewed actually as hydrocommons management.

In California, a hydrocommons based water quality management program is currently underway to address the water quality degradation problem and wetland restoration of Northern California Bay-Delta estuary (Rieke 1998). What differentiates CALFED's hydrocommons approach from watershed approaches to water quality management (detailed in Chapter Four) is that the hydrocommons recognizes the environmental and economic links between the exporting basin and receiving region of transbasin diversions. Essentially, a hydrocommons approach recognizes the environmental links between water pollution of surface/ground waters, transbasin diversions, aquatic ecosystems degradation and drinking water quality.

A hydrocommons based management program for the border region between Baja California and California, or a CALFED on the border, has not been implemented, but certain organizations have initiated working groups and conferences to examine such an option. For these organizations, hydrocommons based management makes sense because in this western part of the U.S.-Mexico border region, the region's primary waterways are not large river basins, such as the Río Grande River basin in the eastern part of the border. Instead Southern California's and Northern Baja California's primary waterways are a network of manmade canals and aqueducts which divert the Colorado River to agricultural fields in Imperial Valley and Mexicali, and west to expanding urban regions such as Los Angeles, Tijuana, Ensenada, and San Diego. The total amount of transbasin diversions range between six and eight million acre-feet each year. These transbasin diversions, along with other diversions within the Colorado River Basin, are the primary cause of numerous water and land based environmental degradation problems along the California and Baja California border. Currently laws and governmental organizations in the United States do not adequately address the links between transbasin diversions, water quality, and habitat destruction. In Mexico, umbrella organizations at the federal and municipal levels do manage in conjunction water supply and quality; however, laws and infrastructure planning rarely address the links between transbasin diversions, water quality, and habitat destruction.

In the following sections I will delineate the CALFED governance process and current problems existing in this hydrocommons governance experiment. After

explaining the CALFED hydrocommons governance process, I will turn to the transbasin diversions which support the Tijuana-San Diego metropolitan region. I will explain the current status of transbasin diversions, and detail the proposed binational aqueduct plan to increase the amount of Colorado River water allocations west to the Tijuana-San Diego metropolitan region. I will explain water quality impacts in both sending and receiving basins of this hydrocommons. Finally, I will detail how two border governance institutions, the IBWC and BECC, may facilitate hydrocommons governance.

CALFED: Linking Water Resources Governance for Northern and Southern California

The Creation of the Bay-Delta Estuary Hydrocommons

Northern California's Bay-Delta region is a "unique and valuable resource, and an integral part of California's water system" (California Department of Water Resources 1995, 1). This region receives runoff from the Sacramento, San Joaquin, Mokelumme, Consumnes, and Calaveras Rivers, which in turn form a seven hundred mile maze of sloughs and waterways. These waterways flow westward and terminate in the San Francisco Bay, the Suisun Marsh,[1] and adjoining bays and marshes (California Department of Water Resources 1995; Water Education Foundation 1998). The Bay-Delta region is the largest estuary on the West Coast of North and South America, and its blend of fresh and salt water supports a wide

[1]The Suisun Marsh is the largest contiguous brackish water marsh in the United States (California Department of Water Resources 1995).

diversity of plant and animal life including chinook salmon, steelhead trout, and Pacific herring (CALFED 1998; Water Education Foundation 1998).

Transbasin diversions from the Bay-Delta estuary establish probably one of the most wide ranging and complex hydrocommons in North America. The annual fresh water outflow of the Bay-Delta estuary ranges from four to forty million acre-feet (MAF), with an average annual flow of thirteen MAF (Littleworth and Garner 1995). This outflow provides water to California's two largest transbasin water transfer projects: the California Department of Water Resources, State Water Project (SWP) and the U.S. Bureau of Reclamation Central Valley Project (CVP). In average years up to fifty percent of the water which naturally drains to the Bay-Delta estuary is diverted. In drought years up to seventy percent of water flowing through the Bay-Delta estuary can be diverted to receiving regions within the hydrocommons (Boyle 1998).

Table 5.1 provides a breakdown of the respective beneficial uses or economies supported by the Bay-Delta estuary hydrocommons. The largest users of water are agricultural enterprises. Diverted water from the CVP project is contracted out by the U.S. Bureau of Reclamation and is used to irrigate crops such as rice, cotton, alfalfa, and cattle pastures (Boyle 1998). Today representatives from the agriculture industry argue that Bay-Delta water transfers must continue because these transfers support California's twenty-four billion dollar agricultural economy (CALFED 1998). Besides agriculture since the 1950s, the Bay-Delta estuary hydrocommons has provided water to cities in Northern California, and

over twenty two million people in Central and Southern California (CALFED 1998; Water Education Foundation 1998). Urban demand on delta water could increase due to the simple fact that California's increasing population will demand more water from its fresh water sources. In the past decade, California's population has experienced a twenty-five percent growth rate, twice the national average (Water Education Foundation 1998). Today California's population is estimated at thirty two million, and by 2020 state officials estimate that over forty-nine million residents will be using water in California (Water Education Foundation 1998).

Table 5.1

Water Use: Northern California's Bay-Delta Estuary

Use	Percentage Used
Agriculture	74
Cities and Industries	19
Other	4
Wetlands	3

Source: Natural Resources Defense Council (1999).

At the end of the State Water Project pipeline, in San Diego, water agencies not only lobby to increase water supplies for its growing urban population, but to increase the amount of Bay-Delta estuary water exports to the San Diego metropolitan region. Although water from the Bay-Delta estuary has water quality problems with organic carbons and bromides (see discussion on water quality below) this water has a significantly lower amount of salts (or total dissolved solids [TDS] levels) than San Diego's other source of imported water—the Colorado

River. After State Water Project (SWP) water is transported to Southern California, Southern California's Metropolitan Water District blends SWP water with Colorado River water. The blending is done precisely to reduce the amount of salts present in Colorado River water. San Diego (which obtains all its water imports from MWD) receives between fifteen to thirty percent blend of water from the State Water Project, and the rest from the Colorado River aqueduct (Laru pers. com. 2000) (see Figure 5.1). Salinity in San Diego's water supply is of concern to different users in the San Diego County. For water supply agencies, high levels of salinity can change the taste of drinking water and can increase the corrosive effects on water plumbing and fixtures (Public Utilities Commission, City and County of San Francisco et al. 1998). San Diego's agriculture industry cites reduced crop output by as much as fifty percent by irrigating with Colorado River water (or high TDS water) (CALFED Public Hearing 1 September 1999). In addition, San Diego's growing biotech industry has expressed the need for high quality, low salinity water for biotech research. Finally, for water reclamation purposes, low levels of salinity result in lower levels of total dissolved solids (TDS) to be removed from wastewater by water reclamation technologies. The reduction of TDS levels increases the quality of reclaimed water, and subsequently reduces water reclamation costs (less filters and processes needed to remove high amounts of TDS) (CALFED Public Hearing 1 September 1999).

Bay-Delta Estuary Hydrocommons' Linkages and Environmental Impacts

California's politicians, the U.S. Bureau of Reclamation, and State of California water agencies and districts understood all too well the economic and political benefits derived by diverting Bay-Delta water to urban and agricultural interests. The politics and law utilized to construct the Bay-Delta hydrocommons, and the economic and urban growth impacts caused by the hydrocommons' transbasin diversions are well documented by Hundley (1992), Reisner (1993), and Boyle (1998). From a Marxist and social theory perspective, Worster (1985, 51-52) labels the Bay-Delta hydrocommons as one integral component of California's "hydraulic society," a society which consists of a modernist capitalist state using its command and control of water to develop an immense political-economy. During the era of Bay-Delta estuary hydrocommons (1940s to the present), water is and continues to be perceived (by certain users, water resources managers and decisionmakers) as: "a commodity that is bought sold and used to make other commodities that can be bought sold and carried to the marketplace. It is, in other words, a purely and abstractly a commercial instrument" (Worster 1985, 52).

Given the historical analysis of perceptions of water as a commodity and the use of water to wield both economic and political power (Worster 1985), it is not surprising that both urban and especially agricultural transbasin water diversions from the Bay-Delta estuary were planned and contracted with no evaluation of the water quality and environmental effects of diverting fresh water from the Bay-Delta estuary (Boyle 1998; Hundley 1992). According to Boyle (1998, 23), during and

even after construction of the Bay-Delta estuary hydrocommons, a comprehension of the environmental destruction caused by transbasin diversions to the Bay-Delta estuary ecosystem was not understood, as indicated by his words below:

> No one had any idea that the system [Bay-Delta estuary] was as much a natural wonder as Yosemite of the redwoods, and no one bothered to study it to obtain data that could aid in making informed decisions. Marine biologist Joel Hedgpeth believes the word "estuary" was not even applied to the Bay-Delta until 1969, when he used it in a congressional hearing. And when [California] Governor Warren held a conference on the proposed State Water Project in 1945, neither the state Department of Fish and Game nor the U.S. Fish and Wildlife Service submitted any comments for the record. In fact—marvelous California touch—the only person to speak for the salmon was the chairman of the Fellowship for Social Justice of the First Unitarian Church in Sacramento. (Boyle 1998, 23)

The issue of preserving declining salmon runs introduced in California the third critical challenge for the Bay-Delta hydrocommons—the need to supply water to support Bay-Delta estuary fish and wildlife. In 1868 the Sacramento River "ranked among the greatest salmon rivers in the world, second only to the Columbia River" (Boyle 1998, 19). In addition, the San Joaquin River was the southernmost river in the world with salmon runs (Boyle 1998). In the 1970s, Sacramento River chinook salmon numbered 80,000. In 1991, the salmon count amounted to just 191 fish (Bates et al. 1993). Presently, salmon spawning runs are endangered by Central Valley and State Water Project dams which prevent salmon and steelhead trout from reaching their spawning grounds. But spawning grounds are not the only salmon habitat endangered. Wetlands in the Bay-Delta estuary which serve as a nursery for baby salmon have been reduced at a dramatic rate. The reduction of wetland acreage has been caused by water diversions and

conversion of wetland habitat to agricultural uses or even urban residential communities.[2] Until recently, fisheries biologists once believed that after hatching from their eggs, salmon immediately needed to swim out to the ocean. However, recent research has revealed that high numbers of young salmon are found lingering for long periods of time in the Bay-Delta estuary. It is believed that these salmon fatten up on insects in the Bay-Delta estuary before entering the Pacific Ocean (Rhoads pers. com. 1998). In addition, the estuary's dense tule marsh vegetation provides cover and hence protects growing young salmon from predators.

Increased water diversions not only result in loss of wildlife habitat, but also diminished water quality within the Bay-Delta estuary. Such a degradation of water quality has both environmental and public health consequences. In terms of environmental consequences, as stated before, the Bay-Delta estuary contains a unique and changing blend of salt and fresh water. Diverting fresh water away from the Bay-Delta estuary to agriculture and urban uses has reduced the amount of water left within the basin to dilute solids such as salts. Hence, if diversions reduce the amount of water left in the river which dilute salts, salinity levels increase. Transbasin diversions are not the only source of increased salinity in the Delta region. Urban polluted runoff and agricultural drainage from farms located within the Sacramento and San Joaquin River basins also contribute to the Delta's salinity

[2]A third use reducing the acreage of native wetlands is the conversion of estuary wetlands to fresh water duck ponds. These ponds support the duck hunting industry and are financially supported by private owners or organizations such as Ducks Unlimited. Although the ponds technically are wetlands, they are freshwater not estuary wetlands (wetlands which require a mix of sea and fresh water) (Rhoads pers. com. 1998).

problem. At the end of an irrigation cycle, farmers pump agricultural wastewater into Delta channels. This wastewater has a high saline content, and contains other pollutants such as selenium[3] and pesticides. Sometimes there is no current to flush the salts and pollutants through the Delta and into the western saltwater bays and marshes. This increase of salinity and other pollutants in Bay-Delta water can weaken immune systems, even kill aquatic species. The large reduction of Delta Smelt species (a species which certain scientists assert tolerates only specific levels of salinity) numbers is one such example. One level up in the food chain, migratory birds[4] and mammals who depend on depleted or contaminated aquatic species as a food source may experience adverse effects either by food source reduction or bioaccumulation of toxins. Indeed as aquatic species numbers have declined in the Bay-Delta estuary, so too are waterfowl numbers declining. In 1959, 1,511,500 waterfowl lived in or visited the Bay-Delta estuary. In 1997 the waterfowl count was estimated at 320,400 (Natural Resources Defense Council 1998).

Bay-Delta estuary water quality is not only important for Delta wildlife, but for drinking water purposes. In fact, compared to national average drinking water quality standards, Bay-Delta estuary water quality is of poor quality, as indicated in Table 5.2 (Public Utilities Commission, City and County of San Francisco et al.

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[3]Selenium in minute concentrations is necessary for growth of many species, but in higher concentrations it is lethal to all organisms; 2.3 parts per billion poison can kill most animals (Boyle 1998). Soils on the west side of the San Joaquin Valley contain high levels of selenium. When the west side of the Valley started to receive water from the Bay-Delta estuary for agriculture, the agriculture runoff from the irrigation agriculture released selenium contaminated water into the Bay-Delta ecosystem (Boyle 1998).

[4]The Bay-Delta region is an important stop for migratory waterfowl along the Pacific Flyway.

1998). According to water supply agencies, as water travels through the Delta the water quality degrades as it mixes with run off from cities and farms and with seawater intrusion from the San Francisco Bay. In addition, transbasin diversions result in higher concentrations of salts and pollutants for Bay-Delta water, as represented in the total dissolved solids levels provided in Table 5.2.

Table 5.2

Comparison of Delta Water Quality with National Average

	Delta Water	National Average
Total Trihalomethanes (TTHMs), parts per billion (ppb)	72	33
Bromide (ppb)	290	45
Total Dissolved Solids (TDS), parts per billion (ppm)	276	184

Source: Public Utilities Commission, City and County of San Francisco et al. (1998).

Besides salinity problems, Delta water contains high levels of organic carbons, which are the building blocks for suspected human carcinogens called trihalomethanes (THMs) (Water Education Foundation 1998). THMs are formed when organic carbons found in water are combined with chlorine. Chlorine is used by many water agencies to treat or disinfect drinking water. Such disinfection reduces the occurrences of gastrointestinal illnesses caused by microscopic organisms living in untreated drinking water. Another disinfection regime, ozone treatment, reduces THMs, but scientists have found that ozone combines with bromide, a component of sea water, to form another carcinogenic disinfection byproduct, bromate (Water Education Foundation 1998). In addition, when

bromide combines with chlorine during the disinfection process it produces a THM known as bromodichloromethane. In 1998, the California Department of Health Services released two studies linking an increased risk of miscarriage with first trimester pregnant women who drank five or more glasses of tap water containing high levels of bromodichloromethanes (Water Education Foundation 1998). Given the public health consequences associated with THMs, water supply agencies are now seeking solutions to reduce the amount of bromide or seawater present in Delta water before it is diverted to users in Central and Southern California.

Evolution of the Scope of Hydrocommons Governance

As indicated by the water supply, water quality, and wildlife habitat linkages problems caused by the construction of the Bay-Delta hydrocommons, it is clear that the Bay-Delta estuary can no longer be thought of as a self contained drainage basin or ecosystem. Indeed transbasin diversions have altered the Bay-Delta estuary's water quality and native ecosystems. In addition, regions receiving water from the Bay-Delta are dependent upon these imported water supplies for local economic activities and burgeoning urban populations. In certain cases (such as San Diego), politicians from the receiving region's are lobbying for increased Bay-Delta water diversions. Understanding the links between water diversions, water quality, species protection, and other environmental resource problems is the first step in solving the complex problems associated with hydrocommons management. According to Weatherford (1990) and Rieke (1998), the next step is to integrate these links in water resources governance and law.

However, how does hydrocommons governance integrate multiple environmental goals? According to Weatherford (1990, 14), water quality planning and consciousness is one political process which can create what he terms "forced integration between water rights administration and water quality control." In essence, three decades of federal enforcement of the U.S. Clean Water Act has resulted in:

> basin plans that juxtapose, and with varying degree of success, integrate beneficial uses, water quality standards and control strategies. The process, as complex and frustrating as it is, has provided a framework within which multiple-purpose development and environmental goals can be analyzed, and to a degree rationalized and adjusted. (Weatherford 1990, 14)

Indeed, water quality regulation enforcement and ever increasing water quality consciousness has and continues to be the primary driving force in the evolution of the CALFED process, a hydrocommons governance experiment which attempts to integrate water supply development with other resource problems associated with the creation of the Bay-Delta estuary hydrocommons.

The first step towards integration occurred in 1967 when the California State Water Resources Control Board (SWRCB) was established to replace the State Water Rights Board (Littleworth and Garner 1995). SWRCB was created to administer California's system of water rights and manage water pollution planning and regulation.[5] SWRCB's institutional integration of water rights and quality management occurred because previously when the State Water Rights Board

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[5]In California, the 1969 California Porter-Cologne Water Quality Act and the 1972 U.S. Clean Water Act provided the regulation mechanisms for water pollution management and reduction.

approved an application to appropriate water, the Board did not take into consideration the downstream water quality effects of the appropriation (Littleworth and Garner 1995). California state assembly hearings investigating the formulation of the SWRCB cited the Bay-Delta estuary as a prime example of this deficiency. The previous State Water Rights Board had recognized the "need to protect water quality as a part of the rights of existing Delta users" (Littleworth and Garner 1995, 113). However, the Water Rights Board only administered water supply rights and disputes. It was unable, in a legal and governance sense, to prevent water quality degradation resulting from diversions (Littleworth and Garner 1995). In 1969 California's Porter-Cologne Water Quality Control Act enabled the newly formed SWRCB to "incorporate water quality considerations into the procedures governing the acquisition of water rights" (Littleworth and Garner 1995, 114). Hence, even before the U.S. Congress enacted the Clean Water Act in 1972, California had created an administrative entity to govern water supply and water quality.

From the late 1960s to the early 1990s, the SWRCB or the State Board held hearings involving water rights of the State Water Project (SWP) and Central Valley Project (CVP). The purpose of these hearings was to coordinate the operation of these projects with protection of water quality, fish, and wildlife within the Bay-Delta Estuary (Littleworth and Garner 1995). The underlying theme of these hearings was that water quality in the Delta should be at "least equal to the levels that would have been available if state and federal projects had not been constructed" (Littleworth and Garner 1995). During these hearings (and subsequent

lawsuits challenging State Board policy for the Bay-Delta estuary), the State Board grappled with complex political and legal questions associated with hydrocommons management. For example, in managing Bay-Delta estuary water quality, is the State Board's primary task protecting water rights, or is it protecting the designated beneficial uses (i.e., fisheries, recreation, etc.) of Bay-Delta estuary waters? Should the State Board consider all competing demands for water, not just state and federal demands on water? What is the role of the Clean Water Act in determining the proper balance between water quality and water diversion interests? Finally, is the State Board's balancing authority (of water quality and diversion interests) limited to water use within the Bay-Delta estuary (Littleworth and Garner 1995)? Can, for example, the State Board mandate water conservation regimes in regions (such as Southern California) importing or receiving Bay-Delta estuary water?

The hearings culminated with the State Board release of the 1988 Draft Water Quality Control Plan for Salinity in the San Francisco Bay and the Sacramento-San Joaquin Delta, and a Pollutant Policy Document. This plan contained the recommended flow and salinity objectives for the Bay-Delta estuary, as well as a program for implementation which included export limits. The plan called for a California "water ethic" which incorporated solutions in both the sending and receiving regions of the Bay-Delta estuary (Littleworth and Garner 1995). Such solutions included water conservation, reclamation, and conjunctive use[6] by those agencies which receive transbasin diversions. In essence, the plan

[6]Conjunctive use is defined as storage of surface water in aquifers for use in later times of need; it is often referred to as groundwater banking (Littleworth and Garner 1995, 234).

recommends that water users of Bay-Delta water, even those who live six hundred miles away in San Diego, would bear the responsibility of restoring the water quality and damaged ecosystem within the Bay-Delta estuary (Littleworth and Garner 1995). However, federal agencies such as the U.S. Environmental Protection Agency, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service found the State Board's Draft Water Quality Control Plan inadequate to protect fish and wildlife in the Bay-Delta estuary (Littleworth and Garner 1995).

Federal agency presence and involvement in Bay-Delta estuary policy making occurred when the 1987-1993 drought resulted in a dramatic decrease of water quality in the Bay-Delta estuary, and a subsequent decrease in native and non-native fish populations (Water Education Foundation 1997). In 1989, the Sacramento winter-run, one of four chinook salmon subspecies, was listed as endangered by the California Endangered Species Act, and listed as threatened by the U.S. Endangered Species Act (Water Education Foundation 1997). The salmon and other Delta species' threatened status led to President Bush's approval of the 1992 Reclamation Projects Authorization and Adjustment Act, which resulted in major changes of water allocation for California's Central Valley Project (CVP). One key change was that 800,000 acre feet of CVP water would be allocated to protect the Bay-Delta ecosystem (Hundley 1992; Quinn pers. com. 1998). In 1993, the EPA along with four other agencies, known as Club Fed,[7] proposed its own

[7]Club Fed consisted of U.S. Environmental Protection Agency, National Marine Fisheries Service, U.S. Fish and Wildlife Service, and the U.S. Bureau of Reclamation (Littleworth and

water quality standards for the Bay-Delta estuary. At the same time, Club Fed proposed to list the Delta Smelt as endangered under the U.S. Endangered Species Act, and the critical habitat designated for species recovery, the entire Delta.

Given the actions of federal entities, agricultural and urban users of the Bay-Delta estuary hydrocommons realized that environmental and water quality issues of the Bay-Delta estuary could no longer be ignored (Quinn pers. com. 1998). During the summer and fall of 1994, state and federal agencies, agricultural and urban water suppliers, and environmental stakeholders developed a joint proposal for resolving Bay-Delta issues. This proposal, known as the 1994 Bay-Delta Accord, included new water quality standards and export requirements to protect the Bay-Delta estuary, and a program to develop a consensus based solution to restore the Bay-Delta estuary (Water Education Foundation 1998). In May 1995 Governor Pete Wilson established CALFED as a consortium of State of California and federal agencies which form the CALFED regional water organization. At present, CALFED's primary goal is to develop a consensus based long term solution and hydrocommons governance structure for the Bay-Delta estuary (CALFED 1998; Water Education Foundation 1997). Table 5.3 presents a listing of government agencies involved in the CALFED decisionmaking process.

According to Rieke (1998), before any solutions can be determined by CALFED, the scope of this new regional water organization must be defined.

Garner 1995).

Rieke's (1998) definition of the scope of a regional water organization (not to be confused with Schattsneider's scope of conflict, a different type of scope to be

Table 5.3

CALFED Agencies

State Agencies	Federal Agencies
Resources Agency of California ◊ Department of Water Resources ◊ Department of Fish and Game	U.S. Department of Interior ◊ Bureau of Reclamation ◊ Fish and Wildlife Service ◊ Bureau of Land Management ◊ U.S. Geological Survey
California Environmental Protection Agency ◊ State Water Resources Control Board	U.S. Army Corps of Engineers
California Department of Food and Agriculture	U.S. Environmental Protection Agency
	U.S. Department of Commerce ◊ National Marine Fisheries Service
	Western Area Power Administration
	U.S. Department of Agriculture ◊ Natural Resources Conservation Service ◊ U.S. Forest Service

Source: CALFED (1999).

addressed later in this section) encompasses three dimensions: substantive, eographic, and temporal. Substantive scope entails what resource problems will be integrated and hence addressed by a new regional water governance entity (CALFED 1999; Rieke 1998). In California, most water organizations' scope is confined to a single resource sector integration (i.e., water supply only or wastewater treatment only) (Rieke 1998, 12-13).[8] However, CALFED's substantive scope has moved beyond the single resource sector mentality. CALFED recognizes and hence integrates into its substantive scope, numerous interrelated Bay-Delta estuary resource problems such as flooding, water quality degradation, watershed management, wetlands and riparian zone management,

[8]The exception to this generalization would be multipurpose watershed and river basin organizations.

wildlife management, and increased water supply reliability (CALFED 1999; Rieke 1998). CALFED's substantive scope shown in Figure 5.2 integrates four general resource areas: ecosystem restoration, water quality, water supply reliability, and levee system integrity. This substantive scope is expanded from previous basin management projects, because CALFED recognizes that problems in one resource area (such as ecosystem restoration) cannot be solved effectively without addressing problems in all four areas at once.

There are numerous ways to define the second component of scope or the geographic scope of a regional water organization. Some regional water resources entities are defined spatially by the boundaries of political regions (nations, states, or municipalities). The geographic scope of San Diego's Metropolitan Wastewater District (MWWD),for example,adheres to the limits of the City of San Diego. Baja California's Comisión Estatal del Agua (CEA, State Water Commission) adheres to the political boundary limits of the State of Baja California. Some regional water resources organizations are defined by natural regions such as the watershed or a river basin. Yet the Bay-Delta estuary hydrocommons does not adhere to political nor natural boundaries. CALFED's geographic scope recognizes the hydrocommons geographic range of resource problems, as demonstrated by a CALFED produced public outreach map shown in Figure 5.3. In addition to the hydrocommons geographic scope, CALFED incorporates a problemshed geographic

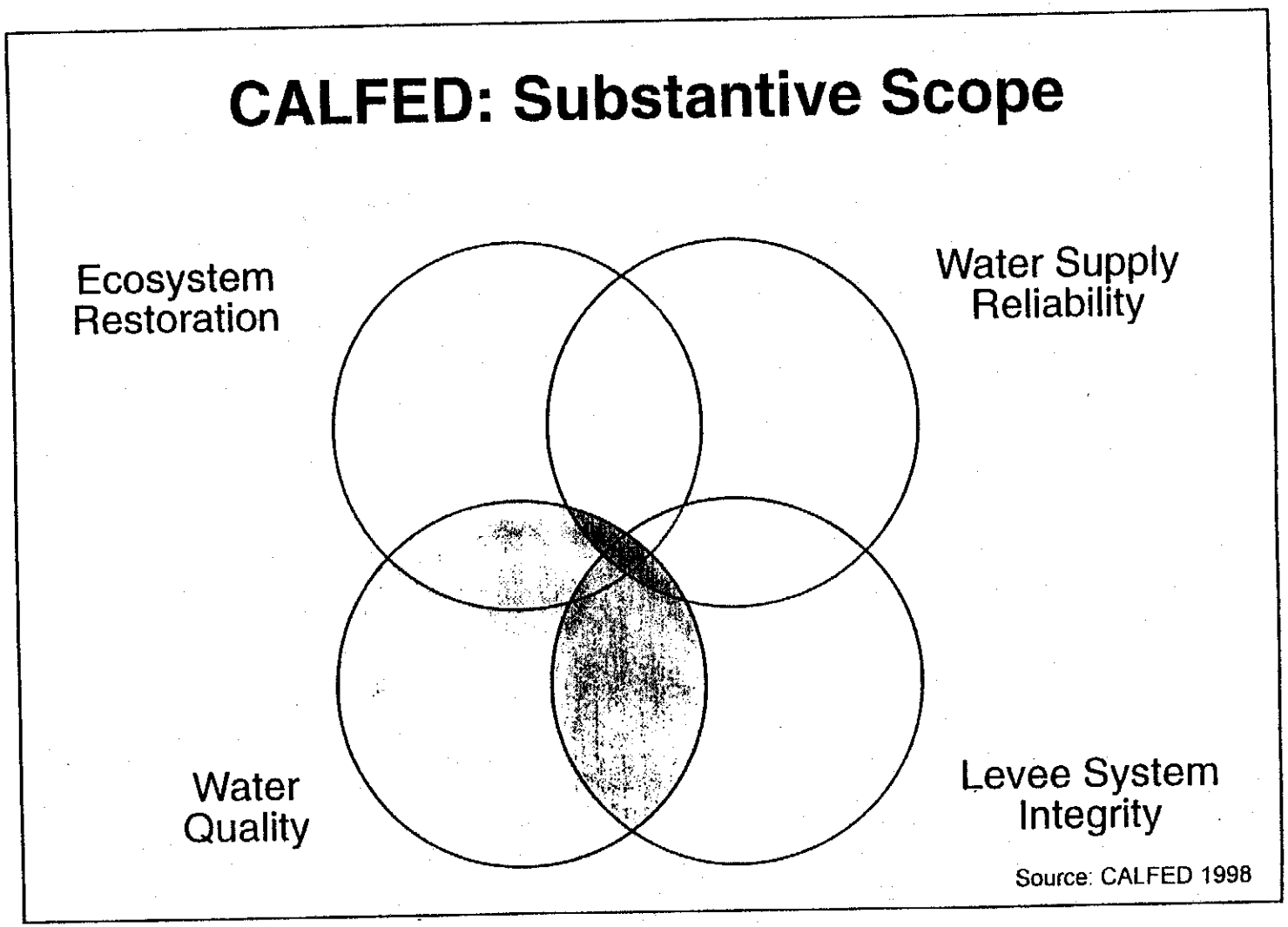


Figure 5.2. CALFED: Substantive Scope

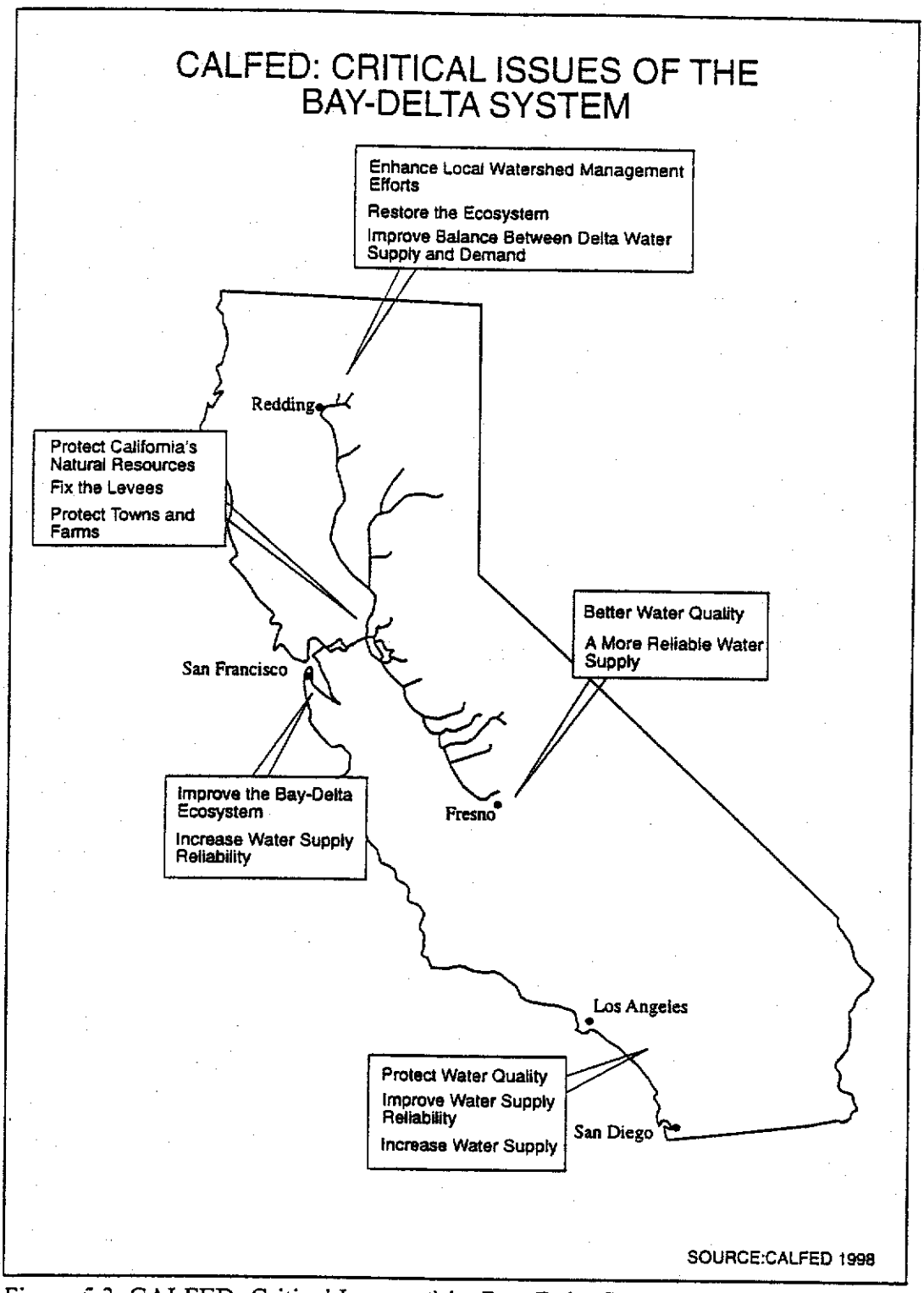


Figure 5.3. CALFED: Critical Issues of the Bay-Delta System

scope. A problemshed is a region which is defined by problem and solution regions, not by boundaries of political jurisdictions or catchment basins.

Figure 5.4 demonstrates CALFED's definition of its geographic scope. It is a scope which divides the hydrocommons into two regions. The first region is the problem region which is defined as the region which is experiencing degrading levels of water quality and subsequent aquatic or land based habitat destruction. According to CALFED, the problem region is defined as the Bay-Delta area. Since the hydrocommons involves transbasin diversions, the geographic scope for developing solutions includes a much broader area. This second region, the solution region, encompasses the regions or places, within and beyond the boundaries of the problem region, which may contribute to identified resource problems, and thus be integral to solving resource problems shown in Figure 5.3.

The third component of Rieke's scope for water regional organizations, temporal scope, defines whether the organization will resolve short or long term solutions. CALFED was formed to provide a long term solution, actually a thirty year plan. CALFED's timeline is divided up into three phases. The first phase is an identification of the appropriate range of solution alternatives. During the second phase, CALFED will develop an environmental assessment of solution alternatives. The third phase is project implementation and governance. As of April 2000, CALFED remains within the second phase of its timeline, or the environmental assessment process.

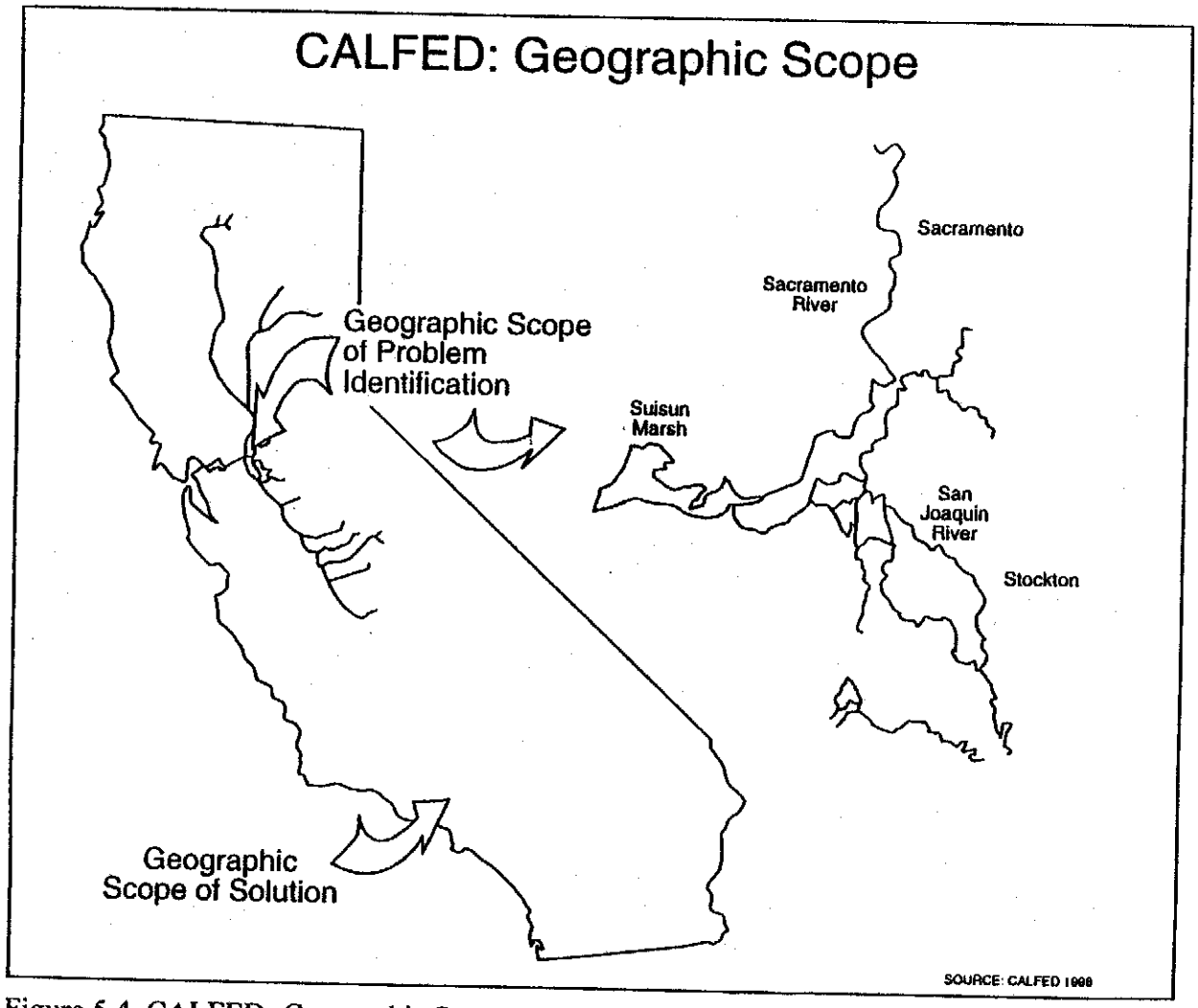


Figure 5.4. CALFED: Geographic Scope

There are two reasons why CALFED's substantive and geographic scope are cited as advantageous by CALFED participants and water policy scholars. The first reason is that CALFED's above defined scope (a scope which integrates four resource areas and integrates the geographic range of the hydrocommons and problemshed) has resulted in an expanded range of choice of technical solutions to resource problems within the Bay-Delta estuary. Within the CALFED governance process, four resource areas (ecosystem restoration, water quality, water supply reliability, and levee system integrity) are integrated in CALFED's substantive scope. Such an integration first recognizes that problems in one resource area can create problems in the other three resource areas (degraded water quality in the Bay-Delta estuary, for example, can result in aquatic species die offs.). Subsequently, the range of choice of solutions is expanded from just one resource area to four. In addition, the resource problems in the Delta are not limited to the geographic boundary of the Bay-Delta itself or even its watershed, but the entire hydrocommons. Given this redefinition of the geographic scope of the problem, then the range of solutions can be expanded to the hydrocommons, or as one CALFED participant states: "We need to work on the larger scope, because otherwise you are not looking at the entire range of the problem and the entire range of solutions to solve the Bay-Delta problem" (author interview). Hence, CALFED's expanded substantive and geographical scope allows for solutions which improve "not just the part that seems to be the problem [the Bay-Delta estuary in

this case] but all parts of the system that contains it [the hydrocommons]" (Hawken, Lovins, and Lovins 1999, 123).

The second reason why CALFED's broad substantive and hydrocommons scope is perceived as advantageous is that it corrects "existing institutional deficiencies associated with an inappropriately narrow or fragmented management regime" (Rieke 1998, 13). As stated in previous chapters, in the United States resource management organizations usually are limited to one sector resource management (i.e., water supply or species protection only). Such a fragmented resource management strategy does not recognize the relationships between various resource areas (such as water supply and quality for example). This fragmentation limits range of choice of solutions available to a resource manager (Hawken, Lovins, and Lovins 1999). In addition, agency fragmentation creates barriers for public and/or stakeholder participation in the water quality governance process, as explained by a Southern California Metropolitan Water District official and CALFED participant:

> CALFED brings all the players under one regional authority. Before everything was so fragmented. You would go to many meetings, have your 10 minutes in the spotlight then move on to the next meeting. It was time consuming and it took up too much energy. Now you can concentrate all your energy on one project with the main stakeholders. (Quinn pers. com. 1998)

Hence, according to this water district official, CALFED's broad substantive and geographic scope essentially makes participation in water governance process easier. However, what is CALFED's governance structure, and governance

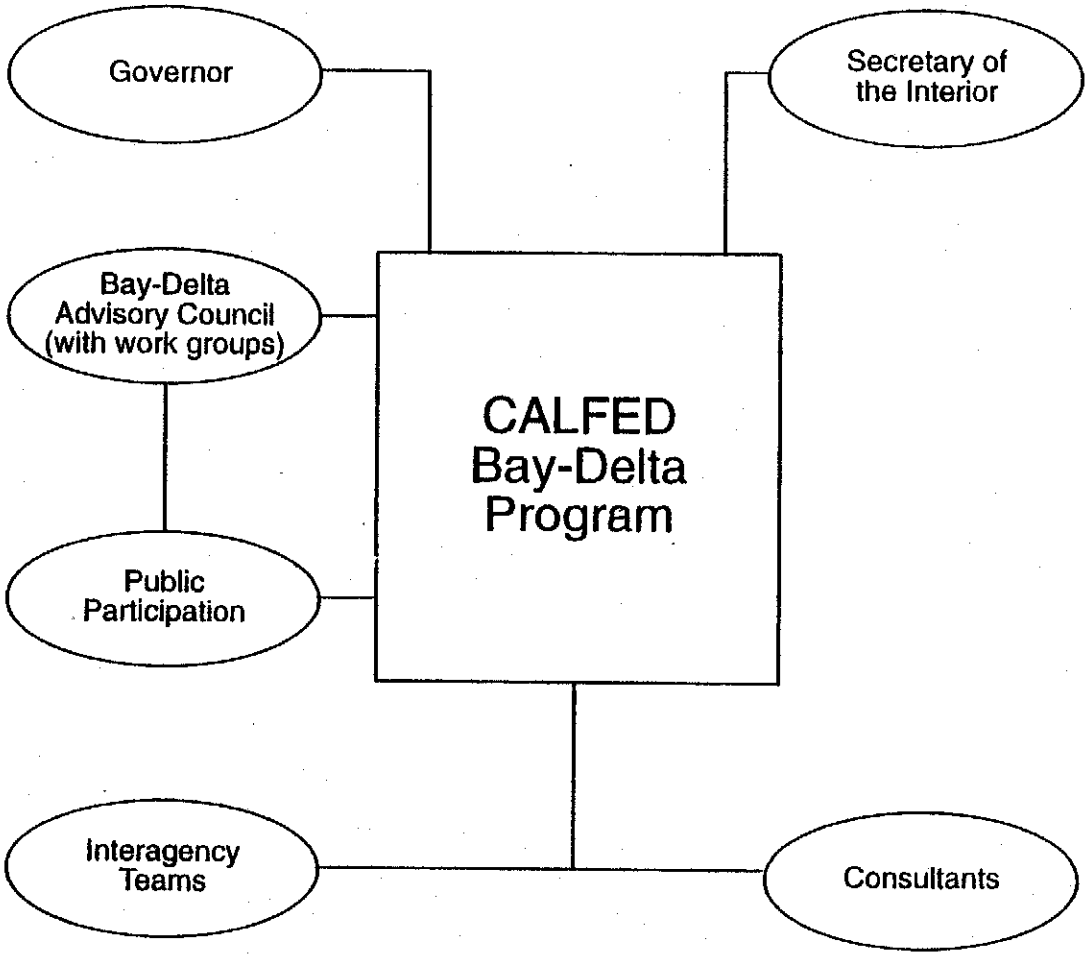
problems associated with its broad substantive and geographic scope? A brief summary of these two topics is provided below.

CALFED Governance

Presently CALFED entails federal/state agency representatives (listed in Table 5.3) and consultants working together to complete an environmental impact statement (EIS)/environmental impact report (EIR) as required by the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).[9] The structure of this governance process is presented in Figure 5.5. The EIS/EIR identifies the range of general resource management strategies to address the four resource problem areas shown in Figure 5.2. The general resource management strategies are: ecosystem restoration, long term levee protection plan, water quality improvement, water use efficiency, water transfers, storage, conveyance, and watershed management. In addition to a delineation of strategies, the EIS/EIR will incorporate these strategies in an analysis of three alternative solutions.

However, state and federal agency generation of the EIR is one part of CALFED's governance. Besides defining the substantive, geographic, and temporal scope, CALFED has devoted time and resources to define the scope of conflict, or to restate, identify those government agencies and other stakeholders which potentially merit formal representation during the CALFED decisionmaking

[9]Under NEPA the environmental assessment document is labeled the EIS, and under CEQA it is labeled the EIR.



SOURCE: CALFED 1998

Figure 5.5. CALFED: Governance Structure

process (Rieke 1998). This defined scope of conflict could be added as a fourth element of Rieke's above defined scope, as portrayed in Table 5.4. Unlike the Border Water Council governance example detailed in Chapter Four, stakeholders, academics, non-governmental entities, and interested citizens formally participate in CALFED's environmental assessment process. As stated in a CALFED (1998, 6) information booklet: "Ultimately, it is the active participation of the entire public that will help fix the Bay-Delta." In essence, the CALFED process is one devoted to defining an expanded scope of conflict.

There are two mechanisms in CALFED which support an expanded scope of conflict. The first is done via a public citizen outreach participation process. Twice a year, CALFED conducts citizen input hearings throughout the state. During these hearings the general public may ask questions and make formal comments. If a citizen desires to know more about the CALFED process, CALFED provides at each public hearing a listing of all CALFED documents available for public review. Many documents are located in libraries or on CALFED's website.

The second mechanism which expands the scope of conflict, is the Bay-Delta Advisory Council (BDAC). BDAC is a federally chartered advisory council of more than thirty representatives from the Native American tribes' and the state's leading urban, agricultural, business, environmental, and fisheries interests. BDAC's primary function is to review documents and/or presentations of work groups sponsored by CALFED, and make policy recommendations during the

Table 5.4

Scope of Regional Water Authority: CALFED

Substantive: What Resource Problems Integrated?	Geographic: Geographic Range of Defined Problem and Solutions	Temporal: Short or Long term	Scope of Conflict: Expanded or Limited
• Ecosystem Restoration • Water Quality • Water Supply Reliability • Levee System Integrity	• Hydrocommons • Problemshed	• Short term: Complete EIR/EIS • Long term: 30 year management plan	Expanded via: • Public Participation • Bay Delta Advisory Committee • Work groups

EIR/EIS process. CALFED created the work groups to evaluate and obtain consensus on solutions for particular resource problems. Membership in work groups is open to anyone who attends work group meetings. There are numerous work groups addressing resource challenges. One work group addresses ecosystem restoration, for example, and within the past year a watershed work group was formed. Every two months, BDAC meets and reviews documents and/or presentations produced by the workgroups. Below are reflections of one BDAC representative I interviewed. Although this representative viewed the BDAC process as one with flaws, this person does believe that public participation via the BDAC and work group process (or an expanded scope of conflict) has expanded the range of choice of solutions in the CALFED decisionmaking process.

What is BDAC and what is its functions?

> BDAC is an advisory body and it does give opinions pretty freely; it rarely reaches consensus. It is not like a watershed group, that targets those things on which it can agree and leaves those things on which it can't agree on the side. BDAC goes straight to those things on which it can't agree and it stays there.
>
> BDAC meets about every two months for a day, day and a half. For example, they get a presentation from the ecosystem roundtable work group for two hours, and they comment on it. The BDAC representatives comment from their own perspective, and which often have more to do with fear of what might happen rather than a real understanding of what is happening. Overall I would say the comments are not taken very seriously.
>
> I would say the biggest problem with BDAC is that it is not taken very seriously, because the people in BDAC are more political than technical. They say what they are expected to say, or what their group sponsor would like to say. If your group is not appointed to BDAC, that perspective is not

represented. That was true of inner city groups and U.S.-Mexico border groups. Only one indigenous representative is appointed to BDAC.[10]

If there are problems with BDAC, then why are you an advocate of expanding stakeholder and citizen participation in the CALFED process?

There were CALFED staff members [government agency staff] who were absolutely confident they knew how to fix the Bay-Delta—add a peripheral canal,[11] and add more storage which meant building dams. It was the old 1950s way of water resources management. They were sure they were doing it right. By opening it up to the public via BDAC and the work groups, numerous other alternatives came in. Doing watershed management in the Sierra Nevadas and Southern California; doing more with conservation; doing groundwater management; bringing in groundwater management agencies in on the process. That's what has come from public participation, looking at much broader menu of alternatives. It is messier, but it is more likely to be useful in the future. The messiness of public participation has resulted in CALFED options being enlarged. (author interview)

One alternative or critique which has entered via public participation into the CALFED process is a rethinking of the geographic range of problems and solutions, or the geographic scope of the CALFED organization. Figure 5.4 represents CALFED's geographic scope of problem and solution areas. Two broad coalitions, watershed groups in the Sierra Nevadas and urban watershed groups in Northern and Southern California, assert that CALFED's scope of problem identification needs to be expanded. The watershed groups in the Sierra Nevadas, a region where

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[10]How does one get appointed to BDAC? The author does not know for all stakeholders, but for environmental representation CALFED asked the Environmental Water Caucus to choose BDAC representatives. The Environmental Water Caucus is the largest coalition of environmental organizations working together on the CALFED process.

[11]The peripheral canal is actually labeled as the open channel isolated facility in CALFED's Alternative Three. The peripheral canal is not a new concept; it was proposed in the 1960s, signed into law by California governor, Jerry Brown, in 1980. In 1982, a successful petition drive to recall Governor Brown's decision put the peripheral canal on the ballot for a vote. In June 1982, California voters approved the referendum repealing Brown's peripheral canal legislation (Hundley 1992).

snowpack provides most of the water to the Bay-Delta estuary, believe that CALFED proposed solutions (especially the proposals supporting building a peripheral canal and dams) would take water away from the mountain watersheds, and hence cause resource problems such the destruction of mountain meadows (due to lack of groundwater under the meadows) in the Sierra Nevadas.

Urban based watershed groups also state that the geographic scope of problem definition should be expanded, because these groups assert that increased amounts of transbasin diversions may exacerbate the problem of nonpoint source pollution or polluted runoff in urban regions which receive the water. According to environmental leaders I interviewed, transbasin diversions are linked to the receiving region's water quality, in that urban regions which receive these transfers could result in increasing rates of urban consumption of land. At present, many environmentalists, pollution experts, and water pollution regulatory agencies throughout the U.S. assert that expanding regions of urbanization result in increased volumes of urban wastewater and polluted runoff (or nonpoint source pollution) in regional watersheds and coastal waters (Center for Marine Conservation 1998; EPA 1999; National Research Council 1993; Tregoning 1999).[12] In the following section I detail the links between transbasin diversions, urban expansion, and nonpoint source pollution impacts for the Tijuana-San Diego metropolitan region.

Both the Sierra Nevada and urban watershed groups assert that the Bay-Delta estuary is not the only problem region in the Bay-Delta hydrocommons. Both

[12]See Chapters Two and Five on nonpoint source pollution and storm water management.

mountain and urban watershed groups view transbasin diversions as causing problems in mountain (sending regions) and urban watersheds (receiving regions) of the hydrocommons. One CALFED participant, Martha Davis, who had worked on the Mono Lake Committee could see the potential of an alliance between the Sierra Nevada and the urban watershed groups, especially with those in Southern California. Martha had the unique experience of understanding the hydrocommons linkages because Mono Lake (a saline lake located in the Sierra Nevada mountains, near the east entrance of Yosemite National Park) had almost been destroyed by transbasin diversions to Los Angeles.[13] Martha worked with mountain and urban watershed contingencies to create a watershed working group in the CALFED process. The section below details the evolution of watershed activism within CALFED hydrocommons governance, and new governance ideas presented by the Sierra Nevada-urban watershed group alliance:

> When the watershed work group got set up in CALFED, they started meeting monthly. In June 1999, the Draft EIR/EIS was released and there was finally a document to show saying, here is a document which will be managing water and will affect your watershed. We wanted to asked watershed groups throughout California, where are you in this document? So a community development organization in the Sierra Nevada got funding to hire a consultant to go and work with Southern California watershed groups. The goal was to develop statements in the response to the EIR/EIS. The consultant found fifty-seven groups organized in Southern California. Some are quite large, like the Los Angeles and San Gabriel Rivers Watershed Council; some are quite small and organized around a lagoon. These groups have been identified; some have been spoken to; some are commenting. Where we will go next is to create more of a sense of identity among watershed groups in Southern and Northern California.

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[13]Mono Lake is a saline lake located in the Sierra Nevada mountains, near the east entrance of Yosemite National Park. The lake contains no fish, but supports a vast population of brine shrimp which in turn feed large numbers of migratory birds (see Littleworth and Garner 1995).

> During the Summer of 1999, a presentation was made by the CALFED watershed work group to the BDAC. What we saw were very professional, very knowledgeable people who had organized their local areas. They knew the players; they knew the experts and the political powers; they knew the problems. They had already sorted through issues which would be very hard to work on, and issues which would be easy to work on. What they were saying to CALFED, if you will work with and through us at the local level—we are not trying to replace you at the state level—but if you will use us as your outlet at the local level, we will be able make sure that the various programs you are trying to put together are integrated. That was the key message, if you want to integrate these large CALFED programs, and they have to be integrated to work, and be cost effective, work through the watershed groups and where you don't have watershed groups, then you should be trying to get one organized.
>
> If I were setting up a new BDAC, I would make sure that watershed representatives were at the core of the BDAC. Because they can see the connection between the issues of ecosystem restoration, water quality and various issues dealt with. They can see the connection between the big CALFED issues and local implementation. Watershed groups are not going to cover everything that needs to be covered, but it would give a much stronger basis of practical discussion. (author interview)

As of April 2000, CALFED was in the process of completing its EIR/EIS. The EIR/EIS is one year behind schedule, and it is not clear if CALFED's decision will be the best option to restore the Bay-Delta estuary ecosystem. Critiques of CALFED cite that CALFED has spent so much time listening to numerous stakeholders and trying to accommodate all stakeholders that a decision will never be made. As cited by a MWD board member at a CALFED public hearing: "CALFED has fallen to a tyranny of consensus" (CALFED Public Hearing 1 September 1999, San Diego, CA). However, I differ from these critics because my analysis demonstrates that CALFED is the first attempt to recognize the geographic range of hydrocommons caused resource problems. In addition, CALFED's commitment to public participation, or an expanded scope of conflict,

has resulted in an expanded range of choice of alternatives for not only dealing with resource problems in the Bay-Delta estuary, but resource problems in mountain watersheds and receiving regions such as urban watersheds in Southern California. Finally, as demonstrated by the above narrative on the watershed work group, CALFED participants are experimenting with multi-scale integration and governance of hydrocommons. In other words, besides an overall hydrocommons governance structure, CALFED could implement its broad substantive and geographic scope solutions at the local level via community based watershed organizations.

In this section, I have demonstrated how CALFED incorporates the Bay-Delta hydrocommons geographic range and integrates multiple resource problems into its decisionmaking process and governance structure. This integration, be it in a geographic or in a substantive scope sense, has resulted in an expansion of the range of choice of solutions for solving resource problems caused by the creation of the Bay-Delta hydrocommons. In addition, CALFED's commitment to expanding the scope of conflict in water resources policy, supports water resources governance which first seeks to inform the public and second encourage active participation of stakeholders and the general public. An informed and participating public has resulted in CALFED continuing to expand the range of choice of technical alternatives for Bay-Delta hydrocommons management, and in certain cases such as the watershed groups, a willingness to experiment in multi-scale governance structures.

However, these governance advances towards democracy in water must continue in the implementation process which will follow EIR/EIS process. Many stakeholders have relayed to me that CALFED's commitment to hydrocommons governance and increased stakeholder participation is largely symbolic, as noted by this environmentalist:

> What CALFED is doing in their documents and in their strategy for dealing with stakeholders is to continue to try to fudge things, and to write the documents in a way that has a lot of qualifying language so that it is hard to tell exactly what is going on. If you are a farmer who wants more storage, you can read it and say well this looks like they might build some more dams. If you are an environmentalist who doesn't want more dams, you can read it and say well it looks like the door is still open for dams, but they have a lot of qualifying language in there so maybe it will be OK. It seems like that is what CALFED has done in the negotiating sessions too. CALFED staff says to everybody, OK we are going to give you what you want, and they continue to just push the actual decisions down the line, and just keep putting qualifying language in EIR/EIS which will keep everyone happy, instead of making a decision and having people live with it. (author interview)

All stakeholders agree that CALFED needs to make difficult decisions—decisions which will not appease all stakeholders. Second, CALFED must be committed to long term Bay-Delta estuary restoration. In essence it must provide regulatory, financial, and personnel resources which will effectively restore the Bay-Delta estuary ecosystem. In addition, the actual governance of CALFED's implementation is yet unclear. In fact, the governance is one facet of CALFED in which the public has yet to review and comment upon. As demonstrated by the above narrative on the watershed work group, CALFED's watershed work group and BDAC are discussing governance alternatives. However, it is unclear if CALFED staff are listening to these discussions, or if CALFED will allow for

public feedback on its proposed governance structure, which as of January 2000 has not been released.

The Bay-Delta estuary is not the only large wetlands ecosystem in the Californias which needs a comprehensive plan for restoration. According to Professor Daniel W. Anderson, Professor of Wildlife Biology at the University of California, Davis, four linked areas in California need immediate attention. These are the Klamath Basin, the San Franscisco Bay-Delta estuary, the San Joaquin Valley, and the Río Colorado (Colorado River) Delta region (Anderson 1999). The latter delta, often referred to as California's "Other" Delta (the other delta besides Northern California's Bay-Delta estuary), is an ecosystem which to date has largely been ignored by policy makers in the California and Baja California. Like the Bay-Delta estuary, the Río Colorado Delta has been dramatically altered by transbasin diversions from the Colorado River. In fact, Tijuana and San Diego seek to increase their allocations of Colorado River water to support expected increases in economic and urban growth. It is the linkages between the Tijuana-San Diego metropolitan region and the Río Colorado Delta which I turn to in the next section of this chapter.

Establishing Hydrocommons Connections between the Lower Colorado River Basin and the Tijuana San Diego Metropolitan Region

Introduction

If the reader reviews the water resources map of the Tijuana-San Diego metropolitan region, presented in Chapter One, the reader will see that this map represents an integrated water resources management approach—both water and wastewater facilities and conveyance systems are represented. However, this map still is an incomplete picture of water resources management in the Tijuana-San Diego metropolitan region. Essentially, the map does not relay the entire picture of interconnected water resources for the Tijuana-San Diego metropolitan region. Figure 5.1 provides the missing information. The map presents outside sources of water supply to this binational region. One is the State Water Project from the Bay-Delta estuary, and second are transbasin diversions from the Colorado River to the Tijuana and San Diego metropolitan region.

In the previous section I focused upon the Bay-Delta estuary hydrocommons which serves the Tijuana-San Diego metropolitan region. In this section I focus upon a second hydrocommons formed to serve expanding urban regions in Southern California and Baja California, the Río Colorado River Delta hydrocommons. I will evaluate a proposed transbasin diversion project which Tijuana and San Diego are pursuing—a binational aqueduct built in Mexico which would bring even more Colorado River water to the Tijuana-San Diego metropolitan region. I will briefly introduce environmental impacts of increased diversions in the sending region of

this hydrocommons, the Río Colorado Delta. Since this study is focused upon water quality in the Tijuana-San Diego metropolitan region, I will focus most of my analysis upon the environmental impacts of increased Colorado River transbasin diversions to the receiving region, the Tijuana-San Diego metropolitan region. Environmental impacts of transbasin diversions in receiving regions is an aspect of hydrocommons governance ignored by many water resources policy makers, including the CALFED staff. Finally, I will evaluate two border institutions, which may govern the hydrocommons along the border between California and Baja California. These institutions are the International Boundary and Water Commission, a pre-NAFTA institution, and the post-NAFTA Border Environmental Cooperation Commission.

Colorado River Transbasin Diversions for Southern California and San Diego

Before I discuss the proposed aqueduct project, let me review the legal and political status of Colorado River transbasin diversions for the binational metropolitan region. In the United States, Colorado River allocations are determined by separate law, known as the Law of the Colorado River. This law is a cumulative series of interstate and congressional acts, beginning with the Colorado River Compact in 1922 and ending with congressional ratification via the Boulder Canyon Project Act of 1928 . This law delineated the Colorado River Basin into two regions; the upper basin included portions of Arizona, Colorado, New Mexico, and Wyoming, or waters which drain into the Colorado River system

above Lee Ferry, Arizona (Littleworth and Garner 1995, 282). The lower basin includes portions of Arizona, California, Nevada, New Mexico, and Utah, or waters which drain naturally below Lee Ferry. According to one interpretation of the Colorado River compact, both basins have been allocated a "beneficial consumptive use" of 7.5 million acre-feet each year (Littleworth and Garner 1995, 283).

At this point in U.S. western water history, no water had been allocated to Mexico, the nation-state where the Colorado River empties into the Gulf of California. U.S. politicians believed that Mexico's water requirements would come from surplus or runoff waters from the U.S. basin states upstream. In 1944, the United States signed a treaty with Mexico requiring the United States to deliver 1.5 million acre-feet per year to Mexico (Littleworth and Garner 1995, 297). After decades of legal battles between Arizona and California, in 1979, lower basin allocation numbers were settled upon as follows: California, 4.4 million acre-feet and not more than half of surplus waters not apportioned; Arizona, 2.8 million acre-feet; and Nevada, 300,000 acre feet (Littleworth and Garner 1995). United States state and federal representatives believed that the allocated supply was enough to handle the aforementioned water apportionments. However, as basin studies reveal today, the average flow of the Colorado River amounts to only 15.2 million acre-feet, and the river is allocated for at least 16.5 million acre-feet (Littleworth and Garner 1995). In essence, if all parties take their full allocations, the river is over allocated.

However, no federal laws allocate water to users within the states. In California, there has existed and continues to exist two primary competing interests for Colorado River water: the Los Angeles-San Diego metropolitan regions and agricultural interests in the eastern part of Southern California. In the 1930s and 1940s these interests agreed upon the allocation of California's Colorado River water. To summarize a very complicated agreement, (known as the Seven Party Agreement), agricultural interests (Palo Verde Irrigation District, Imperial Valley Irrigation District, Coachella Valley Water District) receive 3.85 million acre-feet, Metropolitan Water District of Southern California and City/County of San Diego receive approximately 660,000 acre-feet, and if water is available, another 1.2 million acre-feet to agricultural use in the Colorado River Basin in California (Littleworth and Garner 1995). On the average, California's use of Colorado River water is about 5.2 million acre-feet (MAF) each year, .8 MAF over the designated allocation of 4.4 MAF (Pace 1999).

California's excess use of Colorado River water did not present problems until Arizona and Nevada built facilities to convey and store their respective Colorado River water allocations. In addition, Native American communities had been successful in the courts to obtain a share of Colorado River water. In 1999, U.S. Secretary of Interior Bruce Babbit threatened to impose his own plan for California's Colorado River water supply if California could did not develop a plan to stay within its 4.4 million acre-feet apportionment (Pace 1999). As of Fall 1999,

the Colorado River Board of California[14] has negotiated an agreement to reduce California's use of Colorado River from 5.2 million acre-feet to 4.8 million acre-feet (*San Diego Union-Tribune* 19 October 1999). In the draft Colorado River Board 4.4 million acre-feet plans and presentations I have reviewed, the primary purpose of the 4.4 plan is to "develop programs that enable the Colorado River aqueduct[15] to run full, without harming agriculture or other states" (Colorado River Board 4.4 Plan 1997; San Diego County Water Authority 1999). Unlike the CALFED process, within the management and governance of this hydrocommons there is little to no recognition of water quality nor environmental impacts caused by California's Colorado River diversions. In addition, the public, most notably environmental organizations, have been locked out of California's Colorado River allocation negotiations (*San Diego Union-Tribune* 19 October 1999).

As shown in Figure 5.1, San Diego's source of Colorado River water comes from the Colorado River Aqueduct, an aqueduct owned and operated by Metropolitan Water District of Southern California (MWD).[16] San Diego County

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[14]The Colorado River board of California, established in 1937, is composed of representatives from six public water agencies which receive Colorado River water, the directors of Departments of Fish and Game and Water Resources, and two public members (Morrison, Postel, and Gleick 1996, 7).

[15]The full capacity of the Colorado River Aqueduct allowing for water loss and maintenance is 1.2 million acre-feet (Metropolitan Water District of Southern California [MWD] 1996).

[16]Metropolitan Water District of Southern California (MWD) was formed in 1928, pursuant to California's Metropolitan Water District Act or law (Littleworth and Garner 1995). The Act provided a means for cities and other governmental entities to work together to develop water supply. The purpose of the District is to "provide its service area with adequate supplies of high quality and reliable water, and meet present and future needs in an environmentally and economically responsible way" (MWD 1999). The first major water supply project of MWD was to construct the 242 mile long Colorado River aqueduct. The aqueduct was completed in 1939;

Water Authority is the water supply organization which buys water from MWD, and subsequently sells this imported water to various water districts and cities in the San Diego region (to include the City of San Diego). Table 5.5 provides a breakdown of water supply sources available in San Diego County in 1997. In 1998 San Diego County Water Authority imported 490,000 acre-feet of water from MWD (Laru pers. comm. 2000), and this imported water is a blend of State Water Project water from the Northern California Bay-Delta estuary and from the Colorado River. According to the City of San Diego Manager's Report, dated 24 March 1999, the City of San Diego has received several unsolicited offers for water transfers from Central Valley, Northern California, and the Colorado River Basin. One main issue to for San Diego is the issue of conveyance. How will this water be stored and transported to San Diego? How will conveyance be financed?

San Diego actively supports an increase in water supplies because local government officials cite that San Diego's population will increase from 2.8 million in 1999 to 3.6 million in 2015 (San Diego County Water Authority 1999). In addition, water supplies need to be long term and reliable to support San Diego's eighty-seven billion dollar economy (San Diego County Water Authority 1999). By 2015, San Diego County Water Authority officials estimate that San Diego's growing economy and population will increase the demand of water supplies up to 868,700 acre-feet per year (San Diego County Water Authority 1999).

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water supply delivery began in 1941 (Littleworth and Garner 1995, 15). MWD represents twenty-seven cities and water agencies and serves sixteen million people in six counties of Southern California (*San Diego Daily Transcript* 20 May 1998).

Table 5.5

Water Production in San Diego County: 1997

Source of Water Supply	Acre-feet Per Year
Imported water from MWD	477,880
Ground water*	12,916
Surface Water*	116,241
Reclamation	12,916
Conservation	25,831
Total	645,784

Source: San Diego County Water Authority (1999).

*Since San Diego imports water on a continual basis, and stores imported water in local surface and ground water storage facilities, it is unclear from this chart what exactly is the local amount of developed water supplies.

One key provision of San Diego's plan to increase its water supply is to allow Imperial Irrigation District to transfer or sell 200,000 acre-feet of its Colorado River water allocation directly to San Diego County Water Authority. This water transfer agreement between San Diego County Water Authority and Imperial Irrigation District (IID) was signed was approved by the San Diego County Water Authority Board of Directors in 1998 (San Diego County Water Authority 1999). The agreement proposes to transfer 200,000 acre-feet per year for an initial term of forty-five years. There is a potential to increase the amount of water transfers to a total of 300,000 acre-feet, and to renew the water transfer option for an additional thirty years (San Diego County Water Authority 1999). In 1999, California legislature supported these transfers by setting aside $235 million dollars for use on a number of farm water conservation measures (Pace 1999). These

measures should save agricultural water so that Imperial Irrigation District may transfer or sell conserved water to the San Diego County Water Authority.

The San Diego County Water Authority-Imperial Irrigation District water transfer represents San Diego's move to obtaining its own water imports other than those they receive now from Metropolitan Water District of Southern California (MWD).[17] At present, all of San Diego's imported water is supplied by MWD. By 2015, San Diego County Water Authority (1999) proposes to reduce MWD imports by twenty-five percent. Critics cite that San Diego's need for independence from MWD is resulting in water transfer deals which force San Diego county water users to pay more than they need to for water (Erie 1997). The IID water transfers indeed support this assertion. IID pays the U.S. Bureau of Reclamation (a U.S. federal water development agency) $12.50 per acre-foot of Colorado River water (Erie 1997). If the IID-San Diego County Water Authority transfers are approved by the State of California Water Resources Control Board, IID will sell water to San Diego County Water Authority for $200 per acre-foot of water, and increasing to around $306 per acre-foot of water (Erie 1997). Based upon other agriculture to urban water transfers in California (Central Valley Project water, for example), San Diego should pay between $165 to $185 per acre-foot of water (Erie 1997). One critic estimates that for the initial forty-five year 200,000 acre-foot contract, San

[17]Relations between MWD and San Diego County Water Authority have been always tense. San Diego County Water Authority is MWD's largest purchaser or imported water. Representation on MWD's governance or board of directors is based upon property tax land valuation within respective water districts/authorities. San Diego County Water Authority is demanding governance reform for MWD, a governance which reflects the amounts water agencies use, not property taxes.

Diego ratepayers will spend $1.1 billion dollars more than they should be paying for water (Erie 1997).

However, even with its own water import supplies from IID, San Diego is still dependent upon MWD to transport the water from the Colorado River. At present, the only way for San Diego County Water Authority to transport IID water is through the Colorado River Aqueduct, an aqueduct owned and operated by MWD (see Figure 5.1). Negotiations for the wheeling rate, or the transport fees, of IID water with MWD have been problematic at best. San Diego wants to keep costs down on the transportation fees and states that MWD's wheeling rate is yet another example of MWD over-charging their customers—a practice one San Diego representative asserts has been going on for decades (*San Diego Daily Transcript* 20 May 1998). On the other hand, MWD which has built, financed, and maintains the aqueduct and water treatment facilities, asserts that San Diego should pay for these services in the wheeling or transportation rates. MWD also states that since 1946, San Diego has avoided paying its fair share of total infrastructure and capital improvement costs for water imports (Erie 1997). It is due to the tense negotiations concerning use of MWD's aqueduct that San Diego now looks south to work with Tijuana and build a second aqueduct. This aqueduct will transport IID water transfers and Tijuana's increasing Colorado River water demands to the San Diego-Tijuana metropolitan region.

Colorado River Transbasin Diversions for Baja California and Tijuana

When Mexican government officials were informed of the proposed 1922 Colorado River Compact, they asked U.S. diplomats to consider Mexico as a party in the studies and projects associated with the compact (Hundley 1966). In essence Mexico believed that it had rights to Colorado River water as any state in the United States. However, the U.S. government ignored Mexico's request to participate, and from 1922-1940 Mexico watched from the outside as the United States developed a comprehensive program to appropriate waters within the Colorado River Basin (Hundley 1966). During the 1940s, the U.S. and Mexico entered treaty negotiations to determine Mexico's appropriation of Colorado River waters. The strongest opponents to allocating any sizable amount of water to Mexico were representatives from California who insisted at one point that no more than 250,000 acre-feet of Colorado River water be granted to Mexico (Hundley 1966). In 1944, the U.S. and Mexico signed a treaty which allocates Mexico 1.5 million acre-feet of Colorado River water.

According to the U.S. interpretation of the 1944 treaty, the United States only had to deliver the quantity of water, and not be concerned with the quality of water delivered to Mexico (Hundley 1966). Between 1945 and 1961 decreased runoff, increased transbasin diversions, increased agricultural runoff, and American storage reservoirs greatly increased the amount of salt content of water in the Lower Colorado River basin. With the addition of Arizona's Welton-Mohawk project which dumped into the Colorado River salty drainage water from a large

agricultural area, salt content in the Lower Colorado River Basin reached a high of 2,700 parts per million. In 1961, Mexico refused to use the highly saline water from the U.S., and allowed it to flow to the Gulf of California resulting in crop losses in the Río Colorado Delta region (Hundley 1966). After eleven years of negotiations over the water quality component of Mexico's Colorado River water appropriation, in 1972 and 1973, the U.S. and Mexico enacted an additional agreement which determined that the salt content of water delivered to Mexico could not exceed 115 milligrams per liter (Littleworth and Garner 1995).

According to United States water law, states are empowered to appropriate water, as evidenced by the above mentioned Seven Party Agreement for California's allocation of Colorado River water. In Mexico all waters are owned and appropriated by the nation (CNA 1995, 1996). States, irrigation districts, and municipalities cannot own water, and appropriation cannot be done without federal government supervision and approval. In addition, Mexican water law and appropriations encompass not only water supply, but water quality to include regulation of diverted waters once they are utilized and discharged. The federal organization which has jurisdiction over planning, permitting management, and enforcement of water resources (quality and quantity) is Comisión Nacional del Agua (CNA), or the National Water Commission.

For Baja California, the State Hydraulic Program 1995-2000 (Programa Estatal Hidraulico) "defines the standards for the administration of water in support of hydraulic activities in the State" (CNA 1995, Introduction). This State Program

is written by CNA, and details water quantity and use allocations which support sustainable development in Baja California (CNA 1995). The water allocations are based upon statewide studies which analyze the physical geography, economics, population demographics, hydrology (availability of surface and groundwater), public health, and indices of marginalization (CNA 1995). In addition, designated water uses and water use allocations are presented and evaluated by the hydraulic plan. These uses are domestic use (urban and rural regions), industry, agriculture, generation of electrical energy, aquaculture and fisheries, recreation and tourism, and native ecosystem protection. In the final chapter of the hydraulic program, goals are determined for each water use and strategies to obtain these goals.

If an individual, corporation, and other legal entities, such as states and municipalities desire to obtain a water use concession or allocation of Colorado River water (or any other water body in Mexico), the applicant must apply for a water use concession with the CNA. CNA determines the amount of water allocation by the use of water and by reviewing "water balances and interactions among uses within the basin" (González-Villarreal and Garduño 1994). If the water concession application may conflict with CNA's hydraulic plan or goals, then CNA may suggest alternative sources of water for the applicant such as reclaimed water (CNA 1999b). CNA's allocations of Colorado River water are detailed in Figure 5.6 (CNA 1999b). All water concessions and discharge permits are recorded in the Public Registry of Water Rights (Registro Público de Derechos de

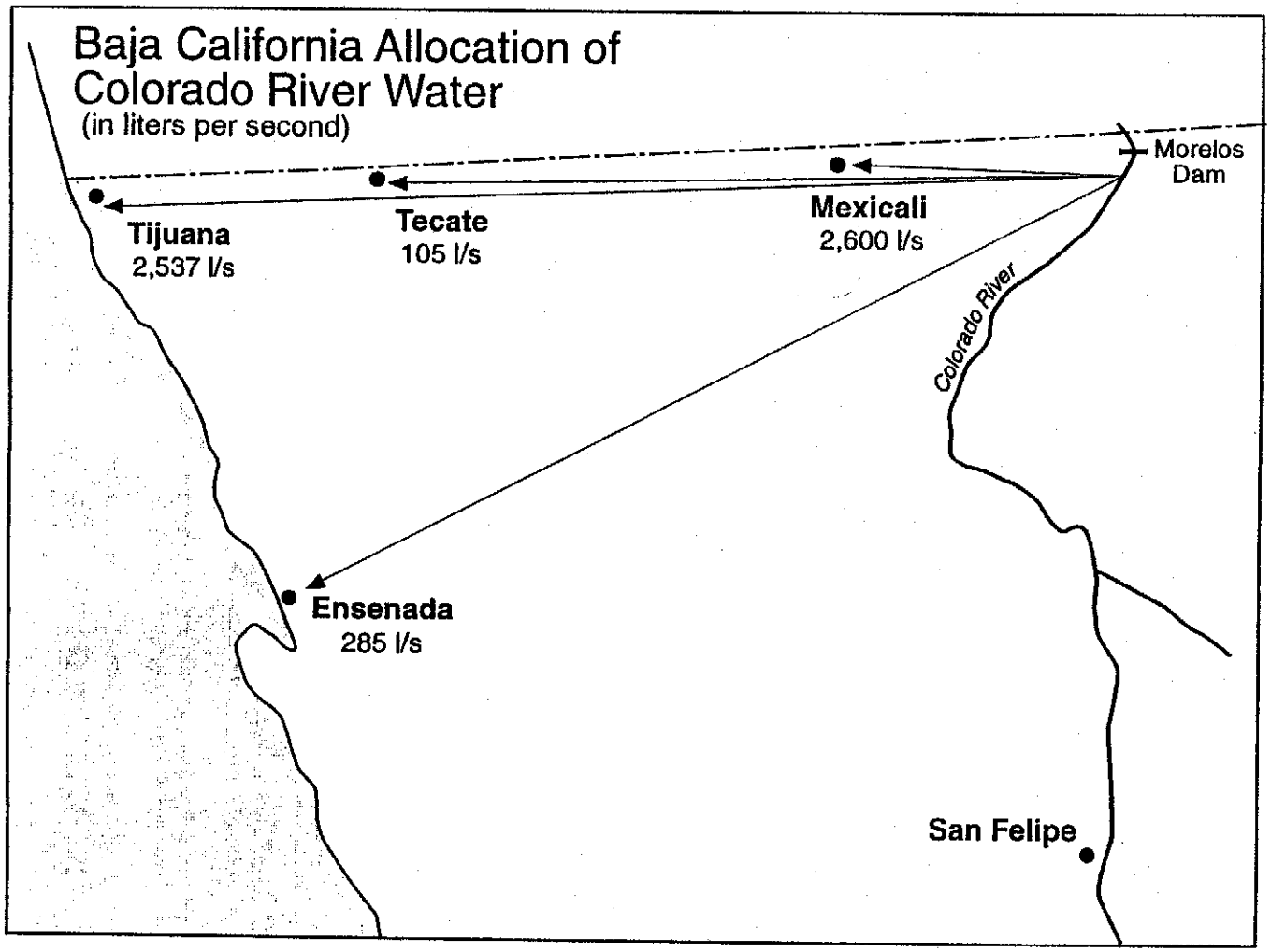

Figure 5.6. Baja California Allocation of Colorado River Water

Agua), which is maintained by CNA (Council for Environmental Cooperation [CEC] 1995; CNA 1997).

As indicated in Figure 5.6, Tijuana's allocation of Colorado River water is 2,537 liters per second (CNA 1999b). This water is delivered by the Río Colorado-Tijuana Aqueduct, an aqueduct operated and maintained by the State Water Service Commission or the Comisión de Servicios de Agua del Estado (COSAE). The water organization which delivers water to Tijuana's water users (imported and local developed water supplies) is a state agency, the Comisión Estatal de Servicios Públicos de Tijuana or CESPT. This agency provides both water and wastewater services to Tijuana and Rosarito Beach (a community approximately sixteen miles south of Tijuana). Table 5.6 provides a breakdown of sources of potable water for Tijuana as of July 1999.

Table 5.6

Water Production in Tijuana: July 1999

Source of Water Supply	Liters Per Second	Acre-feet Per Year
Surface Water: Rodriguez	2,250	56,612
Surface Water: Carrizo	789	19,852
Tijuana-Alamar River Aquifer	40 (capacity: 200)	1,006 (capacity: 5,032)
Colorado River-Tijuana Aqueduct*	0 (capacity: 4,000)	0 (capacity: 100,645)
Water Supplies Sent to Rosarito Beach	- 144	- 3,623
Total	2, 935	73,847

Source: CESPT (1994, 1999), CNA (1999b), and COSAE (1994).

*Tijuana's allocation of Colorado River Water is 2,537 liters per second or 63,834 AF/year.

As shown in Table 5.6, during the month of July 1999, Tijuana did not use its allocation of transbasin diversions from the Colorado River (CESPT 1999). CESPT can import water from the Colorado River Aqueduct (constructed in 1983), but the state agency in charge of the aqueduct, Comisión de Servicios de Agua del Estado (COSAE) does not operate the aqueduct until Tijuana runs out of local surface and groundwater supplies, usually in years with drought conditions. This action saves the state from paying high energy costs to pump water over the mountains between Tijuana and the Colorado River. In addition, the current aqueduct is in a state of poor condition, and there is significant water loss (estimates are between twenty and forty percent) in transporting the water from the Colorado River.

Like San Diego, Tijuana is actively seeking to increase its water supplies to support a growing economy and population. In 1999, Tijuana's population is at 1.2 million, and by 2010 the population is estimated to be well over 2 million (CEA 1999). This city's growth rate, estimated at 5.8 percent (CEA 1999), poses for CESPT a tremendous challenge to provide potable water for all city residents. This is an especially difficult task since state and municipal local agencies receive little or no financial income from the federal government. It is estimated that by 2004 water rationing will start for Tijuana (San Diego Dialogue 1999).[18] According to a local

[18]The amount of water available to Tijuana residents is 88 m^3 per year for each resident (CNA 1999b). According to CNA (1999b), this number is the lowest of any city in Baja California (CNA 1999b). CNA (1999b) cites that according to the World Bank if the average amount of water available is less than 500 m^3 per year per habitant, then the city or region is encountering a severe water scarcity problem.

newspaper, Tijuana has four options to solve the problem of the water shortage. First, is to retrofit and modernize the existing aqueduct. Second, is to construct a second aqueduct which can consistently and efficiently transport water from the Colorado River to Tijuana. Third, is to construct desalinization plants, and fourth, is wastewater reclamation (*Zeta* week of 13-19 August 1999).

CNA (1999b) states that Tijuana's local surface and ground water sources are a function of the amount of rain which falls in the Tijuana river watershed. As with any other arid region, the precipitation is sporadic, thus in CNA's view the local hydrology provides a sporadic and hence unreliable source of water supply. Given the perceived unreliability of Tijuana's local water supply sources, CNA and the Comisión Estatal del Agua (CEA) consider Colorado River water as the only reliable source of water supply for the rapidly expanding city. As shown in Table 5.6, the city's allocation of Colorado River water is approximately 64,000 acre-feet per year. According to CNA (1999b), the demand for water by the city often exceeds this allocation. The average yearly amount received by the City is 3,650 liters/sec or 91,838 acre-feet per year (CESPT 1994). To adjust for the increased demand, CNA (1999b) states that the Tijuana must in the future look to buying water rights from irrigation districts in the eastern part of the state.

The Tijuana-San Diego Binational Aqueduct

The government sponsored proposal to build a binational aqueduct for the Tijuana-San Diego metropolitan region has its roots in the Border Water Council.[19]

[19]Details of the Border Water Council governance structure are provided in Chapter Four.

The Border Water Council was formed in 1998, and it was designed as a forum for water agencies in Tijuana and San Diego to discuss binational solutions to water resources management in the Tijuana-San Diego metropolitan region. As of July 1999, the primary impetus of the Border Water Council is to investigate the possibility of a constructing a binational aqueduct to deliver water from the Colorado River to the Tijuana-San Diego metropolitan region. During the Summer of 1999, Border Water Council representatives completed a technical report and submitted a draft memorandum of agreement (MOU) to the International Boundary and Water Commission (IBWC). On 14 October 1999, IBWC Minute 301 was signed. This minute established the scope, the plan, and responsibilities of the binational aqueduct investigation. Funding for this investigation is three million dollars. San Diego County Water Authority will provide five hundred thousand dollars and the California Department of Water Resources will provide 2.5 million dollars (*San Diego Union-Tribune* 7 September 1999).

There is a second proposal for aqueduct construction by two Mexican businessmen. Francisco Molina, director of a Mexican development company EMTEC, and Gastón Luken Aguilar, chairman of the board of Proxima Gas, propose building a second aqueduct and power plant to pump the water over the mountains (San Diego Dialogue 1999). In February 1999, EMTEC conducted a study concerning transporting Colorado River water to Tijuana and San Diego (*Zeta* week of 13-19 August 1999). The analysis covered two themes: the transport of water and the generation of power to pump the water from the Colorado River

region to Tijuana. The study divided the proposed aqueduct project into three phases. The first phase is power generation, in which an electric plant would be constructed in Baja California to provide power to urban regions in Baja California, and power to pump water from Mexicali to Tijuana. The second phase would be the construction of the new aqueduct between the Valle de Mexicali (Mexicali Valley) and Tijuana. During this phase the current aqueduct would be shut down and repaired. If repaired and modernized the current aqueduct could serve Tijuana with even more Colorado River water in the future.

The new or proposed aqueduct would have a capacity of 525,230 acre-feet per year, with up to 300,000 acre-feet of IID water for San Diego, and 225,230 acre-feet of water for Tijuana (San Diego Dialogue 1999). The total cost of the aqueduct-power plant project is estimated at 800 million dollars. Financing of this project would be provided by private investors, the State of Baja California, the City of San Diego, and a World Bank loan (*Zeta* week of 13-19 August 1999). Project proponents in Mexico state that the aqueduct project first would provide a secure supply of water for the binational region from the present to 2020. Second, the project would maintain the cost of water in the region at reasonable rates, not only for industrial but also domestic uses. Third, it would result in reasonable energy cost rates for Baja California's urban residents (*Zeta* week of 13-19 August 1999).

Despite the two proposals, a binational aqueduct built in Mexico faces political and legal challenges in both Mexico and the United States. On the United

States side, the funding source will determine what laws will apply to such a project. If federal funding is provided, then U.S. law, the National Environmental Policy Act (NEPA), requires an Environmental Impact Study (EIS). In addition, if project funding is drawn from the North American Development Bank's (NADBank) Border Environmental Infrastructure Fund (BEIF),[20] then the project will have to receive certification from the Border Environmental Cooperation Commission (BECC). Both the NEPA environmental assessment and BECC certification processes entail extensive public review and participation. In addition to federal legal requirements, it is unclear as to how other Colorado River states will react to yet another aqueduct or "straw" which will draw water from already an over-allocated Colorado River. At the 1997 Public Officials for Water and Environmental Reform Conference of California Water Policy, the "second" aqueduct for Southern California question was posed to water agency representatives from Nevada and Arizona. Both representatives stated an emphatic "no" to a second aqueduct.

Concerning the IID water transfers, San Diego County Water Authority faces two legal hurdles. The first is the completion of an Environmental Impact Report and public review process, as required by the California Environmental Quality Act. In addition, the transfers must be approved by the State Water Resources Control Board (SWRCB). For this approval, the SWRCB will examine

[20]NADBank was created in the 1994 NAFTA Environmental Accord to assist communities and potential buyers in the financial design and structure of environmental infrastructure projects. BEIF is a program which allows NADBank to combine grant funds and loans for water and wastewater projects (North American Development Bank n.d.).

the type of transfer, or the mechanism used to free up water for the transfer (fallowing, crop shifting, substitution of ground water for surface irrigation, or conserved water for example) (California Department of Water Resources 1993). In addition, the State Board must examine third party impacts or economic consequences to rural communities sending water to San Diego. Farmers and other local business owners in Imperial Valley fear that the IID water transfers could result in fallowing of farm lands, and a subsequent decline of Imperial County's local economy which depends upon agriculture (Water Education Foundation 1996a). Finally, California Water Code prohibits water transfers that would unreasonably affect fish and wildlife (California Department of Water Resources 1993; Water Education Foundation 1996a). The SWRCB will evaluate environmental impacts, and if environmental impacts are determined, the SWRCB may require an environmental water allocation, or a transfer tax to fund environmental water transfers (Water Education Foundation 1996a).[21]

The IID-San Diego water transfers also incur a possible international water conflict. One method to free up water for the transfer is to line the All American Canal in Imperial Valley. This conservation method has been approved by IBWC and is funded by the State of California. The lining will save IID an estimated 100,000 acre-feet per year (Calleros 1991; Hayes 1991). However, water from the All American Canal seeps into an aquifer, and a large section of this aquifer is

[21]The United States 1992 Reclamation Projects Authorization and Adjustment Act encouraged water transfers of CVP water. To account for environmental impacts the Act allocated 80,000 acre-feet of water to the Bay-Delta estuary (see above section on CALFED). Agricultural interests are challenging this allocation in the courts and federal legislation.

located in Mexico. For decades, farmers in the Mexico's Mexicali Valley have used this water from this aquifer for irrigation agriculture. The lining will reduce a significant amount of recharge for the aquifer, an estimated 80,000 acre-feet each year (Calleros 1991). In addition, the lining will not only result in less water in the aquifer, but an increase in the salinity level of aquifer water. Estimated loss of income for damaged crops is around fourteen million dollars (Calleros 1991). Mexico has formally objected to this lining, but the IBWC in the U.S. states that All American Canal waters are U.S. waters (Hayes 1991). Farmers in Mexicali strongly oppose this lining, and continue to bring up the topic in binational forums and conferences.

Concerning agricultural to urban water transfers from the Mexicali Valley to the Tijuana, it is unclear if and how these transfers will occur. Since water use in Mexicali Valley accounts for eighty-one percent of Colorado River water supplies,[22] the Comisión Nacional del Agua plans to examine techniques which may increase agriculture water use efficiency in the irrigation districts (CNA 1999b). These techniques include more precise measurement of consumptive water use, water conservation, and water reclamation (CNA 1999b). These water use efficiency techniques may result in more Colorado River water for Tijuana. However, CNA does not support water transfers from Valle de Mexicali as the only source of water to fulfill Tijuana's growing water demands. In addition, CNA plans to examine the

[22]According to Hayes (1991, 803), the Mexicali Valley or "Vale de Mexicali" is located just south of Imperial Valley and the U.S.-Mexico border. Mexicali Valley is one of Mexico's most productive regions. For the past fifty years, the Valle has produced wheat, cotton, vegetables, and animal fodder (Hayes 1991, 803).

feasibility of desalinization plants to supply water for the expanding urban regions on the west coast of Baja California (CNA 1999b).

At the state level, the State Water Commission (Comisión Estatal del Agua [CEA]) and the State Commission of Water Services (Comisión de Servicios de Agua del Estado [COSAE])[23] are the two state agencies which declare the strongest support to build a second Colorado River aqueduct for Tijuana. According to the COSAE State Hydraulic Plan (1994), the 1992 National Waters Law allows for the sale of irrigation water rights. The water acquisitions may occur in three ways. First, Tijuana or the State could rent the agricultural land and thus obtain water rights attached to the land. Second, the land and the water rights could be sold to Tijuana or the state. In these two cases it seems that the agriculture land will be fallowed for the water transfers. The third strategy is to substitute reclaimed water for irrigation uses in Mexicali Valley. The unused Colorado River water will then be transported to Tijuana (COSAE 1994). In COSAE's discussion of water transfers neither third party nor environmental impacts are addressed. CEA officials support the water transfers, but remain quiet on how the transfers will occur.[24]

In this section I discussed how, in the U.S. and Mexico, the hydrocommons for the Lower Colorado River basin is formed from a legal and political perspective. I detailed both domestic and international water conflicts concerning

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[23]This agency operates and maintains water aqueducts in Baja California.

[24]Besides water transfers to fulfill Tijuana's demands, CEA plans to reclaim water for urban landscaping and non-potable industrial uses (see Chapter Four).

Colorado River transbasin diversions. Finally, I detailed the binational aqueduct proposal and legal and political challenges both cities will face in completing this aqueduct. In the next section, I will address the potential environmental impacts caused by increased Colorado River transbasin diversions. This analysis examine environmental impacts in both the sending and receiving region of the hydrocommons.

Colorado River Hydrocommons Connections and Environmental Impacts—The Sending Region, the Colorado River Delta, and Salton Sea

The Colorado River Delta and Upper Gulf of California

Prior to dam construction and consequent transbasin diversions, the Colorado River flowed freely from Wyoming and Colorado to the Colorado River Delta where it deposited its nutrient rich waters in the Upper Gulf of California in Baja California, Mexico. At the turn of the century, the Colorado River or Río Colorado Delta, California's and Baja California's second major delta-estuary (besides the Bay-Delta estuary in Northern California), was the largest and most diverse desert wetland system in North America (Anderson 1999; Morrison, Postel, and Gleick 1996). This Delta spanned an enormous area, more than 150 miles long and 100 miles across (Bates et al. 1993) and is represented in Figure 5.7. The Delta supported between 200 and 400 plant species in various habitats from forests, to grasslands, to tidal wetland marshes and estuaries (Morrison, Postel, and Gleick 1996). Aldo Leopold described the region as one of hundreds of green lagoons,

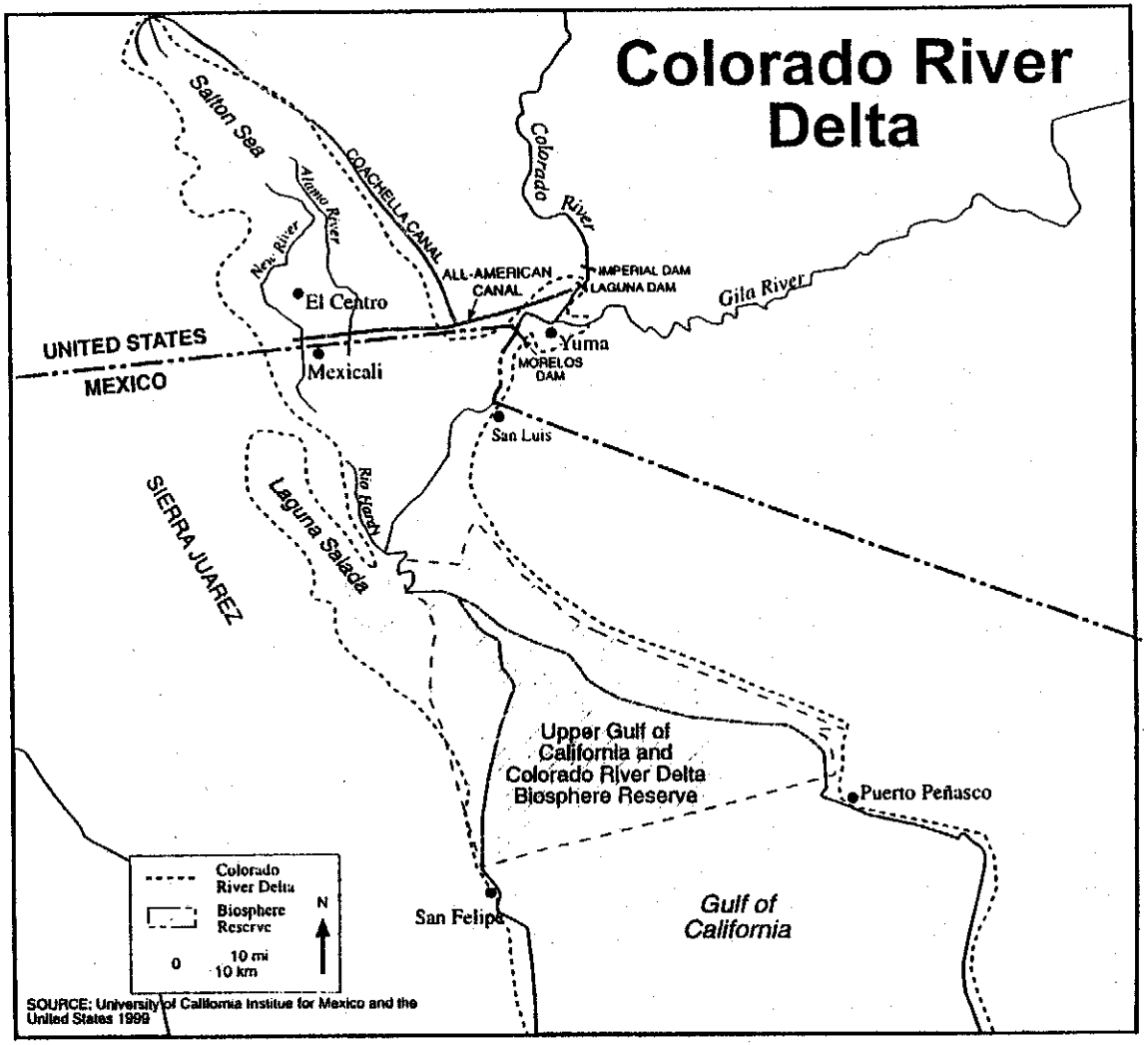

Figure 5.7. Colorado River Delta

awesome jungles, and lovely groves (Leopold 1968). Geese, doves, pelicans, egrets, sea turtles, bobcats, jaguars, tropical birds and deer thrived in the Delta (Bates et al. 1993).

In addition, nutrients, sediment loads, and fresh water from the Colorado River supported not only the Delta wetland habitat, but the diverse and productive Upper Gulf of California marine ecosystem. Mexico's Upper Gulf of California or the Sea of Cortez was once a place of special biological richness and a seemingly limitless source of fish for food, commerce, and sport (Vincent 1999, 1). In this marine ecosystem, a gulf shrimp fishery and commercial sports fishing industry once thrived. Finally, the biodiversity of the Delta and the Sea of Cortez supported Native American communities, such as the Cocopa Indians, who lived as fishers and flood farmers in the Colorado River Delta-estuary region (Morrison, Postel, and Gleick 1996). The Cocopa (people of the river) community flourished on the overflowing Gulf fisheries, and harvested crops such as melons, squash, and endemic grasses.

In 1999, Colorado River transbasin diversions in the U.S. and Mexico have reduced dramatically the natural flow of water, silt, and nutrients to the Colorado River Delta and the Upper Gulf of California. Except for rare high flood years (as has occurred in 1983 and 1998), the entire flow of the river is diverted and used (Glenn et al. 1996; Morrison, Postel, and Gleick 1996, 22). The dramatically reduced Colorado River flows has desiccated the Delta and the Upper Gulf estuaries. Below Mexicali Valley, the previous rich wetland region now consists of

salt and mud flats. Wetlands and riparian habitat supported by the natural flow of the Colorado River have diminished considerably (Glenn et al. 1996).[25] Wetland habitat does exist but only where agriculture drainage water is discharged or groundwater flows. Estuary habitat in the Upper Gulf of California is probably the most endangered habitat because the estuaries no longer contain adequate amounts of freshwater flow to support estuary ecosystems which require a mix of fresh and saltwater flows (Glenn et al. 1996).

Since so much wetland habitat has been lost, a number of species who have depended upon the Colorado River Delta and the Upper Gulf ecosystem are now threatened or endangered. One group of threatened species are migratory birds which depend on the Delta wetlands and Sea of Cortez as a major breeding and spawning habitat region. The Delta and the Sea of Cortez is considered by avian biologists as an important link in the Pacific Flyway system (Anderson 1998, 1999). The Pacific Flyway system, shown in Figure 5.8, includes numerous wetland regions such as the Colorado River Delta, the Salton Sea, and Northern California's Bay-Delta estuary. These wetlands host migrating water fowl as they travel North or South along the west coast of North and South America. Avian species found in the Colorado River Delta region include the endangered Yuma Clapper Rail, brown pelicans, white pelicans, Virginia rails, least bitterns, white-face ibis, green-backed heron, and black-crowned heron (Anderson 1998; Morrison, Postel, and Gleick 1996).

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[25]Some of the wetland loss can be attributed to conversion of wetlands to agricultural use (Water Education Foundation 1999).

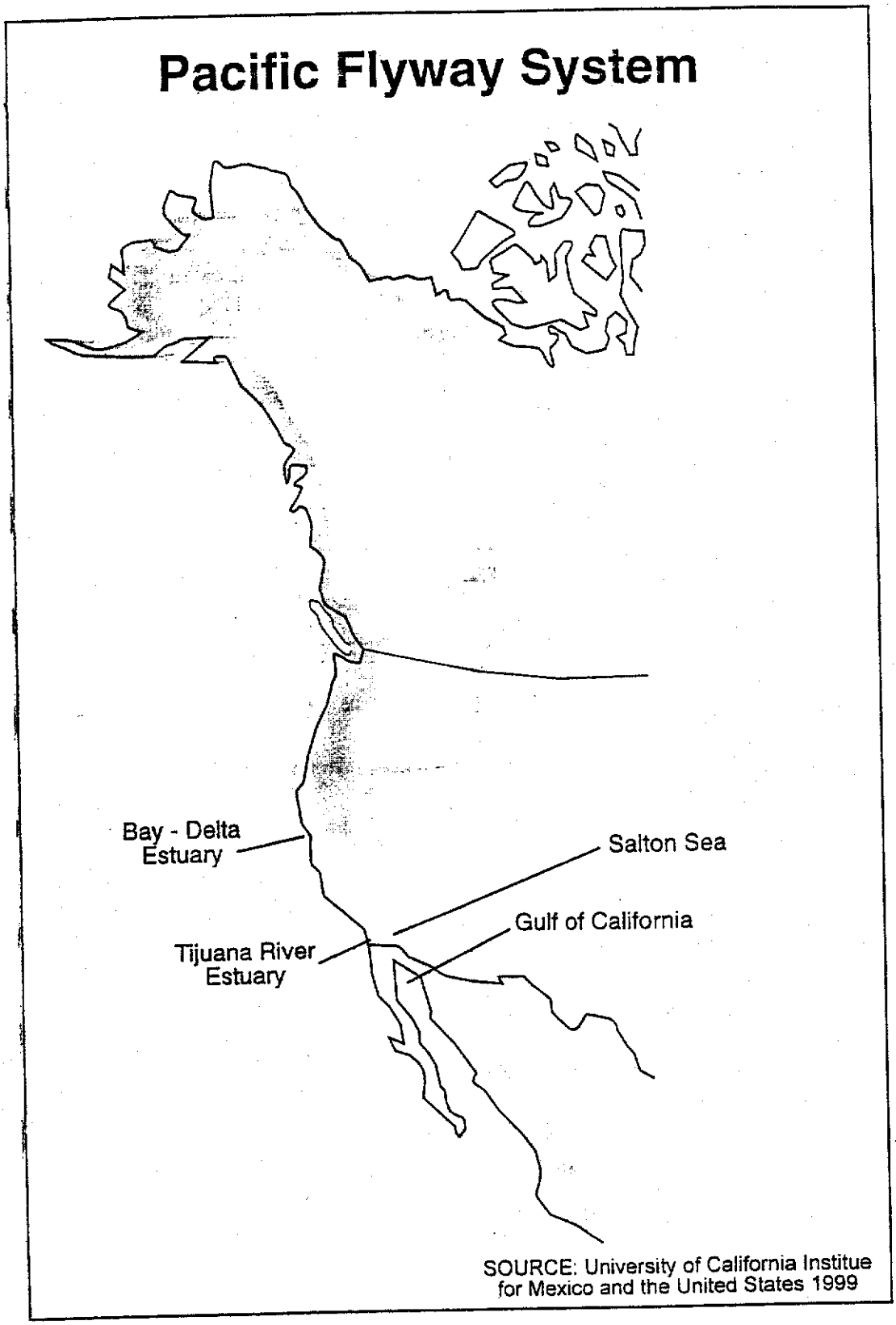

Figure 5.8. Pacific Flyway System

Not only wetland ecosystems but marine ecosystems have been impacted by the diminished Colorado River flows into the Upper Gulf of California. Local fisherman and local biologists in the Gulf of California assert that the sharp decline in Gulf shrimp and commercial fish fisheries is due in part to the lack of nutrient-rich water inflow from the Colorado River into the Gulf of California.[26] The loss of fisheries has resulted in a decline in green sea turtle populations. Finally, since fish populations have declined in the Delta and the Gulf, Colorado River Native American communities such as the Cocopa,[27] daily diets are less healthy, due to a dramatic reduction of fish consumption (Morrison, Postel, and Gleick 1996).

For Mexico, Gulf of California, the marine ecosystem degradation caused by Colorado River transbasin diversions has resulted in a severe reduction in numbers of two charismatic indicator species. The first is the vaquita (or little cow), the world's most endangered porpoise. The vaquita's range is the Delta and Upper Gulf of California. This porpoise grows to about four feet in length and feeds on small fish and squid. Very little is known about the vaquita since it is believed that only a few hundred remain. Most scientists assert that the sharp decline in Northern Gulf of California fish populations (the vaquita's food source) is to blame for the near extinction of the vaquita. This sharp decline is caused by over-fishing in the Gulf, and insufficient Colorado River fresh water flows entering the Gulf

[26]According to Glenn (1999), increased fresh water Colorado River flows has resulted in increase in shrimp catch as far south as the coast of Guyamas.

[27]When the Delta was a thriving marine ecosystem, Cocopa subsisted on eating fish at least three times a day.

(Vincent 1999). One Mexican biologist has witnessed the vaquita feeding in the Delta during low tide. This biologist now asserts that the vaquita depends upon young fish and shrimp which breed and grow in the Delta estuaries (*San Diego Union-Tribune* 17 June 1998). If this observation is true, then the vaquita's survival is dependent upon increased Colorado River flows to the Delta.

The second indicator species is the totoaba, a large silver-blue fish found only in the Gulf of California. As in the case of young salmon which use Northern California's Bay-Delta estuary as a nursery, biologists have found that the shallow waters and dense sea grass vegetation of the Río Colorado Delta-estuary provide breeding and nursery habitat for the totoaba. Totoaba spend approximately the first year of their life in the Río Colorado Delta-estuary feeding on crustaceans and small fish. After the first year, the totoaba spends most of its adult life in the deep waters of the Gulf of California. The totoaba can grow up to two meters in length and weigh 140 kilograms (Morrison, Postel, and Gleick 1996, 23). Each year, mature totoaba return to the Delta to breed and lay eggs. Totoaba harvests in the Delta were once enormous, and it was common place to find totoaba carcasses on beaches in the Upper Gulf. Today the fish is on the verge of extinction.

Given that the United States is diverting most of the Colorado River water (fifteen million or more acre-feet), and given that the 1944 treaty grants Mexico only 1.5 million acre feet of Colorado River water, Mexican responses to save the Río Colorado Delta and Upper Gulf ecosystem are localized and limited at best. The first response has been that universities in Baja California are documenting the

hydrological and geomorphological (i.e., sediment flows) effects of reduced Colorado River flows in the Upper Gulf of California. In addition, university researchers are examining altered wetland ecosystems and their impact upon avian and marine biologies. The most ambitious university sponsored project is a last ditch effort to save the totoaba.

At the Universidad Aútonoma de Baja California in Ensenada (UABC, Ensenada),[28] fisheries biologists have constructed probably the last breeding and nursery habitat available for the totoaba. In the early 1990s, the Mexican government recognized that the totoaba was heading for extinction. Subsequently, UABC fisheries biologists were sent out to the Gulf to capture and breed seven adult totoaba. These totoaba now live in two large sea water tanks at UABC, Ensenada. Twice a year the biologists raise the temperature of the tank water. This rise in temperature sparks breeding behavior, resulting in thousands of totoaba eggs. The eggs are hatched, and young totoaba spend between four months to a year growing in nursery tanks at UABC, Ensenada. During the first year of the totoaba fishery project, only three totoaba survived the hatching and rearing process. In 1999, I witnessed hundreds of young totoaba in the nursery tanks. UABC biologists have relayed to me that the survival rate now is much higher because they are learning from past mistakes and presently provide better nursery conditions for young totoaba. When the biologists receive approval from the

[28]Ensenada is located on the west coast of the Baja California peninsula sixty miles south of Tijuana.

Mexican government, the totoaba are trucked from Ensenada across the Baja Peninsula and released into the Upper Gulf of California.[29]

In addition, Mexican national government officials now recognize that the Colorado River Delta is key to the environmental health of the Lower Colorado River Basin and the fisheries in the Gulf of California. In 1993, the Mexican government set aside 2.3 million acres of water and land within the Delta and the Upper Gulf as an United Nations Biosphere Reserve (Vincent 1999; Water Education Foundation 1999). The Biosphere, portrayed in Figure 5.7, encompasses over 400,000 acres within its core zone, limiting activities to research, small scale shell harvesting, and limited ecotourism (Water Education Foundation 1999). For the manager of the Biosphere Reserve and conservation biologists in the U.S. and Mexico, the major goal of the reserve is to obtain more fresh water flows from the Colorado River.[30]

What is rarely recognized in U.S. and Mexican negotiations for Colorado River water is the environmental impacts of transbasin diversions to the Delta and Upper Gulf of California. As noted above, California is attempting to reduce its water allocation amounts, but this reduction of allocation is done so that other states in the Colorado River Basin can increase water use to their full allocation apportionment designated in the 1922 Colorado River Compact. In Colorado, the

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[29]This information on the totoaba was provided to me during a tour of the totoaba fisheries facility at UABC, Ensenada, 22 October 1999.

[30]How much flow is the question. Because the Delta is located within an arid desert region with intermittent precipitation and hence river flow patterns, Dr. Edward Glenn from the University of Arizona asserts that around 500,000 acre-feet every three to four years would support riparian habitat in the Delta (Water Education Foundation 1996a).

Denver Water Department will need an additional 100,000 acre-feet to serve anticipated growth in the next forty years. Nevada will be diverting its full entitlement by 2007 (*San Diego Union-Tribune* 19 October 1999). In Mexico, west coast cities such as Tijuana, Rosarito Beach, and Ensenada are counting on increased Colorado River diversions as the next source of water to support each city's anticipated growth. However, as argued by Morrison, Postel, and Gleick (1996), since Mexico receives less than ten percent of Colorado River flows, it is unrealistic and inequitable for Mexico to assume all the responsibility of restoring ecosystems in the Río Colorado Delta and the Upper Gulf of California. As indicated by the above discussion on the totoaba fishery and the Delta Biosphere Reserve, Mexico has taken localized steps to slow down the degradation process. Restoration can only be accomplished with international cooperation and agreement. As is being done in the CALFED process for Northern California's Bay-Delta estuary, all Colorado River water users need to take responsibility for downstream consequences such as the Río Colorado Delta ecosystem degradation. This allocation of responsibility potentially can be governed within a hydrocommons governance structure.

The Salton Sea

As I have stated before, the Colorado River Delta encompassed a huge desert wetland desert ecosystem, up to as much as 3,000 square miles (Anderson 1999). Today due to transbasin diversions, there exist wetlands in California which are part of the Delta wetland ecosystem. The largest and most biodiverse

wetland/marine ecosystem is that of the Salton Sea (see Figure 5.7), a terminal saline lake located thirty five miles north of the U.S.-Mexico border and ninety miles east of San Diego. The Salton Sea is connected to the Colorado River Delta by riparian or wetland corridors along the Colorado, Hardy, New, and Alamo Rivers (Cohen, Morrison, and Glenn 1999). Both the Salton Sea and the Delta support similar habitats, such as low desert, riparian woodlands, wetlands, and hypersaline marine habitat (Cohen, Morrison, and Glenn 1999).

The Salton Sea was created in 1905 when Colorado River flood waters destroyed the headworks of a canal which served Imperial Valley farm cooperatives (Pomento 1998). The result of this flooding was that the Colorado River changed its course and flowed north into the Salton basin for approximately two years. Today the Salton Sea and its wetland habitat encompass 380 square miles, and have an average depth of approximately thirty-one feet (Cohen, Morrison, and Glenn 1999). In addition, the Salton Sea has been created by and is still the product of Colorado River water. The Salton Sea receives Colorado River water diversions which are first used for irrigation in Imperial and Coachella Valleys. After irrigation use, the agriculture drainage or return flows are then deposited into the Salton Sea. Besides agriculture wastewater, via the New and Alamo Rivers, the Salton Sea receives municipal and industrial wastewater from Mexicali, Mexico. The Salton Sea does receive some freshwater from groundwater flows and seepage from irrigation canals and drains. However, for the most part the Salton Sea acts as an agricultural and municipal wastewater sump (Pomento 1998). The estimated

total amount of water inflow to the Sea is 1.35 million acre-feet (Cohen, Morrison, and Glenn 1999).

Agricultural and municipal wastewater flows sustain the Salton Sea, but at the same time pollutants and chemicals found in these effluent flows threaten to kill the Sea's aquatic and avian life. Scientists have identified four categories of pollutants which threaten the Salton Sea ecosystem: salinity, nutrient loading, selenium, and pesticides. According to Cohen, Morrison, and Glenn (1999, 15), "annual inflows to the sea contain four million tons of dissolved salts, 15,000 tons of nutrients and such as nitrogen and phosphorous and variable levels of selenium, other metals and pesticide residue." Pollutant concentrations increase over time because "the only outflow for water entering the Sea is through evaporation." To restate, the evaporation process reduces fresh water in the Sea, and consequently increases pollutant concentrations of salts, nutrients, selenium, and pesticides (Cohen, Morrison, and Glenn 1999, 15).

The Sea's hypersaline and nutrient rich water support huge numbers of marine invertebrates, which in turn feed large numbers of fish species, which in turn nourish waterfowl populations. The fish species which inhabit the Salton sea are non-native, a result of government efforts to initiate recreational fishing at the Sea. Marine species such as sargo, orangemouth corvina, gulf croaker were introduced during the 1950s (Pomento 1998). The most common fish in the Sea, the tilapia, entered the Sea from agriculture drainage ditches. The tilapia was

introduced by Imperial Valley farmers to control aquatic weeds in irrigation ditches (Cohen, Morrison, and Glenn 1999; Pomento 1998).

The Salton Sea and nearby crop lands provide a mix of habitat and food sources for a high diversity of waterfowl. Each year over one million birds representing 380 species (five of which are endangered) spend some time at the Sea (Pomento 1998). These species include the Yuma Clapper Rail, peregrine falcon, brown and white pelicans. In March 1998, over 26,000 American white pelicans were observed at the Sea, roughly the entire population of the species (Cohen, Morrison, and Glenn 1999). Scientists assert that the Salton Sea habitat is not the only reason for the large numbers of migratory bird population present at the Sea. In essence over ninety percent of wetland habitat in Southern and Central California and the Colorado River Delta has been destroyed (Anderson 1999). Subsequently, since so much wetland habitat has been destroyed, the Salton Sea has evolved into a critical wetlands breeding ground for migratory birds who travel the Pacific Flyway (Anderson 1999; Cohen, Morrison, and Glenn 1999; McNaughton 1998). One scientist noted with irony that the Salton Sea is now flooding with agricultural wastewater (diverted from the Colorado River) and creating wetland habitat, while the Colorado River Delta wetlands are drying up due to lack of water (McNaughton 1998).

The Salton Sea has a rich aquatic ecosystem and high levels of avian biodiversity. However, this ecosystem experiences large scale mortality events for both fish and waterfowl species. Each year large fish die offs occur, resulting in up

to a million fish deaths (Cohen, Morrison, and Glenn 1999). There appear to be several reasons for these fish die offs. The most common cause of die off is eutrophication.[31] Eutrophic conditions in the Salton Sea result in reduced levels of dissolved oxygen available for fish, and hence each year during warm weather conditions, thousands of Salton Sea fish die due to lack of dissolved oxygen available, or a condition commonly referred to as hypoxia. Another cause of widespread fish mortality is temperature change. The most common fish in the Salton Sea, the tilapia, is a nonnative fish (from Africa), and sensitive to water temperatures below fifty-five degrees Fahrenheit, and hence subject to mass die offs during the cold winter months (Cohen, Morrison, and Glenn 1999). Tilapia die offs are also caused by disease outbreaks which weaken the fish, and in turn allow for other diseases such as botulism to penetrate the fish tissues (Bloom 1998). In the case of botulism, the disease spreads beyond fish to waterfowl populations which prey upon diseased fish.

The most disturbing mortality event at the Salton Sea is the recent advent of waterfowl bird die offs. In 1992, more than 150,000 eared grebes died at the Sea within a three month period. In 1996, more than 20,000 birds, representing sixty-four species including 1,996 endangered brown pelicans and 8,000 white pelicans (fifteen of the North American white pelican population), died of avian botulism. In 1998, another 17,000 birds representing seventy species died from Newcastles

[31]Eutrophication occurs when large amounts of nutrients from agricultural wastewater enter the Sea, which in turn initiate a rapid increase of plant and phytoplankton growth in the Sea. Algal respiration and decomposition of dead algae and plankton leads to diminished levels of dissolved oxygen (DO) available for all aquatic species including fish.

disease and avian cholera (Bloom 1998). U.S. Fish and Wildlife response to these bird die offs has been localized responses such as care and rehabilitation of sick birds, and the incineration of dead birds.[32] Scientists and Fish and Wildlife officials studying the bird mortality phenomenon believe that the avian botulism is transmitted to birds from dying tilapia. Other scientists state that selenium and pesticides found in agricultural wastewater discharged into the Salton Sea weaken bird immune and reproductive systems, and hence could be another cause of Salton Sea bird die offs and reproductive failure. Each year over six million pounds of pesticides are applied to crops in Imperial Valley (Cohen, Morrison, and Glenn 1999). U.S. water quality laws, most notably the Clean Water Act, do not regulate point source water pollution from agricultural runoff.[33]

As with the Río Colorado Delta, the amount of water flowing into the Salton Sea is likely to decrease. As stated before, water agencies in Southern California are currently negotiating to reduce California's Colorado River water use from 5.3 to 4.4 million acre-feet. In addition, the CALFED staff and stakeholders are making it clear that an increase of imported water from Northern California's Bay-Delta estuary to Southern California is unlikely. These two events are spurring

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[32]One grim addition to the Salton Sea National Wildlife Refuge is an incinerator to cremate dead birds. This incineration prevents further spreading of disease amongst waterfowl. In 1997, Fish and Wildlife management of the disease outbreak has resulted in the Service going $350,000 over its budget allocated for the Salton Sea (Bloom 1998).

[33]However, the local Regional Water Quality Control Board (Region 7) is in the process of completing total maximum daily load (TMDL) studies of pollutants deposited by agriculture in the Salton Sea basin. These TMDL studies could result in regulation of agriculture wastewater discharges into the Salton Sea (Public Officials for Water and Environmental Reform, California Water Policy Conference 14 October 1999, Los Angeles, CA).

changes in water use policy and practice in Southern California. One policy change which may reduce Salton Sea water inflows is the water transfer agreement between Imperial Irrigation District (IID) and San Diego County Water Authority. As stated above, in this agreement IID will sell conserved water to San Diego. Essentially conservation measures would reduce the volume of fresh water present in agricultural run off entering the Salton Sea. This fresh water dilutes the concentrations of pollutants present in agriculture wastewater flows entering the Sea. Wastewater inflows to the Salton Sea originating in Mexico also will decrease. Baja California's Comisión Estatal del Agua plans to expand its wastewater treatment capacity in Mexicali, and this water will be reclaimed for industrial processes and urban landscaping (CEA 1999).

Given these anticipated changes in water management in the U.S. and Mexico, Cohen, Morrison, and Glenn (1999) estimate that inflows to the Salton Sea may decrease from 1.35 to about 0.8 million acre-feet. As water inflows are reduced, the salinity, nutrient, and other pollutant concentrations (selenium and pesticides, for example) in the Sea will increase. The increase of pollutant concentrations in the Sea could result in a further weakening of fish and waterfowl immune and reproductive systems, and subsequently result in ever increasing fish and waterfowl moralities. In addition, the Sea's elevation will decrease and the lake bed will be exposed. Exposure of hypersaline lake beds (as have occurred in the case of Mono Lake, Owens Lake, and the Aral Sea) result in an increase of wind

blown salts and dust, air pollutants which will adversely affect both human and animal populations in the Salton Sea region (Cohen, Morrison, and Glenn 1999).

In this section I have detailed the geography and environmental conditions of the Río Colorado Delta, a delta encompassing wetlands and marine ecosystems in both California and Baja California. Like Northern California's Bay-Delta estuary, the Río Colorado Delta ecosystem is dramatically altered by the construction of the Colorado River hydrocommons. Unlike the Bay-Delta estuary, policy makers in the United States have ignored the connections between transbasin diversions and environmental degradation in the Río Colorado Delta region. Mexico, on the other hand, has responded with localized projects in the problem region of the hydrocommons. Yet unlike the CALFED process, Mexican solutions cannot include United States receiving regions of the Colorado River hydrocommons as part of the solution to Río Colorado Delta ecosystem restoration. The primary reason for this lack of incorporation of U.S. receiving regions (and their responsibility for the consequences of their transbasin diversions) is simply that the "other" Delta of the Californias is for the most part located in Mexico. Yet this attitude might change, due to adverse environmental impacts which occur in receiving regions of Colorado River hydrocommons. In Southern California, an awareness of environmental impacts due to transbasin diversions is emerging from water pollution and coastal water protection stakeholders, and it is this water quality component of hydrocommons construction that I detail in the following section.

Colorado River Hydrocommons Connections and Environmental Impacts: The Tijuana-San Diego Metropolitan Region

Introduction

> A San Diego-Baja aqueduct study is a good idea. But dare we hope that the worthies studying the idea will plan what to do with the water after it has been flushed into Baja's sewers? And ours too, for that matter. This year for the first time in decades, I have not needed medical attention for infected sinuses and ears. Because this year, for the first time in decades, I have not gone into our ocean. Cleaning up the water we already have should be of first importance. (Editorial, *San Diego Union-Tribune* 17 September 1999)

The above editorial sums up a concern often not thought of in the construction and management of hydrocommons. What are the environmental or to be more specific land use and subsequent water quality impacts of the diversion to the region which receives the transbasin diversions? In addition, if there are environmental impacts in the receiving region caused in part by transbasin diversions, should not these impacts in the receiving region be a consideration in proposals, such as the Tijuana-San Diego binational aqueduct, which seek to increase water imports from the Colorado River? In essence, as has been posited by the CALFED watershed work group, should not environmental impacts in receiving regions be considered in hydrocommons governance? The following two sections will posit water quality impacts to San Diego-Tijuana metropolitan region caused by transbasin diversions from the State Water Project and the Colorado River. Since the current approach to science and regulation of clean water is a relatively new field (approximately thirty years old), certain below-listed impacts have not been substantiated by long term scientific research. However, these impacts reflect ideas

developed by players involved in the water quality political process, and by scientific researchers who are just now starting to understand the links between transbasin diversions, urban growth, and water quality in Southern and Baja California.

Linking Imported Water with Coastal Water Quality

As demonstrated by the above editorial, the most obvious linkage between an increase in water imports and water quality is that an increase in water supply may result in an increase of wastewater flows (Gunnerson 1991; Osann and Young 1998). In Mexico, according to state and federal level hydraulic plans both water supply use and wastewater discharges are incorporated together in analyses and planning efforts. From CNA, CEA, and CESPT hydraulic plans, Guzman (1998) reviewed the water supply and wastewater discharge data. His analysis revealed that between 1984 and 1999 Tijuana's developed water supply has nearly doubled. The increase of water supply resulted in a threefold increase in wastewater discharges, and threefold increase in uncontained wastewater flows. What is not evident from Guzman's analysis of the state and federal documents, is an analysis of the quality of wastewater effluent.

Water supply and wastewater discharge flows in San Diego are managed by separate agencies, and hence at times conceptually difficult to link. As stated throughout this dissertation, unlike Tijuana, water quality and supply management, governance and planning are done separately in San Diego. In terms of water

quality, San Diego region's water quality plan and objectives, known as basin plans, are developed by the State of California Regional Water Quality Control Board (RWQCB). These plans address point and nonpoint source pollution. San Diego's Metropolitan Wastewater Department is required to submit yearly reports to the RWQCB for compliance with its NPDES permits. Water supply plans, called integrated water resources plans, are produced by water supply agencies at different political scale levels. The integrated water resources plan, known as Bulletin 160, is developed at the state level by the State of California Department of Water Resources. MWD and San Diego County Water Authority also produce yearly integrated water resources plans—again these plans address water supply issues only. However, the City of San Diego Water Department did do complete integrated analysis of the region's water supply and water quality issues in its 1996 Watershed Sanitary Survey. Unlike Mexican hydraulic plans, the survey does not incorporate wastewater discharges to the ocean, but the plan does recognize nonpoint source pollution impacts to local water quality.

As indicated by the above discussion on the California 4.4 plan, there is much discussion as to the cumulative amount of water imported to Southern California. However, unlike Mexican and Baja California agencies' hydraulic plans which integrate water and wastewater management, there is little discussion by California's wastewater and water agencies (in public hearings and public outreach programs, for example) concerning the cumulative loads of wastewater which is deposited into Southern California's coastal region. An exception to this statement

are studies generated by the Southern California Coastal Water Research Project Authority or SCCWRP. This research authority was formed in 1969 to address the limited knowledge of the effects of wastewater and other discharges to Southern California's coastal marine environment. SCCWRP is governed by a nine member commission which includes representatives from city, county, state, and federal government agencies. After thirty years of increased water diversions and urban growth in Southern California, SCCWRP is now releasing long term historical analysis of the cumulative impacts of point and nonpoint source discharges to Southern California coastal waters.

Concerning wastewater discharges, SCCWRP has done analysis of the four largest municipal wastewater treatment facilities discharging into Southern California's coastal waters. These plants are the Point Loma Wastewater Treatment Plant, Orange County Sanitation District Plant, the Joint Water Pollution Control Plant for Los Angeles County, and Hyperion Treatment Plant for City of Los Angeles. According to a 1998 SCCWRP report, between 1971 and 1996, the combined flow of all four treatment plants has increased by nineteen percent. Cumulative wastewater flows from these four plants peaked near 1,200 millions of gallons per day (mgd) in 1988, and average 1,100 mgd in 1996 (Raco-Rands 1998).[34] During this time the volume of wastewater discharged has increased for three of the plants. The most noticeable is the ninety percent wastewater flow

[34]Other plant increases: Orange County Sanitation District eighty-two percent, Hyperion Treatment Plant seven percent, Joint Water Pollution Control Plant volumes decreased eleven percent. In 1995 the plant's effluent comprised of eighty-nine percent of municipal wastewater discharged into Southern California's coastal waters (Raco-Rands 1998).

increase for San Diego's Point Loma Wastewater Treatment Plant. One plant in Los Angeles experienced a decrease of eleven percent in wastewater flows. The study cites that population growth patterns, regional industry types and numbers, presence or absence of water reclamation programs, and inland discharge sources account for differences among the plants (Raco-Rands 1998, 4).[35] An increase in developed water supply was not cited as a possible cause of increased wastewater discharges. Table 5.7 provides an initial analysis linking water imports, City of San Diego water supplies, City of San Diego urban population numbers and wastewater flows. As the reader will note there is a positive correlation between water imports and Point Loma's wastewater flows. However, the reader must also note that the service areas, land use types, and populations served for each agency listed in Table 5.7 are not the same.[36]

Even though wastewater flow volumes have increased in Southern California, the amount of certain pollutants discharged have decreased. For example in 1971, nearly 600 metric tons of copper and chromium were released by these four plants (Raco-Rands 1998). In 1996 approximately six and fifty-four metric tons of chromium and copper, respectively, were discharged by the plants.

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[35]In terms of the Los Angeles case study, the urban population had increased by thirty-four percent between 1971 and 1996, but wastewater flows had increased by only seven percent at the Hyperion plant and decreased by eleven percent at the Joint Water Pollution Control Plant. The study cites that expanding upstream treatment and reclamation facilities are the cause of this decrease in wastewater flows.

[36]In fact, numbers from the San Diego County Water Authority can be misleading because water imports for San Diego County not only support urban uses but agricultural uses. Hence, I have included City of San Diego usage. Remember MWWD discharges reflect not only discharges from City of San Diego, but fifteen other municipalities or wastewater districts outside San Diego's city limits.

Between 1971 and 1996, oil and grease discharges decreased seventy-six percent (Raco-Rands 1998). The study cites that increased source control, land disposal of biosolids, sludge dewatering, and technological advances in primary and secondary treatment methods account for the reduction in contaminant mass emissions (Raco-Rands 1998). Again there is no discussion of whether water conservation methods have contributed to a decrease of pollutants discharged (Osann and Young 1998). In addition, the study does not examine trends in bacterial and viral pathogen discharges. Scientific research has yet to produce cost effective and accurate tests to monitor biological contaminants.

Table 5.7

Links Between Water Supply, Urban Growth, and Wastewater Discharges

Year	SDCWA Imports (AF)	City of SD Total Water Supply Deliveries (AF)	City of SD Population	MWWD Wastewater Discharges (mgd)
1974*	337,757	153,671.7	1,358,000	102
1980	309,826	175,667.4	1,862,004	132
1990**	674,016.1	236,491.0	2,498,000	185
1998	433,490.1	210,936.9	2,690,255	194

Sources: Ganster (1998a); Laru pers. com. 2000; City of San Diego Metropolitan Wastewater Department National Pollution Discharge Elimination System (NPDES) Permit Annual Reports, San Diego Regional Water Quality Control Board.

*1974 is the first year MWWD filed an NPDES permit for wastewater discharges from the Point Loma Wastewater Treatment Plant
**1990 reflects a drought year, hence a large increase of water imports.

An increase of wastewater flows entails a need for more and larger pipelines to collect and convey the wastewater to a POTW. Given the increased water supply

and urban population growth in the San Diego-Tijuana metropolitan region, environmentalists in San Diego and Tijuana charge that the city planning process does not address the need to increase daily sewage capacity and the need for more maintenance on sewer lines (more pipelines entail more inspections, cleaning, and replacement of pipes—see Chapter Three) (*The Beacon* 22 July 1999). In addition, environmentalists assert that both cities fail to address sewage overflows and spills before they occur. Instead elected officials spend money on an emergency basis to fix sewage spills (the deferred maintenance strategy—see Chapter Three). According to the lead water quality activist Donna Frye:

> You can only fit so much stuff into a pipe. San Diego is building projects and adding users. Where you had a single family home, you now have a 12 unit condo building; where you had a mom and pop store, you now have a mini-mall. Poor planning is the culprit, and we are dealing with the problem after the fact. When looking at a pipe which is fifty years old, over capacity and in poor structural condition, the answer to the question: "Should we have repaired our pipes earlier?" is self evident. (*The Beacon* 22 July 1999)

Urban growth/expansion and the consequent wastewater infrastructure expansion in San Diego and Tijuana is a topic which should be addressed by future research. In addition, analyses of the costs associated with an increase in infrastructure maintenance and infrastructure replacement demand are needed. The essential question to ask is does urban growth and/or expansion result in a per capita increase in wastewater collection and treatment costs? According to Hawken, Lovins, and Lovins (1999), large municipal treatment plants and the consequent thousands of miles pipelines serving these plants do not make economic sense. The authors cite a study in Adelaide, Australia, which reports that

> while large sewage-treatment plants do gain some economies of scale, they also gain bigger diseconomies because they must pay for the sewer network to collect wastes for a larger area. The network's pipes and pumps account for about 90 percent of the total cost of wastewater treatment. Designed to capture only the advantages of the treatment size without counting its collection costs, standard designs are probably at least tenfold, and may even be a thousandfold larger than economic optimum. (Hawkens, Lovins, and Lovins 1999, 228)

However, expanding urban wastewater collection systems may not be the only culprit associated with rising wastewater treatment costs for large cities such as San Diego. Water resources researcher Gunnerson (1991) asserts that the amount of water supplied to the region is an essential element associated with wastewater treatment costs. From his analysis of World Bank data and his own field research, on average it costs five to six times as much to dispose of urban wastewater as it does to supply it (Gunnerson 1991, 187). If per capita consumption of water increases from twenty to over 700 liters per day, then the ratio of sanitation to water supply costs increases to more than fifteen to one (Gunnerson 1991). Gunnerson's (1991) cost analysis includes costs not only to treat the wastewater, but also wastewater infrastructure and maintenance costs.

The above discussion of wastewater infrastructure and urban growth/sprawl leads us to a controversial yet necessary topic which must be addressed before I discuss the cumulative impacts of nonpoint source pollution to California's and Baja California's watersheds and coastal waters. In essence, what is the relationship between imported water and urban growth? According to Reisner (1993), Gottlieb (1988), Worster (1985), and other water scholars, from a historical perspective cities like Los Angeles and San Diego could not grow without an increase of

imported water. Many water agencies in San Diego County state that the agencies simply supply water; the agencies do not conduct land use planning, and hence do not encourage urban growth or sprawl in San Diego County. On the other hand, Tijuana water agency officials recognize even encourage the link between water supply and urban/industrial growth (CEA 1999; CNA 1999b). If we examine the data in Table 5.7, for San Diego there seems to be a positive correlation between urban population growth and water imports. Tijuana's rapid population growth rate (5.8 percent each year) has also been accompanied by a twofold increase of developed water supplies between 1984 and 1999 (Guzman 1998). On the other hand, Southern California Metropolitan Water District cites that its aggressive conservation measures have resulted in the district's population increasing by 2.8 million between 1987 and 1997, without an increase of water supplies (Hubbell pers. com. 1999).

Given the conflicting data, probably the more appropriate question to ask, in terms of environmental costs and impacts, is does an increase of water imports encourage an expansion of urbanized land use? In both cities, urban centers are not only growing in population numbers, but also in square miles of urbanized region. However, the amount of expansion does differ. According to Ojeda's (2000) historical analysis of native habitat acreage in the Tijuana River watershed, in 1938 the city (which occupies the lower part of the watershed) covered less than one percent of the watershed, or 17.35 square miles. By 1994, the city had extended to over seven percent of the watershed, or 121.45 square miles for 1,035,415 residents

(Ganster 1998a; Ojeda 2000). A similar historical analysis of habitat and land use changes has not been conducted for San Diego. In fact, it was very difficult for me to obtain figures on urban expansion in San Diego, because local politicians throughout the region fiercely assert that San Diego is not a sprawling metropolis, like its neighbor Los Angeles to the north.[37] In addition, one must not only consider urbanized spaces within San Diego's city limits, but urbanized spaces within the numerous incorporated cities which are suburbs of San Diego. San Diego's urbanized region can best be estimated by the total square miles of urban services provided such as sewerage service.[38] San Diego's Metropolitan Wastewater District's sewerage service area, which encompasses the City of San Diego and fifteen cities and districts, is 450 square miles (MWWD n.d. [a]).[39] Within this service area, MWWD serves approximately 2,000,000 residents. Given these numbers, Tijuana's urban population density is approximately 8,500 persons per square mile, and San Diego's is 4,444 per square mile. Hence, San Diego's urban consumption of land is two times greater than Tijuana's.[40]

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[37]San Diego's planning staff members cite to me that "changes in land use" in San Diego have occurred, but officially, no one relayed to me that urban consumption of land is occurring in the region.

[38]The extent of sewerage and piped water service can be considered the urban limit line for the San Diego region. Environmentalists in the region assert that this urban limit line is constantly being extended, and never enforced.

[39]If one examines the map of MWWD service area in Chapter Four, one can see that even this geographic representation of urbanization in the San Diego region is incomplete. MWWD does not service urban regions in the north part of San Diego County, a region which is rapidly growing in terms of urban growth and expansion, especially for cities such as Oceanside.

[40]In fact, the trend towards low density urban sprawl will continue in San Diego. According to the 1999 San Diego Association of Governments Cities/County Forecast, between 1995 and 2020

Given that both cities' imported water supplies and urbanized regions are increasing, it seems that for this binational region, water imports do encourage urban sprawl. However, one can clarify the imported water urban sprawl link controversy by asking a simple question. What is the intended use of the imported water? If the use of the imported water is to build more residential and industrial units in regions that were previously not urbanized, then yes imported water is supporting urban expansion. For the Tijuana-San Diego metropolitan region, presently local politicians' and water agencies' rhetoric supports increasing imported water supplies to build more homes, and high tech/tourism based economies (see for example Editorial "Working for Water," *San Diego Union-Tribune* 4 September 1998). In terms of the Imperial Irrigation District (IID)-San Diego County Water Authority transfers, a staff member of the State Water Resources Control Board cites that San Diego's mayor, Susan Golding, intends to build new homes with the IID water. This use of water is problematic to this staff member as she/he asks "What happens after the transfer contract expires in seventy-five years, and IID decides to sell this water to another water user?" In Tijuana, land use planners are also preparing for tremendous growth along major highways between Tijuana and Tecate to the east, and Tijuana and Rosarito Beach to the south. One planner in Tijuana relayed to me that he would like to see more centralized urban development. However, landowners along these highway

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low density single family housing will increase by 201 percent. Multiple family housing will increase forty-two percent.

corridors are lobbying local politicians to allow for Tijuana's urban expansion (Graizbord pers. com. 1999).

Urban growth and consumption of land do matter in terms of the region's water quality, simply because it is believed by scientists, the United States Environmental Protection Agency, and coastal water pollution non-governmental organizations (such as the American Oceans Campaign, Heal the Bay, San Diego BayKeeper) that urban growth and sprawl are the primary cause of the ever increasing amounts of nonpoint source pollution present in Southern California's and Baja California's coastal waters. As discussed in previous chapters, nonpoint source pollution does not originate from a single source, rather it is human/animal waste, chemicals, oil, and other substances that have collected on the ground, are washed off by water flows, and eventually enter and pollute watersheds and coastal waters.

Urban expansion and increasing population growth exacerbate urban polluted runoff in two ways. First, increasing populations generate more contaminants. A listing of major contaminants, their sources and effects, is provided in Table 5.8 (American Oceans Campaign 1997). Second, when regions urbanize, there is an increase of impervious surface area. These impervious surfaces do not allow rainwater to be absorbed by vegetation or soils, and hence storm water runoff flows in greater velocities and volumes to surface waters (American Oceans Campaign 1997; San Diego Association of Governments 1997). Pollutants such as copper (released from car brake pads every time we brake),

Table 5.8

Major Pollutants in Urban Storm Water

Pollutant	Major Sources
Heavy metals (chromium, lead, mercury, copper, cadmium, zinc, mercury	Automobile usage—emissions, brake pad residues Atmospheric deposition Industrial activities Commercial activities
Hydrocarbons (oil, grease, petroleum-based products, polycyclic aromatic hydrocarbons)	Parking lots Roads Restaurants Household activities Automobile emissions Improper disposal of motor oil Illegal dumping into storm water conveyance systems
Nutrients (nitrates and phosphates)	Fertilizers Animal waste Detergents Atmospheric deposition Leaking sewer pipes
Sediments	Construction sites Graded areas left unplanted Stream channels eroded by increased volume of runoff Agricultural lands
Toxic organics (pesticides, polychlorinated biphenyls [PCBs])	Lawn care Agricultural use Industrial uses Household activities (using paints and solvents) Illegal dumping into storm water conveyance systems
Bacteria and other pathogens	Pet wastes Rotting organic material Washing down restaurants or other food preparation sites—meat markets Feed lots Sewage overflows, leaking sewer pipes

Sources: American Oceans Campaign (1997); San Diego Association of Governments (1997).

fertilizers, oil, bacteria, and viruses are picked up by runoff and discharged untreated to surface waters via the storm water conveyance system. Furthermore impervious areas greatly impede the natural pollutant filtration system when rainwater is allowed to percolate into the soil, or accumulate in wetland regions.

In essence as the surface area of impervious surfaces increase, there is an increase of urban runoff flows (Bay and Schiff 1996). As urban populations grow there is a greater concentration of nonpoint source contaminants which enter urbanized region's storm drains, rivers, streams and coastal waters. Between 1972 and 1995 Southern California's urban runoff and its toxic compounds has increased over 1,100 percent (*Los Angeles Times* 6 September 1999). Table 5.9 summarizes the major pollutants found in Southern California's polluted runoff, and the amounts in metric tons deposited in coastal waters.[41]

Table 5.9

Southern California Runoff Pollutants—Historical Increases

Pollutant (in metric tons)	1972	1995	% Change
Copper	18	88	+389
Zinc	101	316	+213
Lead	90	39	-57
Nitrate	980	8,800	+798
Phosphorous	410	2,900	+607
Total Runoff (gallons)	**63.9 billion**	**771 billion**	**+1,106%**

Source: Los Angeles Times (6 September 1999), citing data from the Southern California Coastal Water Research Project Annual Reports.

[41]Polluted runoff is especially problematic for bay and estuary regions, which are semi-enclosed and poorly flushed out by tides. For the San Diego-Tijuana region, urban runoff is identified as a primary source of pollution for semi-enclosed water bodies such as the San Diego Bay, Mission Bay, the Tijuana River, Sweetwater River, and San Diego River estuaries.

These numbers not only address urban runoff flows which occur during the region's wet season (November-April), but the region's dry season (May-October). Since water is imported from the Bay-Delta estuary and the Colorado River, certain rivers (including the Tijuana River) which should be dry during the region's dry season, are now flowing year round. Dry weather flows originate from landscape irrigation runoff (which contains organic matter, fertilizers, and pesticides), leaking water/sewer lines, and runoff from swimming pools, car washes, or even using water to clean sidewalks, driveways, and small businesses such as restaurants. In addition, urban runoff from storm water and dry season imported water use recharges and subsequently contaminates not only surface water but groundwater resources. In Coronado, California, a beach community west of downtown San Diego, imported water use has caused groundwater levels to rise so much (and threatened to flood resident homes) that the City of Coronado decided to pump out and discharge the groundwater onto its beaches. What the City did not know was that this groundwater contained high levels of bacterial contamination, and the pumped groundwater now contaminates the City's beaches.

Along with the increase of urban polluted runoff, for the past thirty years Southern California's surfing community started noticing an increase of infections and illnesses in surfers who had spent long periods of time in ocean water—especially after a storm event. This concern of health impacts of urban based water pollution is reflected in the quote from the *San Diego Union-Tribune* editorial at the beginning of this section. Viral and bacterial pathogens are present in polluted

runoff. Pathogens can afflict swimmers and surfers when polluted ocean water enters their ears, nose, or mouths. Surfers exposed to pathogens risk contracting gastroenteritis, hepatitis, ear nose and throat infections, respiratory ailments, diarrhea, rashes and other illnesses (American Oceans Campaign 1997). Most of the time the diseases are not life threatening; however, the increased risk of ocean caused illness has caused much concern for Southern California's surfing community and parents of children who spend long periods of time in ocean waters. In 1995, the Santa Monica Bay Restoration Project and the University of Southern California researchers conducted an epidemiological study to examine the health effects of swimming near storm drain outfalls in the Santa Monica Bay (American Oceans Campaign 1997, 9). The study:

> . . . compared individuals swimming at the outfall location, with those swimming 400 yards away, found substantial increases in experiencing fever, chills, ear discharges, vomiting, coughing and phlegm, respiratory diseases and gastrointestinal illness among those swimming directly in front of the outfall. (American Oceans Campaign 1997, 9)

The study confirmed what surfers had been claiming for decades. There is an increased risk of illness associated with swimming near storm drain outfalls (the discharge outlets for polluted runoff). Polluted runoff presents health risks to those who swim in Southern California's waters.[42] In Chapter Four, I discuss place based approaches (AB411 and 538) in reducing bacterial contamination of beaches. These

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[42]Although some water quality activists such as Donna Frye assert that the problem is not just the storm drains. Frye believes that viruses from POTW discharges, sewage spills, and leaking sewer lines also contribute to an increased risk of illness for Southern California's surfers.

approaches are the first measures taken to monitor and identify bacterial pollutants within coastal urban watersheds.

This section discussed the links between imported water supplies, urban expansion, and coastal water quality in Tijuana and Southern California. For Tijuana, an increase of water supply (imported or locally developed such as desalinization) entails an increase in wastewater flows and, more significantly, a possible increase of uncontained wastewater flows. As with Tijuana, San Diego's imported water supplies and wastewater flows have increased, but the amount of pollutants discharged from large municipal wastewater treatment plants have decreased dramatically since 1971. An increase of imported water at times can be linked to urban growth, and definitely can be linked to urban consumption of land, especially if the specific use of imported water is to urbanize previously rural or open space regions. Both Tijuana and San Diego seek to increase Colorado River water allocations, and both cities desire to use this water to build homes, industrial parks, and retail centers—essentially urbanize more land in the binational metropolitan region. An increase of urban population with an increase of urbanized land or impervious surfaces results in an increase of urban runoff and contamination in both wet and dry weather seasons. The link between imported water and local watershed/coastal water contamination is especially clear during the dry season when storm drains and local rivers continue to flow with polluted runoff from imported water uses. This runoff contains contaminants such as oil, pesticides, bacteria, and heavy metals from urban activities. As indicated by assertions of

surfers and scientific studies, polluted runoff along with raw sewage discharges pose a health risk to Southern and Baja Californias' swimmers, surfers, and even coastal marine life as demonstrated by Figure 5.9. However, urban sprawl and its consequent pollution from point and nonpoint sources not only threaten coastal waters, but drinking water sources within the receiving region of the hydrocommons. Below is a discussion of local water supply contamination resulting from urban consumption of land. What is interesting to note is that certain local politicians and water agencies in the region assert that one remedy for urban contamination of local water resources, is an *increased reliance* on imported water supplies.

Linking Water Imports with Local Surface/Groundwater Water Contamination

Probably the greatest threat to Tijuana's local water supply is water pollution from industrial/urban point and nonpoint sources. One indicator of the concentration of pollutants in Tijuana's local supplies is the Tijuana River aquifer. This aquifer lies beneath the Tijuana River, a river which travels through the City of Tijuana (see map of Tijuana River in Chapters Four and Five). According to Guzman (1998) over 100 wells draw from this aquifer, producing an average of 5,000 acre-feet per year of water. After analyzing twenty well samples during wet and dry weather conditions Guzman (1998) concludes that the aquifer is contaminated. Wells which demonstrate high levels of total dissolved solids, nitrates, and fluctuating numbers of coliform, Guzman (1998) concludes, are

Figure 5.9. Urban polluted runoff awareness billboard. City of San Diego 1999. One of the major pollutants found in urban polluted runoff is motor oil leaking from cars, or motor oil illegally dumped (after an oil change for example) into storm drains.

contaminated by uncontained wastewater flows. A second source of well contamination is the presence of heavy metals such as barium and silver, contaminants which originate from industrial, commercial, and automobile activities. What Guzman did not address in his analysis is contamination from nonpoint sources found in Tijuana's polluted runoff flows. Such an analysis would be difficult since there is still a significant amount of uncontained wastewater flowing in Tijuana's arroyos and streams. However, given the above discussion on Southern California's urban runoff pollution, it can be expected that as Tijuana's urbanized population and urbanized region grows so will the amount of urban polluted runoff flows increase. Tijuana's main supply surface water reservoirs, Presa Rodriguez and Presa Carrizo (located in the southeast non-urbanized section of the city, see Figure 4.2), are currently protected from urbanization and urban sources of contamination. However, colonias are expanding from the west towards both these reservoirs.

Protection from urban point and nonpoint source pollution is not the case for San Diego's surface and groundwater supplies. Just southeast of San Diego, the Sweetwater River flows into the Sweetwater Reservoir, a local supply source of fresh water for residents which reside in east San Diego and suburbs such as National City, Chula Vista, and Bonita. Urbanization has started to encroach on land near the western part of the reservoir and regions upstream the reservoir. According Dennis Bostad, the Director of Water Quality for Sweetwater Authority (the water supply agency which manages the Sweetwater Reservoir) runoff from

urbanized area within the Sweetwater watershed causes a severe degradation of drinking water quality. This water quality degradation is caused by storm water runoff, and continuous dry season urban runoff flows (Bostad pers. com. 1999). To illustrate his point Bostad referred to one indicator of drinking water quality for health and taste standards, the amount of Total Dissolved Solids (TDS), or an indication of the amount of salts present in drinking water supplies. Table 5.10 summarizes the data Bostad (pers. com. 1999) presented to me:

Table 5.10

Salts Present in Drinking Water Supplies

Type of Water	TDS Parts Per Million (ppm)
Local surface waters (unaffected by urbanization)	200-250
Colorado River imported water	600-1,000
Reclaimed water	1,250
Urban runoff	2,000-5,000

As one can see from this chart, according to Bostad and the Sweetwater Authority, the best water quality is from local surface water unaffected by urban pollution sources. In fact, Sweetwater blends its local water supplies with Colorado River water to dilute the amount of TDS present in imported Colorado river water.[43]

Yet given that urban runoff TDS levels are ten to twenty times higher than natural runoff and given the above discussion of the types of pollutants found in

[43]Southern California Metropolitan Water District blends its Colorado River water with State Water Project water to reduce the high amounts of TDS present in Colorado River water.

urban runoff (to include oils, heavy metals, and viruses), urban development within the Sweetwater River watershed and its consequent polluted runoff was contaminating Sweetwater Authority's drinking water supply. In essence, due to urban runoff contamination, the Sweetwater dam and reservoir have become an urban runoff retention and treatment facility (Bostad pers. com. 1999). As urban development continues to grow in the drainage areas which contribute runoff flow to the Sweetwater Reservoir, increasing runoff will be absorbed into the groundwater basin; resulting in continuous and increasing flows which will be high in TDS or salts.

In fact, Bostad was especially concerned about urban runoff from reclaimed water, a source of non-potable water both San Diego and Tijuana plan to develop extensively in the future. According to Bostad, reclaimed water may contain a high amount of organic carbons (when combined with chlorine, organic carbons created THMs which are carcinogenic—see above discussion on Bay-Delta water and organic carbons), and even viruses as Bostad (pers. com. 1999) states below:

> For example, there are issues about reclaimed water and gray water two ways people are exploring for additional water supply. The problem with reclaimed water and gray systems I think is that people don't totally understand what the runoff impacts can be. They are looking more towards applications or uses of reclaimed water. Runoff impacts are, for example, if you reclaim water and it is not treated to a high enough quality, you could reclaim water, and it could have very high total organic carbon load, upwards of ten mg per liter. If water is reclaimed but it hasn't had organic carbon removed during the reclamation process, then you are applying a tremendous amount of organic carbon laden water back into the runoff. This could have a tremendous impact on a local reservoir where we are already struggling with high levels of organic carbons. Another problem is cryptosporidium, a lot of the reclaimed water is not monitored for that. With reclaimed water we need to research it how it impacts

downstream drinking water reservoirs and downstream water quality to habitat, and learn more about.

Given the high concentrations of pollutants found in urban runoff and the possibility of viral contamination from urban and reclaimed water runoff, in 1991 Sweetwater Authority initiated construction of an urban runoff diversion system Sweetwater Authority n.d.). The system completed in 1998 intercepts and directs a significant portion of urban runoff from the reservoir. Urban runoff, or high TDS water, is diverted into PVC-lined holding ponds which form wetland marshes. Some of the urban runoff is allowed to percolate into an aquifer downstream, where it is treated using reverse osmosis demineralization (Sweetwater Authority n.d.). Some of the diverted high TDS runoff does not enter the aquifer and continues down the Sweetwater River, where it discharges and deposits its pollutants into the San Diego Bay. The urban runoff diversion system removes annually 535 tons of salts each year from the Sweetwater Authority water supply (Sweetwater Authority n.d.).

However, even with the urban runoff diversion system, water quality within the Sweetwater River water, along with most rivers in the San Diego-Tijuana metropolitan region, continue to be threatened by urban development, or more specifically land use development conducted with no consideration of downstream water quality impacts. At present many stakeholders (including SCCWRP and the EPA) involved in the politics of urban polluted runoff state that polluted runoff is primarily a beach or coastal water problem. However according to Bostad (pers.

com. 1999), as urban development moves inland or upstream, the problem extends upstream to fresh water resources:

> Historically what has happened is most of growth has occurred on the Coast. So as the concentration of growth moves east [upstream], that means that all the runoff is still the most concentrated at the Coast. As growth continues to move east, that line of impact of runoff will move East also. Right now you are affecting the beaches where people are absolutely upset about the conditions of the beaches. People in the County are not as cognizant of the impacts to the drinking water reservoirs located near the coast. But the same urban runoff problems occur at reservoirs with trash, bacterial contamination, all types of urban or high TDS water runoff. We are trying to keep the TDS runoff to 5-600 milligrams per liter. Generally with all the reservoirs in our system in the County, many are attached to imported water supply, and if more and more growth is allowed upstream of these reservoirs, they could come under pressure from having impacts from urban flows. Sweetwater is the only reservoir in the County right now which has an urban runoff diversion system. As they build in South County around Otay reservoir, and build in North County upstream of reservoirs there will be more pressures of urban runoff to drinking water quality in both places. It will happen more and more as growth continues.

In the San Diego-Tijuana metropolitan region land use planning rarely if at all takes into consideration protection of local watershed or coastal water quality. The concern of urban polluted runoff is more often than not ignored, because environmental assessments (as required in San Diego by the California Environmental Quality Act) of each urban development project state that individually the project can pose significant cumulative impacts in a watershed, but these impacts cannot be mitigated (City of Santee 1997). However, what needs to be addressed is the cumulative impacts of urban point and nonpoint sources for the watershed and coastal receiving waters. One planner I interviewed suggested that planning departments in this metropolitan region should map projected urban growth patterns not by each city/political jurisdiction (as it is commonly done in

Tijuana and San Diego), but map urban sprawl in each watershed. Then, he states, the public and land use planning decisionmakers can visualize the cumulative amounts of polluted runoff generated by urban development as it continues to expand upstream (author interview).

In addition, water agencies in the San Diego metropolitan region need to expand their perception of water quality from that of simply imported water quality, and include water quality issues within local watersheds. As Bostad points out below, if urban development continues upstream, imported water reservoirs may be the next sites of contamination of urban polluted runoff. Bostad's solution to localized water quality problems encompasses an integrated vision of water resources management. Such a vision integrates imported water use, land use planning, and local watershed protection:

> Since the 1960s, we at Sweetwater have been making water quality improvements. Developing multiple barriers to water quality degradation. The treatment plant built in the 1960s is one type barrier, the other is going backwards into the watershed supply system, and that is why we have our urban runoff diversion system. Recently, we are taking more and more efforts to interact with the County planning department. We are trying to improve land use practices that may impact water quality.
>
> Our interaction with the County planning department has been less successful, because of the approach. I think there should be better communication between the County and water agencies. We need to impart a better way to express the value of source water management as an important tool for future land use planning and protection of water resources. I think part of the problem is that there is a mixed perception of local water and protection of local water resources. The City of San Diego, Helix, Sweetwater Authority, Oceanside and Vista are the only ones which have local supply reservoirs. As a result most of the people in the County perceive water quality from the perspective of imported water quality not local water quality. So I think it is real important that we get a better understanding of source water quality, and the reasons to protect local sources. We need to have a better understanding of

local water quality throughout the entire water community, so that there is more of a united front in understanding that there is not just one agency such as ours, saying hey there is a problem with water quality in our watershed. But when people talk to other people or agencies protecting water quality in other watersheds, they will perceive that there is a problem.

The San Diego County Water Authority [the agency which imports water for San Diego County] for example has a different perspective. First they don't treat water. They don't have local reservoirs which they are protecting from urban runoff. Their perspective is one of import, and that is going to change because they are developing programs for local storage, and I think their perception that "We can put water in a reservoir which is not protected" is going to change because that water is going to require additional treatment, therefore it will cost a higher cost. Or if there is a situation where there is enough deterioration of that water that they put in a reservoir then perhaps they can't take it out and treat it one hundred percent, then they will have to blend it again. So there are other issues of loss of supply due to loss of local water quality, they will have to address in the future. (Bostad pers. com. 1999)

It is at this point that my discussion of water quality impacts within the hydrocommons comes to full circle. I have discussed how imported water supplies can encourage, in part, urban growth and most definitely urban expansion. I have discussed how urban pavement of land and its by-product urban polluted runoff contaminates coastal waters and even local fresh water supplies. As Bostad implies above, part of the San Diego's local water quality problem is water importation. San Diego's water quality degradation occurs because agencies which import water and city planning departments do not consider or plan for land use development and consequent local water quality impacts caused by water imports. It is this connection which needs to be made between transbasin diversions, land use planning, and water quality. Transbasin diversions do have water quality impacts in both sending and receiving regions of a hydrocommons.

I end this section with a personal story of water importation and local water quality protection. In August 1999, my parents who reside in Lakeside, a suburb seventeen miles east of San Diego, asked me to attend a public hearing on contamination of a aquifer which provides water to Lakeside residents. The aquifer is a large groundwater basin directly underneath the San Diego River.[44] This groundwater has significant levels of nitrates and TDS, hence the local water supply agency blends the groundwater with imported water to improve drinking water quality (Riverview Water District Public Hearing 11 August 11 1999). My parents' water supplier, Riverview Water District, uses local groundwater supplies to reduce the high cost associated with imported water. At present Riverview Water District's wells produce approximated thirty-two percent of the District's water supply (Riverview Water District 2000).

The public hearing I attended was called because earlier that summer, ground water samples contained unsafe amounts of methyl tertiary butyl ether, a gasoline additive commonly referred to as MTBE. MTBE is an oxygenating agent added to gasoline for cleaner gas combustion, hence cleaner air. However, in California, cleaner air has meant contaminated drinking water. MTBE is leaking from underground storage fuel tanks, fuel pipelines, and other sources, and is subsequently contaminating surface and groundwater sources. MTBE is a known

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[44]This aquifer is known as the Santee/El Monte groundwater basin. At least eighty-three private, municipal, or industrial wells are in operation in the Santee/El Monte Basin (Weinberg 2000).

carcinogen, and takes years to break down in water bodies (Lakeside Water District 1999).

The MTBE contamination in Lakeside is believed to be caused by three gas stations which are located on or near the aquifer. These gasoline stations' leaking underground storage tanks are believed to be the source of MTBE contamination. At the 11 August 1999 hearing I listened to public health experts discuss MTBE, and why there is a cause for concern. I listened to a representative from the County of San Diego who said that the gas stations may be the cause of contamination, but that the gas stations were currently in compliance with environmental law (environmental law in terms of hazardous material storage). I listened to a hydrologist talk about the hydrology of the aquifer, and the different, yet expensive methods available to clean up the aquifer. One resident asked the board of "experts" why could you just not use legal action to get the gas companies to clean up the wells? The representative from the County of San Diego said legal action to clean up the wells might be a possibility, but if you do that, then well the gas companies (Texaco, Arco, and Chevron) will pass on the costs to the Lakeside residents, and gas prices in Lakeside might increase. At this point, a resident brought up a suggestion, why not shut down the wells and just rely on imported water? In essence then Lakeside residents would not have to worry about local water pollution, not worry about higher gas rates, and still have safe drinking water. A heated discussion then ensued, because some residents did not want to have to pay higher costs for imported water. At present locally pumped

groundwater from the Santee-El Monte groundwater basin is produced for the approximate cost of sixty-five dollars per acre-foot. Riverview Water District pays $550 dollars per acre-foot to buy imported water from San Diego County Water Authority (phone interview with Riverview Water District 30 May 2000).

Approximately one month after the hearing, Riverview Water District shut down all four wells due to MTBE contamination. The wells provided thirty-two percent of the District's water supply, and these water supplies will be replaced by more expensive water imports provided by the San Diego County Water Authority (Lakeside Water District 1999).[45] The California Regional Water Quality Control Board claimed jurisdiction of the well contamination problem, but no action has been taken against the gas stations. In addition, Lakeside property owners along the San Diego River, and thus over the aquifer, applied to San Diego County Planning Department to rezone all land adjacent to the river for heavy industrial use. None of the water agencies have objected to this zoning proposal, in terms of further contamination of aquifer water supplies. Local residents are fighting the industrial park proposal, not for water quality reasons, but because they would rather have the land converted into a river park. It seems that Lakeside's San Diego River and the aquifer water quality might become another casualty to urban development with no consideration to water quality impacts.

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[45]According to the Riverview Water District, it is working with local and state agencies to obtain funding for an MTBE treatment facility. In addition, the District has applied for financial reimbursement from California's State Department of Health Services for the cost differential between well and imported water (Riverview Water District 2000, 4).

In this case, water importation indirectly is the culprit. In essence, when the Riverview Water District decides to shut down the wells and import water, then residents and water districts don't have to pay attention to local water quality impacts associated with urban development. An activist from the Environmental Water Caucus sums up the link between water importation and local water quality protection:

> For some reason it seems easier for people to take water from far away rather than clean up and protect what is right there. I think for a while the system was set up that did make it much easier and maybe cheaper. People don't shift gears very easily, so if you have been in the water industry for a while that is the solution you will look for—to just import the water from somewhere else. (author interview)

In his book *Cadillac Desert*, Marc Reisner (1993) uses the Los Angeles urban growth machine case study to explain the vicious cycle that occurs between water importation and urban growth. Essentially his argument is that if a city imports water and then grows (in urban population numbers and urban land expansion), this urban growth causes a demand for more water. Subsequently, there is yet another demand for more imported water, which results in more urban growth and so forth. I would like to add another component to this "vicious cycle"—the degradation of water quality in the receiving region of the hydrocommons. From my standpoint, if a city imports water, then the city grows and expands, which then causes a demand for more water, which then results in more imported water and consequent urban growth/expansion. The city grows and eventually the first signs of cumulative water quality problems appear. Beaches start closing and surfers are getting sick from increasing levels of urban polluted

runoff and raw sewage discharges. As urban pavement of land moves upstream, local water resources become contaminated by urban development and polluted runoff. This contamination of local water supplies forces local water agencies to either curtail urban growth near local water resources or import water, which then allows urban sprawl without consideration of local water quality to continue. The Sweetwater Authority has tried with little to no success the former strategy, integration of water importation, urban planning, and local water resources management. Lakeside may opt for the later—water importation. When will this vicious cycle end in Southern California? More importantly, from my interviews with local politicians and water agency directors in Tijuana, it seems that Baja California's political and business leaders plan to follow Southern California's model of water importation, and consequent economic development and urban expansion.

My argument is not that urban growth or development is essentially bad or wrong, but at some point we need to start asking the difficult questions concerning what are the local land use development implications, and more importantly the localized water quality impacts of imported water? Water quality activists, the U.S. EPA, and even local water pollution government officials all have told me that the best solution is to integrate in terms of governance: water use, land use planning, and water quality. This integrated governance approach sounds a lot like a CALFED for the receiving region of the hydrocommons! In 1999, the County of San Diego's Smart Growth Coalition water resources working group started a

discussion on the links between water supply, land use planning, and water quality. However, representatives from this task force are not optimistic. Most believe that local city politicians, land use planners, land development corporations, and water import agencies will ignore this document, and hence continue to ignore the links between water importation, urban growth/sprawl, and water quality.

In Los Angeles water quality activists and watershed movements are just now starting to understand these links or connections. Watershed movements throughout Los Angeles, Riverside, and Orange Counties are starting to flourish, taking on the extremely difficult task of watershed restoration and protection in a highly urbanized region. These movements such as Dorothy Green's Los Angeles & San Gabriel Rivers Watershed Council and Andy Lipkus' TreePeople assert that Southern California's water pollution problem is not one limited to coastal contamination and beach closures. The problem is associated with land use planning without consideration to local water quality, a lack of ethic of care for urban watersheds in Southern California and imported water (see Chapter Four for more documentation on these movements). Concerning imported water, Southern California's urban watershed movements are coordinating with watershed organizations in Northern California in the CALFED process (a topic discussed earlier in the CALFED section of this chapter). In the CALFED process watershed movements call for watershed protection in not only the sending region of the hydrocommons, but the receiving region as demonstrated by the below statement

from a letter written by urban watershed and environmental justice groups to CALFED:

> Water management decisions (especially those made without a connection to land use) can promote sprawl and can result in increased infrastructure costs to urban residents as well as increased concentrations of non-point source pollution in urban streams and waterways. . . . Our communities already suffer from deteriorating infrastructure and polluting industries, and we want to ensure that CALFED programs do not add to these burdens. (Environmental Water Caucus 1999)

As indicated above, the watershed groups participating in CALFED are concerned with not only environmental impacts in the sending region, but the problem of urban expansion, urban polluted runoff, and subsequent degraded surface and ground water quality of urban watersheds which receive water imports. Subsequently, in Southern California, watershed groups recognize the importance of the north-south hydrocommons alliances and discussions fostered by CALFED governance. Yet, what about the Colorado River hydrocommons or to restate, the east-west connections which need to be made? Unfortunately for the Colorado River hydrocommons there is no CALFED or hydrocommons governance, and hence little to no public forum to inform the general public of the environmental impacts of transbasin diversions, or for watershed groups to work with government officials to expand the range of choice of alternatives to include watershed protection of both sending and receiving regions of the hydrocommons. At present, in negotiations for Baja California's and California's Colorado River water allocations including the proposed water transfers between agricultural interests and the Tijuana-San Diego metropolitan region, numerous watershed advocates and

stakeholders are excluded from Colorado River negotiations of water transfers and allocations (*San Diego Union-Tribune* 19 October 1999).

Expanding the Scope of Conflict: Hydrocommons Governance Along the Border of the Californias?

> On October 14, 1999, International Boundary and Water Commission Minute Number 301 was signed by U.S. Section Commissioner John M. Bernal and Mexican Section Commissioner Arturo Herrerra Solís. Minute 301, or the Joint Colorado River Water Conveyance Planning Level Study for the San Diego, California, Tijuana Baja California Region, provides for a joint study by state authorities in California and state and federal authorities in Baja California for the Colorado River water supply conveyance options in the United States and/or Mexico—commonly referred to as an aqueduct study. (IBWC 1999)

As detailed above in the section on the binational aqueduct, this study examines the possibility of a binational aqueduct which will transport Colorado River water to the Tijuana-San Diego metropolitan region. If built, the aqueduct will allow for an increase of imported Colorado River water to the Tijuana-San Diego metropolitan region. San Diego will receive up to up to 300,000 acre-feet of conserved Imperial Irrigation District water, and Tijuana up to 225,230 acre-feet (San Diego Dialogue 1999). Both cities plan to use this water for economic and urban growth purposes. Negotiations for this binational aqueduct minute and study have been limited to IBWC officials and water agency representatives from California, Baja California, Tijuana, and San Diego. From my limited observation of this aqueduct study process (since the process is closed to the public), environmental impacts of the transbasin diversions in both the sending and receiving region were not included in this Minute.

One binational border government organization, the International Boundary and Water Commission (IBWC), can serve a key role in shaping the future of the binational aqueduct, and possibly the implementation of hydrocommons governance for Colorado River transbasin diversions along the U.S.-Mexico border. In this section, I will first examine the IBWC's interactions the with Border Water Council in the aqueduct process, and detail how this process limits the scope of conflict of Colorado River water allocations. Second, I will introduce a proposed hydrocommons governance based upon the above CALFED analysis. This proposed hydrocommons governance could be a step towards resolving and governing water quality, wetlands, water supply problems associated with Colorado River transbasin diversions in California and Baja California.

The Post-NAFTA International Boundary and Water Commission

The International Boundary and Water Commission is an international organization which has its roots in the 1848 Treaty of Guadalupe Hidalgo. This treaty resulted in the creation of the International Boundary Commission in 1889. In 1944, the United States-Mexico Water Treaty renamed the International Boundary Commission to the International Boundary and Water Commission (IBWC). At present, the Commission's operational and governance mandate, as stated in the 1944 Treaty between U.S. and Mexico,[46] is the application of boundary and water treaties and settling differences that may arise in their application (IBWC

[46]This treaty detailed the apportionment of binational water resources along the U.S. and Mexico border. See above section on the Colorado River and water apportionment.

1999; Ybarra pers. com. 1999). The IBWC is composed of a United States Section (U.S.-IBWC) and a Mexican Section (Comisión Internacional de Limites y Aguas [CILA]). Each national section is headed by a Commissioner, who according to the Treaty, must be an engineer (Mumme 1993). The Commissioners meet at least on a weekly basis (IBWC 1999).

IBWC decisions are conducted through the minute process which result in numbered IBWC minutes. IBWC minutes are recommendations to both governments which detail the obligations of each government for a particular project. Ybarra (pers. com. 1999) cites three types of minutes or decisions which can be negotiated by the IBWC. The first type of minute decision is simply administration and implementation of the 1944 Treaty. These minutes detail responsibilities of each government in terms of implementation of the 1944 Treaty. The second type of minute supports the liaison-investigative functions of the IBWC (Mumme 1993). The liaison investigative minute delineates the framework for technical studies as delineated by the Treaty or as requested by both governments. This type of minute delineates the sharing of responsibilities and costs for both governments, and is the minute process designated for IBWC Minute 301. The third type of minute supports the judicial function of the IBWC, which entails settling of differences which arise from treaty applications (Mumme 1993; Ybarra pers. com. 1999).

Within the past decade, water resources scholars have become quite critical of IBWC's decisionmaking or minute process (see, for example, Ingram, Laney,

and Gillilan 1995; Mumme 1993). Most of the critique stems from the fact that in the past (before NAFTA, more specifically), IBWC provided little to no opportunities for public participation, and is reluctant to disclose information to the public. This political culture of confidentiality and secrecy in IBWC deliberations and information resources management stems from IBWC's interpretation of the 1944 Treaty which is silent on the issue of public participation (Mumme 1993). However, according to U.S.-IBWC representative Manual Bob Ybarra (pers. com. 1999), IBWC Minute 301 represents the "new post-NAFTA IBWC" devoted to: (1) more transparency in the decisionmaking process, (2) more consultation with local communities and U.S. Congressional representatives, and (3) a Minute process which reflects a bottom up approach. Mr. Ybarra stated to me that the Border Water Council submission of the MOU reflects IBWC's post-NAFTA commitment to the above three listed goals because now city and state representatives can directly contact the IBWC for minutes and technical guidance. In his eyes, the IBWC 301 minute process is bottom up because, it reflects the needs of local community within the Tijuana-San Diego metropolitan region.

Yet, if one looks closely at the political process and the players involved in the creation of IBWC Minute 301, one must ask specifically whose needs does the minute reflect or fulfill? In essence, who made the decision to propose IBWC Minute 301? Was the public involved in this decision making process, and if not why? As I have documented in Chapter Three and earlier sections of this chapter, the proposal for IBWC Minute 301 was initiated and created by the Border Water

Council. If the reader remembers from Chapter Four, nearly all meetings (except the first meeting) of the Border Water Council have been closed to the public. For the past twenty months only government water agency representatives have participated in the Border Water Council focus group meetings. The lead agency for the Border Water Council, the San Diego County Water Authority, representatives assert that keeping focus groups small (and thus limiting the scope of conflict) has allowed the focus groups to formulate recommendations without much delay. Public input will be asked once recommendations are made. In essence, no public input has been allowed in the Border Water Council hearings, and thus in the process to create IBWC Minute 301.

Since Minute 301 reflects the decisions and negotiations made in closed hearings of the Border Water Council and IBWC (all Minute hearings are closed to the public), then this minute reflects needs and interests of the Border Water Council and IBWC representatives. On the U.S. side, representation entails San Diego County Water Authority staff members, and to a limited sense California Department of Water Resources staff members (the two agencies which will provide financial resources for the study—2.5 million dollars). On the Mexican side, CESPT, CEA, and CNA staff members participated in Border Water Council focus group meetings. On both sides of the border, elected officials (at the state and federal level) have been briefed on the Minute proposal. The proposal has received mixed reviews from elected officials, or to restate, not all officials support the idea of a binational Colorado River aqueduct for the Tijuana-San Diego metropolitan

region. Hence, given Border Water Council's lack of public participation and limited scope of conflict, can one indeed assert that Minute 301 reflects "bottom up" decisionmaking as indicated by IBWC? Probably not.

Hence, is limiting the scope of conflict in the creation of Minute 301 a strategy utilized by San Diego and Tijuana representatives to assert their power over other water agencies and stakeholders who seek to use Colorado River water? One San Diego water official cited to me that the primary reason for Border Water Council's "closed focus group meetings" is that San Diego County Water Authority does not desire participation of other Colorado River water users, especially Metropolitan Water District. In essence, the perception is that MWD's participation would slow the Minute process down, or worse even prevent any progress on a binational aqueduct. Remember, if San Diego and Tijuana are not successful in obtaining the binational aqueduct then San Diego remains dependent upon MWD to transport IID water through MWD's Colorado River aqueduct. Indeed it seems that Border Water Council's limited scope of conflict mentality is one that may very well be rooted in the assertion of power over other Colorado River water users such as MWD. However, San Diego's strategy to limit the scope of conflict not only is rooted in power assertion, but it is a governance strategy rooted in place, or to be more specific place-as-locale (the areal and social setting which social relations are constituted).

Place-as-locale (which includes institutional history and culture) plays a significant role and supports the integration of place and institutions in explaining

water quality governance styles of organizations such as Border Water Council. If we examine Border Water Council and CALFED from the perspective of place-as-locale, we may ask the following question: Given that both these place-based approaches cover a significant amount of territory (in essence both are dealing with geographic ranges of transbasin diversions or a hydrocommons), why is it that governance strategies are so different (especially in terms of diversity of stakeholders and public participation)? The Border Water Council's and IBWC's governance in the creation of IBWC Minute 301 emulates traditional governance style supported by water agencies, which is to let the engineers and water board members formulate policy, and public comment occurs after policy is created. Representation of diverse interests is usually prevented because water agencies and local politicians control (or appoint) who gets to provide input in the decision making process. However, CALFED has chosen a different style, which encourages numerous stakeholders representing diverse water use/quality interests in the policy formulation procedure. CALFED's encouragement of diversity is in part explained by "place" because Bay-Delta environmental restoration is a central focus of the project. CALFED's diversity of representation has resulted in a broader range of choice analysis technical solutions, even governance strategies. The question now for CALFED (and for those who support implementing a CALFED on the border linking the Southern California/Baja California with the Colorado River) is can the many stakeholders involved in the decision making process obtain consensus? If I would ask a member supporting the current "small

and limited public input" status of the Border Water Council, the answer would be no.

But what if we decide to say yes to expand the scope of conflict for the binational aqueduct, or even to manage the hydrocommons and the consequent environmental problems caused by Colorado River transbasin diversions along the border between California and Baja California? As discussed above, CALFED negotiations, as problematic as they are, have fostered discussion within watershed based environmental groups in Southern California and Baja California to address environmental problems within the Colorado River hydrocommons, a hydrocommons which serves growing urban populations in Southern California and Baja California. Certain water resources scholars and groups would like to apply CALFED as a template to implement binational hydrocommons based governance for Colorado River hydrocommons problem regions such as the Río Colorado Delta and the Salton Sea (Anderson 1999; Cohen, Morrison, and Glenn 1999; Morrison, Postel, and Gleick 1996; Pontius 1996). In addition, as indicated by the above section on water quality problems in the Tijuana-San Diego metropolitan region, Border Water Council's negotiations to increase water imports and construct a binational aqueduct has resulted in a public discussion on the links between water imports, urban growth, and coastal water quality. Essentially, at the true end of the pipeline—the ocean outfalls which discharge municipal wastewater and the storm drain outlets which drain onto Southern California and Baja California

beaches—another problem, coastal water contamination, is emerging due in part to increased water transfers along the border of Baja California and California.

By way of conclusion, I suggest that along with a feasibility study of a binational aqueduct for the Tijuana-San Diego metropolitan region (IBWC Minute 301), IBWC could conduct a second feasibility study to initiate a hydrocommons based binational water council for the Californias border region. Such a feasibility study is within the jurisdiction of IBWC in that one function of the IBWC is to settle differences which arise from treaty applications. Investigation of and hopefully IBWC supervision of a binational hydrocommons council would be the first step to resolve water quality, Delta ecosystem, water supply differences which arise from Colorado River transbasin diversions, as delineated in the 1944 Treaty between the U.S. and Mexico.

As CALFED has done, the binational council would initially serve as a forum to examine and hopefully expand the range of choice of technical and governance solutions for the numerous water quality and supply problems caused by transbasin diversions along the California-Baja California border. In my proposed council, IBWC commissioners would supervise this council, and such supervision by IBWC would be advantageous for numerous reasons. First and foremost, IBWC has worked well for many years in diplomatic negotiations with Mexican water agencies and various public administrations. Second, unlike other border institutions (Border Environmental Cooperation Commission, Border XXI), IBWC has the technical and administrative expertise in managing binational water

resources, as indicated by Minute 294,[47] and the impetus to do regional water resources planning.

Besides technical planning, my proposed binational hydrocommons council, like CALFED, would be committed to extensive public participation, and conduct work groups on hydrocommons problem and solution definitions associated with increased Colorado River water transfers to the Tijuana-San Diego metropolitan region. As evidenced by the CALFED's watershed work groups and BDAC, expanded public participation by all stakeholders in hydrocommons governance has resulted in an expanded range of choice of technical and governance solutions. In addition, as BDAC does in CALFED, the binational council could review and comment upon appropriate IBWC Minute proposals *before they are negotiated and signed*. This commitment to public participation would support IBWC's post-NAFTA goals of increased transparency and community participation in binational water resources decision making. However, as cited by numerous authors and participants I interviewed for this research, IBWC has yet to increase public participation activities for its projects and Minute proceedings. There does exist a post-NAFTA binational organization which promotes and coordinates public participation for border environmental infrastructure projects, the Border Environmental Cooperation Commission or BECC. Since the creation of BECC, IBWC has worked successfully with BECC to increase public participation for border wastewater infrastructure projects. BECC's role on the proposed binational

[47]IBWC Minute 294 details development of regional plans to improve water quality and wastewater treatment. This planning process is supported by EPA funds (Ybarra pers. com. 1999).

council, as has been done in before in other projects, would be to coordinate public participation in the coordinating council and workgroups.

Given IBWC's technical and diplomatic expertise in border water resources management, and BECC's experience and commitment to public participation, a hydrocommons based binational council is a feasible governance alternative for resolution of the water supply, water quality, and ecosystem degradation problems caused by Colorado River transbasin diversions along the U.S.-Mexican border. The primary opposition to a binational hydrocommons council would be United States' Colorado River water users who at this point control Colorado River water allocations by keeping the scope of conflict limited to the water and government agencies. This assertion is supported by the closed hearing sessions for California's 4.4 Plan, and the closed negotiations in the Border Water Council and the IBWC Minute 301 process. It is unclear as to whether opposition for a hydrocommons binational council would exist in Mexico. Mexican water agency leaders do support integrated water and wastewater management and would support binational action restore the Colorado River Delta. A possible source of opposition could stem from Tijuana's political and business leaders who seek to divert more Colorado River water to Tijuana, Rosarito Beach, and Ensenada.

A hydrocommons based binational water council committed to open public participation would democratize water resources management for the Californias' border region, and possibly the Colorado River basin, and thus diffuse the concentration of power United States' Colorado River water users currently wield in

border water quality governance. In addition, hydrocommons governance would bring to the negotiating table numerous stakeholders in U.S. and Mexico with diverse interests, especially those interested in protecting water quality in the Gulf of California (the sending region) and coastal waters off the Tijuana-San Diego metropolitan region (the receiving region of the hydrocommons). Such an integration of water supply and water pollution management would be welcome by Mexican stakeholders and water resources agencies, but difficult to accept for U.S. water agencies such as the San Diego County Water Authority and San Diego's Metropolitan Wastewater Department. Again this difficulty is rooted in the U.S. institutional history of resource sector fragmentation, and reluctance to relinquish control or power to stakeholders in other resource sectors and nation-states.

Conclusion

The geography of water resources along the border between California and Baja California demonstrates a network of manmade aqueduct and storage facilities utilized for water transfers. This hydrocommons transports Colorado River for agricultural uses in the eastern part of the Californias border region, and ultimately west to urban centers on the Pacific Coast. As with other urban regions in Baja California and Southern California, the Tijuana-San Diego metropolitan region is dependent upon water imports for the region's rapidly growing industrial and residential needs. Both San Diego and Tijuana seek to increase Colorado River

water imports, and both cities are investigating the possibility of constructing a binational aqueduct to transport imported Colorado River water.

The hydrocommons which supplies water to the Tijuana-San Diego metropolitan region, along with other transbasin diversions within the Colorado River Basin, has resulted in greatly diminished fresh water flows entering the Río Colorado Delta. The diminished fresh water flows has desiccated wetlands in the Delta which threaten species migratory waterfowl which visit the Delta and the Salton Sea to breed and rest. In addition, marine species in the Upper Gulf of California (Gulf shrimp, vaquita, and totoaba) are endangered by diminished Colorado River flows.

However, transbasin diversions not only adversely impact sending regions such as the Delta, but receiving regions. In Tijuana-San Diego metropolitan region, a region which imports up to ninety percent of its water supply, water imports do contribute to increasing urban populations and urban consumption of land. This urban expansion results in more contaminants, and second an increase of paved surfaces. As with any urbanized region, polluted runoff flows pick up chemicals and germs and discharge concentrated amounts of bacterial and chemical pollutants into rivers and coastal waters. In both Tijuana and San Diego, polluted runoff is the primary public health risk for surfers and swimmers in the region's surface waters. Finally, for rapidly urbanizing regions, nonpoint source pollution is threatening local water drinking water quality resources. Certain water agencies such as Sweetwater Authority ask for integration of water resources and land use

planning. Other communities such as Lakeside chose to shut down local drinking water resources and import even more water. In times of global warming and increasing drought conditions, the latter strategy may not provide a cost-effective, reliable, and secure drinking water supply.

Given these environmental impacts in both sending and receiving regions of the hydrocommons supporting Southern California and Baja California, certain organizations are calling for hydrocommons governance along the border of the Californias. CALFED, a hydrocommons based water quality management program, is currently underway to address the water quality and wetland ecosystem degradation in Northern California's Bay-Delta estuary. The CALFED process has resulted in a restructuring of the scope of regional water resources governance. First CALFED's substantive scope integrates four general resource areas—ecosystem restoration, water quality, water supply reliability, and levee system integrity. This expanded substantive scope is significant because CALFED cites that problems in one resource sector may cause problems in other resource sectors. Subsequently, the range of choice of solutions is now expanded from one resource sector to four. In addition, even though the Bay-Delta estuary is defined as the problem region, CALFED's geographic scope is expanded beyond the Bay-Delta estuary watershed. Under CALFED the entire Bay-Delta hydrocommons, to include San Diego, is defined as the region in which solutions for the Bay-Delta estuary restoration may be found. Finally, CALFED has expanded the scope of conflict which has resulted in an extended public participation process, to include

open work groups which redefine Bay-Delta hydrocommons problems, and propose new solutions. The expanded substantive scope, geographic scope, and scope of conflict has resulted in an expansion of the range of choice of alternatives to not only improve water quality in the Bay-Delta estuary, but to govern CALFED. One innovative suggestion provided by urban watershed groups is that receiving regions must also be considered as problem regions, in that water imports do result in increased wastewater discharges and polluted runoff contaminating local rivers, estuaries, coastal waters, even local water supplies.

I conclude this chapter by proposing that along with the binational aqueduct feasibility study, IBWC should conduct a second feasibility study to initiate a hydrocommons based binational water council for the Californias border region. This binational council, as CALFED has done, would be committed to extensive public participation, and conduct work groups on hydrocommons problem and solution definitions associated with increased Colorado River water transfers to the Tijuana-San Diego metropolitan region. As evidenced by CALFED's watershed work groups and BDAC, expanded public participation by all stakeholders in hydrocommons governance could result in an expanded range of choice of technical and governance solutions for the numerous water quality and supply problems caused by transbasin diversions along the California-Baja California border. At present, in negotiations for Baja California's and California's Colorado River water allocations, including the proposed water transfers between agricultural interests and the Tijuana-San Diego metropolitan region, numerous watershed advocates and

stakeholders are excluded from Colorado River negotiations of water transfers and allocations. Hydrocommons governance committed to public participation could diffuse the power U.S. water agencies wield in Colorado River water allocations along the U.S.-Mexico border. Such a diffusion of power would allow for more participation by diverse stakeholder interests (especially those who protect ocean water quality in the sending and receiving region of the Colorado River hydrocommons) and possibly a more democratic process in water quality management along the U.S.-Mexico border.

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APPENDIX

INTERVIEW INTRODUCTION LETTERS, CONSENT FORMS, AND TEMPLATES (ENGLISH AND SPANISH)

INTRODUCTION LETTER

Dear Sir or Madam,

Thank you so much for taking some time out to assist me in my research on the water quality governance process within the Tijuana-San Diego metropolitan region. I believe the study will assist all participants in the water quality political process in better understanding the complex, and often confusing process of water quality governance.

Part of my research methodology entails interviewing governmental and non-governmental representatives involved in improving the region's water quality. You will participate in one interview which should last between 45-60 minutes. You may choose any site for your interview -- home, office, restaurant etc.. Please understand that your participation is voluntary, and you have the right to withdraw your consent or discontinue participation at any time.

I have enclosed an interviewee information form and a listing of my four place based case studies. These enclosures should answer most questions you may have about our interview. Once again many thanks, and if you have any questions, you may reach me by email at: smichel61@aol.com I look forward to our interview in the near future.

Sincerely,

Suzanne M. Michel

HUMAN SUBJECTS CONSENT FORM

Tijuana-San Diego Water Quality Governance Study
Interviewee Information Form

You are invited to participate in a study of water quality governance within the Tijuana-San Diego metropolitan region. The research is being conducted by Suzanne M. Michel, Doctorate Degree Candidate in the University of Colorado, Boulder Department of Geography, Boulder CO 80309-0260. Local phone: (619)534-6042. The project is under direction of Professor James Wescoat, Department of Geography, University of Colorado, Boulder, Campus Box 260, Boulder CO 80309-0260. Phone # (303) 492-4877. We believe the study will yield new insights concerning water quality governance and citizen participation. These insights will assist all participants involved in improving the region's water quality, and in better understanding the complex, often confusing process of water quality governance.

If you decide to participate, you will be asked to provide information about your participation concerning the region's water quality. You will participate in one interview which should last between 45-60 minutes, and you may be asked to participate in a follow up interview. The topics covered will be your own perception of the water quality, your opinions of current policies/programs concerning water quality within the region, and binational cooperation in water quality management. A benefit from your participation in this study is that you will have access to information concerning your organization's and other organization's participation in water quality politics. The information will be available upon completion of the dissertation, and includes a listing of organizations involved in water quality politics, and an analysis of different place -based approaches of water quality governance (point source vs. watershed approaches for example).

You may choose any site for your interview -- home, office, restaurant etc. Please understand that your participation is voluntary, and you have the right to withdraw your consent or discontinue participation at any time. You have the right to refuse to answer any question(s) for any reason.

One risk concerning your participation could be an untimely release of information. However, we are taking the following precautions to prevent any release of information. All your responses will be kept confidential. Your identity, organizational affiliation will be kept confidential. No information will be shared with other individuals and organizations until completion of the dissertation. Your interview will be identified by code number and the data (including tape recordings) will be available only to the myself and my faculty advisor, Dr. James Wescoat. If anecdotal data is recorded, all identifying material will be modified to maintain confidentiality. All interview tapes and files will remain locked and secure in my home in Santee, California, USA. Upon request, I will destroy interview tapes and files associated with your interview, five years after completion of the study.

If you have any questions regarding your rights as a subject, any concerns regarding this project or any dissatisfaction with any aspect of this study, you may report them -- confidentially if you wish --- to the Executive Secretary, Human Research Committee, Graduate School, Campus Box 26, Regent 308, University of Colorado, Boulder, Boulder CO 80309-0026, USA or by telephone: (303) 492-7401. Copies of the University of Colorado Assurance of Compliance to the federal government regarding human subject research are available upon request from the Graduate School address listed above.

_____
Signature of the Investigator

INTERVIEW TEMPLATE

Water Quality Governance in the Tijuana-San Diego Metropolitan Region
In-depth Interview Questions

Permission to use tape recorder? Y N

General Organization Questions

1. Name (optional): _____

2. Name of your organization and mission statement?

_____

_____

_____

_____

3. Where is your organization headquarters? How many members?

_____

_____

4. How long has your group been active in the Tijuana-San Diego metropolitan region? Are you active with any of the four water quality case studies?

_____

_____

5. Have you conducted any studies or published reports concerning pollution, water quality and/or public health in this region? If so what is the title, and may we obtain a copy of this report(s)?

_____

_____

Place and Water Quality

1. In your own words describe the water pollution or water quality problem in the region.

_____

_____

_____

_____

2. Explain your role of participation in the four projects(s). Please tell me why you participate in this project.

_____

_____

_____

3. Can you give me the advantages and disadvantages of your geographical focus?

_____

_____

_____

4. When applicable ask the informant's opinions of the other case studies (i.e. advantages/disadvantages)?

_____

_____

_____

Justice and Water Quality:

1. Have you heard of the term environmental justice? In your own words define environmental justice?

_____

_____

2. Do you consider yourself participating in environmental justice activism. Why/why not?

_____

_____

Water Quality Governance and the Politics of Scale

1. Which country do you conduct activism (US and/or Mexico), and with which organizations?

_____

_____

2. Comment on the responsiveness and/or effectiveness of the following government agency levels in fulfilling your goals -- federal, state, municipality, border (IBWC, BECC etc.). Which specific government agency do you feel best listens and responds to your needs? Why? When applicable ask for responses of agencies in both countries.

_____

_____

3. Have you filed any complaints with a governmental agency? With which agency, and resultant actions taken by the government?

_____

_____

4. Who do you think are the most powerful governmental agencies/organization in water quality politics, and why do you perceive these organizations as powerful?

_____

_____

_____

5. Are the proceedings in your project open to the public. Which proceedings. Why or why not?

_____

_____

_____

6. Do you believe there should be more or less stakeholders in the project. Why or why not?

7. How would you improve public participation?

8. Provide and ideal governance structure and/or decisionmaking process to solve the region's water quality problems. Focus on type of governance structure, what type of actions/decisions this structure would do, decisionmaking procedures, public input, geographic focus.

Statement of Qualification of Ph.D. Advisor for Suzanne Michel

CURRICULUM VITAE January 1, 2002

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M.A. The University of Chicago -- Geography (1979). "Naturalistic Plantings in the Cultural Landscape."

B.L.A. Louisiana State University – Landscape Architecture (1976).

Positions: The University of Colorado, Professor of Geography, 2000-present; Associate Professor, 1993-2000; Assistant Professor, 1989-93. Associate Chair of Geography and Director of Graduate Studies, 1999-present. Member, Institute of Behavioral Science, Environment and Behavior Program, 1993-present. Faculty Associate, College of Architecture and Planning, 2000-present. Advisory Board Natural Hazards Research Application and Information Center, 1992-present. Faculty Associate, Peace and Conflict Studies program and INVST service-learning program.

The University of Chicago, Assistant Professor of Geography; Member of the Committee on Southern Asian Studies; The Center for Middle Eastern Studies; and the Committee on Public Policy Studies. 9/1983-8/1989.

PUBLICATIONS. Organized under two headings— *Water Resources;* and *Landscape Research (Indo-Islamic).* All single-authored except as noted.

1. Water Resources

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"The Scale(s) of Dynastic Representation: Monumental Tomb-Gardens in Mughal Lahore," *ECUMENE: Journal of Environment, Culture, and Meaning* 1 (1994) 324-48.

"L'acqua nei giardini islamici: religione, rappresentazione e realta" [Water in Islamic Gardens: Religion, Representation, and Reality]. In *Il Giardino Islamico: Architettura, natura, paesaggio.* Ed. A. Petruccioli. Milan: Electa, 1994, pp. 109-126.

"Toward a Map of Mughal Lahore: A Survey of Cartographic Sources from 1590 to 1990." *Environmental Design: Journal of the Islamic Environmental Design Research Centre* (1993 [publ. 1995]): 186-93.

"Ritual Movement and Territoriality: A Study of Landscape Transformation during the Reign of Humayun." *Environmental Design: Journal of the Islamic Environmental Region Research Centre* (1993): 56-63.

"The Shahdara Gardens of Lahore: Site Documentation and Spatial Analysis." *Pakistan Archaeology* 25 (1993): 333-66 (with M. Brand and N. Mir).

"Gardens vs. Citadels: The Territorial Context of Early Mughal Gardens, *Garden History: Issues, Approaches, Methods*, pp. 331-58. Ed. J.D. Hunt. Washington, D.C.: Dumbarton Oaks, 1992.

"Gardens of Conquest and Transformation: Lessons from the Earliest Mughal Gardens in India." *Landscape Journal* 10:2 (1991): 105-14.

James L. Wescoat Jr., Michael Brand and M. Naeem Mir, "Gardens, Roads, and Legendary Tunnels: The Underground Memory of Mughal Lahore," *Journal of Historical Geography* 17,1 (1991): 1-17.

"Gardens of Invention and Exile: The Precarious Context of Mughal Garden Design During the Reign of Humayun (1530-1556)," *Journal of Garden History* 10: 106-116, 1990.

"Picturing an Early Mughal Garden," *Asian Art* 2 (1989): 59-79.

"The Islamic Garden: Issues for Landscape Research", *Environmental Design: Journal of the Islamic Environmental Design Research Centre*. Rome (1986): 10-19.

"Early Water Systems in Mughal India", *Environmental Design: Journal of the Islamic Environmental Design Research Centre*, special issue on water in Islamic architecture and design, vol.2, 1985.

Technical Reports:

"Water and Sanitation." Report to the United Nations Commission for Human Settlements (UNCHS). June 2000. Adapted as chapter 10 in *Cities In A Globalizing World: Global Report On Human Settlements 2001*. London: Earthscan, 2001.

James L. Wescoat Jr. and Sarah Halvorson. "Ex Post Evaluation of Dams and Related Water Projects: Patterns, Problems and Promise." Report to the World Commission on Dams, South Africa. May 2000. Findings and recommendations incorporated in *Dams and Development: A New Framework for Decision-Making*. London: Earthscan, 2000.

Dennis Mileti (and 100+ contributing authors). *Disaster by Design*. Assessment of Research and Applications on Natural Hazards. Washington: Joseph Henry Press. Brief contribution on international and comparative hazards research.

"South Asia Development Triangle Initiative -- Transboundary Water Issues Paper," by J.L. Wescoat Jr. and H.C. Pereira, 1997 for the FAO Investment Centre and World Bank. 100 pp.

W.E. Riebsame with James Wescoat and Peter Morrisette. 1997. "Western Land Use Trends and Policy: Implications for Water Resources." Report to the Western Water Policy Review Advisory Commission. Denver, CO.

Marilee Long, Mark Kumler, Sharon Gabel, James L. Wescoat Jr., and Greg Luft, "People and Water: An Information Challenge," Colorado Water Resources Research Institute Task Force Report, 1996. Publication no. 6. Fort Collins: Colorado Water

Resources Research Institute.

James L. Wescoat Jr., Gary Fleener, and Betsy Forrest, "Historical and Geographical Conditions in the Upper Mississippi River Basin," *Studies on Natural and Human Factors Related to Flood Management in the Upper Mississippi River Basin*. Report for the Scientific Assessment and Strategy Team, 1994.

James L. Wescoat Jr. and Jeffrey W. Jacobs. "Flood Hazards in Asia." *Natural Hazards Working Paper*. Boulder: Natural Hazards Center, July 1993.

James L. Wescoat Jr. and Robin M. Leichenko. "Complex River Basin Management in a Changing Global Climate: Indus River Basin Case Study in Pakistan, A National Modelling Assessment. *Collaborative Paper*, no. 5. Boulder: CADSWES, Center for Advanced Decision Support for Water and Environmental Systems. June 1992.

Encyclopedia Articles, Brief Publications, Reviews, and Electronic Publications:

Review of *Places Where Men Pray Together: Cities in Islamic Lands, Seventh through the Tenth Centuries* by Paul Wheatley, University of Chicago Press. For *Historical Geography* (2003).

The Mughal Gardens Website. http://www.mughalgardens.org. Principal researcher and writer. Site produced by Smithsonian Productions and designed by 9th Insight, Inc.

Articles commissioned on "Islamic Environmental Ethics," and "Islamic Gardens and Landscape Design" for the on-line *Encyclopedia of Religion and Nature*, forthcoming 2002.

"Environmental Geography: History and Prospect," commentary on essay by B.L. Turner II in the *Annals of the Association of American Geographers* (in press, March 2002).

James L. Wescoat Jr., Richa Nagar and David Faust. "Social and Cultural Geography", for *Indian Encyclopedia of Sociology and Social Anthropology.* New Delhi: Oxford University Press, forthcoming 2002. 65pp.

"Water Resources." *International Encyclopedia of the Social and Behavioral Sciences.* London: Elsevier, forthcoming, 2001.

"Review Essay: *Mississippi Floods: Designing a Shifting Landscape,*" by Anuradha Mathur and Dilip da Cunha, Yale University Press. For *Studies in the History of Gardens and Designed Landscapes* (in press, 2001, pp. 1-5).

"Landscape Heritage Conservation in Agra: An Historical-Geographic Perspective"; and

"Landscape Heritage Conservation Timeline For Agra." In *Taj Mahal Heritage Conservation Plan.* Ed. Amita Sinha, et al. Lucknow and Urbana: University of Illinois, Department of Landscape Architecture, and Uttar Pradesh Tourism Department, 2000, pp. 4-9.

"West by Midwest: Comments on "Comments on `Growth Management And Water Resource planning' By A. Dan Tarlock." In proceedings of *Improved Decision-Making for Water Resources: The Key to Sustainable Development for Metropolitan Regions,* 10pp. Chicago: Great Cities Institute, University of Illinois at Chicago, 1999 (final publication planned for 2002).

"History, Theory, and Graduate Education: A Vitruvian Challenge," *Progress in Human Geography,* Viewpoint, 24,1 (2000): 19-21.

"Water, Urbanism, and Landscape Design in Rome," *Design Quarterly,* special issue on Rome (forthcoming).

Review of *Mapping an Empire: the Geographical Construction of British India, 1765-1843,* by Matthew H. Edney. *Historical Geography,* 27 (1999): 251-4.

Commentary on *Environmentalism,* by Timothy O'Riordan, in *Progress in Human Geography,* series on "Classics in human geography revisited," 23:4 (1999): 610-11.

Review of *The Environment and Christian Ethics* by Michael Northcott (Cambridge University Press) for *Quarterly Review of Biology* (1998).

Editorial consultant on the Pakistan entries for the new *Columbia Gazetteer of the World.* Ed. Saul Cohen. 3 vols. New York: Columbia University Press, 1998.

"Obtaining Environmental Information On-Line," *Environmental Impact Guidelines,* no. 2. Rome: FAO Investment Centre, 1997. http://www.fao.org/waicent/faoinfo/tcd/tci/resource.htm.

Review of *History of Islamic Philosophy* by S.N. Nasr and O. Lehman, 2 vols., Routledge Press. For *Canadian Philosophical Reviews,* 1996.

Review of *Boundaries and Frontiers in Medieval Muslim Geography* by R.W. Brauer, Philadelphia, American Philosophical Society, 1995; and *The Rise of Islam and the Bengal Frontier, 1204-1706,* Berkeley, University of California Press, 1993. For *Historical Geography,* 1997.

Review of *L'homme et secheresse* by Monique Mainguet, Paris, Masson geographie, 1995 For *Environment* (1996).

Review of *Slide Mountain, The Folly of Owning Nature* by Theodore Steinberg, Berkeley, University of California Press, 1995, for *Common Knowledge* (forthcoming 1996).

"Lahore" entry, *The Dictionary of Art*, Macmillan Publishers (1995).

"Varieties of Geographic Comparison in *The Earth Transformed*," review forum in *Annals of the Association of American Geographers* 84:4 (1994).

Review of *Water in Crisis*, ed. Peter H. Gleick, Oxford University Press. For *Environment* (May 1994).

"Climate Change and International Water Problems: Issues Related to the Formation and Transformation of Regional Organizations," in *The Role of Regional Organizations in the Context of Climate Change*. NATO Advanced Research Workshop proceedings. Ed. M. Glantz. Dordrecht: Kluwer Academic Publishers, 1994, pp. 96-103.

Review of *A Historical Atlas of South Asia*, by J. Schwartzberg, Oxford University Press. For the *Annals of the Association of American Geographers* (1993).

Review of *Vision or Villainy: Origins of the Owen's Valley-Los Angeles Water Controversy*, Abraham Hoffman, Texas A&M Press, 1991. For *Environment and Planning A* (1993): 149-50.

Review of *Wagering the Land: Ritual, Capital, and Environmental Degradation in the Cordillera of Northern Luzon, 1900-1986*, by Martin W. Lewis, University of California Press, 1992. For *The Professional Geographer* 45 (1992): 116.

Review of *Integrated Water Management*, ed. Bruce Mitchell, Bellhaven Press, 1990. For *Global Environmental Change: Human and Policy Dimensions* (March 1992).

"The [Bangladesh] Flood Action Plan: A New Initiative Confronted by Basic Questions." *Natural Hazards Observer* 16:4 (1992): 1-2. Reprinted in NHRAIC Working Paper no. 77 (1992). Reprinted in *Natural Hazards* (1992).

"Climate Warming in Developing Countries: Issues and approaches in the Indus River Basin of Pakistan," in *Proceedings: American Society of Landscape Architects, Landscape/Land Use Planning*. Kansas City: ASLA, 1991, pp. 105-13.

Article on "The Colorado River," *Encyclopedia Britannica*; revision of article by M. John Loeffler (1994).

Grants, Honors, and Projects:

Advisor on the conservation of gardens and waterworks of the Taj Mahal, for the Archaeological Survey of India and Taj Mahal Conservation Collaborative, 2001-.

Organization of Islamic Capitals and Cities (OICC). Second prize for *Mughal Gardens in Lahore: History and Documentation* by M. Naeem Mir, M. Hussain, and James L. Wescoat Jr. Cairo, Egypt. February 2001.

National Science Foundation, Geography and Regional Science Program. Principal investigator. "Water, Poverty and Sustainable Livelihoods in Colorado." $210,681. Co-investigators include Anthony Bebbington, Charles Howe, and John Wiener. 1999-2002.

Uttar Pradesh Department of Tourism and Consulate of India. Advisor for Taj Mahal National Park Master Planning team, led by V. Bellafiore and Amita Sinha, University of Illinois, Department of Landscape Architecture, 1999-2000.

Smithsonian Institution, Foreign Currency, Travel Grant. "Mehtab Bagh Project." June1998 and October 1999. Responsible for field research on garden waterworks at a site opposite the Taj Mahal in Agra, India. In collaboration with the Archaeological Survey of India. Elizabeth Moynihan, Principal Investigator.

NOAA, Office of Global Programs, Integrated Regional Water Assessment in the Interior West. Seed grant for research on effects of climate variability on acute water problems faced by low-income social groups, $10,000, 1999-2000.

Chair, National Research Council Committee to Review the Grand Canyon Monitoring and Research Program, Water Science and Technology Board, 1998-2001. Project described in *The National Academies News Report* 49:2 (1999): 11-12.

American Society of Landscape Architects, Research Merit Award, 1998, for "The Mughal Gardens Project."

Government of Pakistan, First prize national book award in 1998, for Mahmood Hussain, Abdul Rehman and James L. Wescoat Jr., *The Mughal Garden: Interpretations, Conservation, Implications.* Lahore: Ferozsons Ltd., 1996.

American Academy in Rome. Rome Prize Fellowship in Landscape Architecture, 1996-1997 to study "The Uses of Water in Metropolitan Landscape Design" and "The Landscapes of Roman Water Law."

Dumbarton Oaks, Board of Senior Fellows, Studies in Landscape Architecture, 1995-2001.

Allama Iqbal Award (first prize). Government of Punjab, for books published in 1993 on Punjab. 30,000 Rs., for Abdul Rehman and James L. Wescoat Jr., *Pivot of the Punjab: The Historical Geography of Medieval Gujrat*. Lahore: Dost Publications, 1993.

University of Colorado, Global Change Research Program, "Water Resource Management and Design at the University of Colorado." To organize a collaborative program among the colleges of arts and sciences, engineering, and environmental design. 1994-95. $8,500.

National Research Council, Water Science and Technology Board. Committee on "The Future of Irrigation in the Face of Competing Demands," 1993-1995.

Allama Muhammad Iqbal Award (first prize). Government of Punjab, for books published in 1991 on Punjab. 30,000 Rs. Sajjad Kausar, Michael Brand, and James L. Wescoat Jr. *Shalamar Garden*. Karachi: Pakistan Department of Archaeology, 1991.

University of Colorado, Natural Hazards Center, "Evolution of International Flood Hazards Programs in Asia, 1900-1992." $4,000.

U.S. Environmental Protection Agency. "Complex River Basin Management in a Changing Global Climate: Indus Basin, Pakistan." Coordinated international case study of potential impacts and adjustments involving 23 Pakistani scientists, engineers and planners, 1989-1992, in conjunction with the Pakistan Water and Power Development Authority. W.E. Riebsame, Principal Investigator. In country case study budget of approx. $50,000.

Smithsonian Institution, Foreign Currency Program, Travel grant for research in India and Pakistan. "Garden, City and Empire: The Historical Geography of Mughal Lahore." September 1987-1992. $289,000 in Pakistani rupees. Multi-disciplinary research project with the Pakistan Department of Archaeology; Department of Architecture, University of Engineering and Technology in Lahore, and Arthur M. Sackler Gallery in Washington, DC. Supervised field research, site documentation, and mapping (Principal Investigator).

Colorado Endowment for the Humanities. Small grant. "Colorado Water: The Next 100 Years." Technical Advisor and speaker. 1989-91 (Barbara Preskorn, Principal Investigator).

Rockefeller Residency Fellowship in the Humanities, Center for Asian Art, Smithsonian Institution. Research project: "In Gardens Watered by Running Streams:' The Meanings of Water in Mughal Gardens at Agra," 1986 and 1987.

Dumbarton Oaks Fellowship in the History of Landscape Architecture. Research project:

"From Bagh-i-Gul Afshan to the Gardens of the Taj: The Evolution of a River Garden Landscape in Mughal India," summer 1985.

National Science Foundation Graduate Fellowship in Geography, 1979-82.

University of Chicago Graduate Fellowship, 1978-9.

American Society of Landscape Architects, Award for Academic Achievement, 1976.

Teaching and Advising:

Graduate Courses:

History and Theory of Geography
Comparative Environmental Studies
Water Resources
Landscape Research
Kashmir Reading and Research Seminar
Environmental Policy: Policy Responses to Global Change
Environmental Geography Seminar

Undergraduate Courses:

World Water Problems
Water Resources in the Western U.S.
Urban Water Conservation
Kashmir Reading and Research Seminar

Graduate Students Supervised and Their Fields (*=completed):

***Ph.D. Advisor* (chronological)**

Mary McNally (Chicago): Native American water rights* ; Associate Professor, Eastern Montana State University.

Random DuBois (Chicago): Water management in the Philippines*; Senior Environmental Officer, U.N. Food and Agriculture Organization Investment Centre, Rome.

Jeffrey Jacobs (Colorado): Water management in the Mekong*; Senior Staff Officer, Water Science and Technology Board, National Research Council.

Kate Berry (Colorado): Native American water rights*; Associate Professor of Geography, University of Nevada-Reno.

Susan Edwards Baird (Colorado): Landscape history and design in Denver*; Senior Landscape Architect, Denver Parks Department.

Jon Mitchell (Colorado): Water Management in Pakistan*; General Manager, Aga Khan Education Service-Pakistan.

Dan Bedford (Colorado): Water Management in Central Asia*; Assistant Professor of

Geography, Middlebury College.
Danish Mustafa (Colorado): Irrigation and Flood Hazards in Pakistan*; Assistant Professor, University of South Florida.
Hanna Gosnell (Colorado): Endangered Species Act Implementation in the San Juan River Basin*; post-doctoral researcher, CU Center for the American West.
Sarah Halvorson (Colorado): Water and Health in Pakistan*; Assistant Professor, University of Montana.
Suzanne Michel (Colorado): U.S.-Mexico Water Management in the Tijuana Basin*; Post-doctoral researcher, San Diego State University.
Lisa Headington (Colorado): Urban Riverfront Parks and Social Change in Denver.
Paul Lander (Colorado): The Aesthetics of Urban Water Conservation
Andrea Ray (Colorado): Climate and Water Management in Colorado

M.A. Advisor
Elizabeth Brooks: Water management in the Great Plains*
George Clark: International water treaties in South Asia and the Middle East*
Whitney Seymour: Urban water management in Chicago*
Robin Leichenko: Urban water management in Karachi*
Sharon Gabel: Water management in the San Luis Valley*
Courtney Hauge: International water management in the Nile*
Laurel Phoenix: Water Management in Colorado*
Sarah Halvorson: Women and Water in Northern Pakistan*
Tamara Laninga: Watershed Management in the Western U.S.*
Meredith Knauf: Mountain Water Resources and Recreation.

University Service:

University of Colorado, 1989-
Associate Chair and Director of Graduate Studies, 1999-
Summer Chair, Department of Geography, 1999-
Chair, Personnel Promotion and Tenure Committees, 2000-1
Graduate Studies Committee, 1989-91; 1992-93; 1998-99.
Undergraduate Studies Committee Chair 1993-94; 1995-96.
Personnel Committee, 1990-92; 1997-98. Reappointment committee chair.
University of Colorado Faculty Retention Task Force, 1999-2000.
Internal Review Committee for Anthropology, 1998.
Natural Hazards Center Advisory Committee, 1992-
Natural Hazards Director Search Committee, 1992-3
Environmental Conservation Committee, 1992-3
Boulder Faculty Assembly Representative, 1993-6
Geography representative, Environmental Policy Certificate Program, 1993-
Global Change and Environmental Quality, Grant review committee, 1995.
University of Colorado representative for the Boulder Childrens' Water Festival,

for 500+ fifth grade students: 1993, 1994, 1995.

University of Chicago, 1984-1988; Graduate Student Advisor; Admissions Committee

Professional Service:

U.S. Bureau of Reclamation, Research Steering Committee, 2001, 2002.

Proposal and Manuscript Reviews: **1992:** National Geographic Society, National Science Foundation (2), *Human Ecology*, *Irrigation and Drainage Systems*, Edward Arnold, and The University of Chicago Press, *Annals of the Association of American Geographers* (2); **1993**: *Annals of the Association of American Geographers* (1), *ECUMENE* (3), National Science Foundation (1), *Society and Space* (2), UK Economic and Social Research Council (1); *Economic Geography* (1); *Global Environmental Change* (1). **1994:** American Water Resources Association, Symposium Paper review (1); *Economic Geography* (1); National Science Foundation (1). *ECUMENE* (1); *Political Geography* (1); Software review [CYBERNET] for Haested Methods (1). **1995**: National Science Foundation (1); *Landscape Journal* (1); *Annals AAG* (1); *Professional Geographer* (1); Edward Arnold (1); *ECUMENE* (1); *Political Geography* (1). **1996:** *Philosophy and Geography* (1); *ECUMENE* (1); SSRC South Asia Predissertation Fellowship Panel. **1997:** Oxford University Press (2 mss.); **1998:** *Political Geography; ECUMENE.* **1999:** *ECUMENE*; British Archaeological Reports; *Journal of Historical Geography*; **2000:** Rosenberg International Forum; *Environmental Hazards* (1); National Research Council (1); **2001**: National Research Council (1); NCSA papers for Istanbul conference (3); *Society and Space* (1); *Philosophy and Geography* (1); *ECUMENE* (1); *Environment and Planning A* (1).

External Promotion, Tenure, and Distinguished Professorship Recommendations: **1993** (2); **1994** (3); **1996** (1); **1997** (1); **1998** (1); **1999** (1); **2000** (1); **2001** (2).

University Council on Water Resources, Board Member, 1997-98.

Editorial Boards:

Philosophy and Geography (new journal 1995-); *ECUMENE: Environment, Culture and Meaning* (1992-); *Environmental Hazards* (1998-); *Irrigation and Drainage Systems* (1986-9). *Environmental Design: Journal of the Islamic Environmental Design Research Centre* (1990-present); *Progress in Human Geography* (1998-2000).

Project Experience:

GARDEN DESIGN:

Memorial Sculpture Garden, Boulder Police Department, Design Competition, 2000. Designed with Florrie and Ruth Wescoat. Built and dedicated May 2001.

Residential landscape design in Boulder with Florrie Wescoat; two projects in 1995; four projects in 1996; two projects in 1997; two projects in 1998; two projects in 1999; four projects in 2000; and two projects in 2001.

Robie House Committee, The University of Chicago, 1985-6. Planting design for the entry to Frank Lloyd Wright's Robie House.

ENVIRONMENTAL PLANNING AND LANDSCAPE DESIGN:

World Commission on Dams, South Africa. Preparation of a report on ex-post evaluation of large dams and related water projects using internet search methods. 1999.

U.N. Food and Agriculture Organization, Investment Centre Division, Rome. 1996-7. 1) Workshop on "Incorporating environmental considerations in project evaluation," 2) Preparation of guide to "Obtaining environmental information on-line" (June 1997); and 3) Preparation of a report on "Transboundary water issues in the Ganges-Brahmaputra river basin."

Design Workshop, Inc., Denver, CO, 1992-5. Landscape Architects and Planners. Occasional short-term design review

World Bank, Environment Department 1991-2. Integrating Global Biodiversity and Cultural Heritage Conservation in Asia. World Bank, Urban Infrastructure. 1990. Integrating urban shelter planning with cultural heritage conservation in Pakistan.

ISPAN (Irrigation Support Program for Asia and the Near East), 1991. USAID Regional Water Sector Strategy for Asia and the Near East--Strategy paper.

SHEAFFER & ROLAND, INC., Chicago, IL; Landscape Architect/Environmental Planner, 1980-3. Consultant on an integrated land and water use site plan for a new town near Colorado Springs.

Project landscape architect on a watershed recreation project in Crystal Lake, IL.Conceptual design of recreation facilities in coordination with surface drainage and groundwater recharge processes.

Project landscape architect for the "Garden Housing" project in Idlewild, Michigan. Responsible for siting 23 low-income rural rental housing units, roads, and services. Grading, drainage, planting, and handicapped access plans for earth-bermed housing.

Landscape architect on a project to upgrade the visual and functional character of a sanitary landfill project on Nantucket Island, MA. Responsible for phased design of landfill grading, drainage, and revegetation.

Landscape architect for a wastewater reuse operations building in Vineland, NJ. Planting design for the operations building with plants native to the Pine Barrens.

DELEUW, CATHER & CO., Chicago, IL; Landscape Architect/Environmental Planner, 1978-80.

Landscape architect for the preliminary design of Interstate 70 through Glenwood Canyon, Colorado. Responsible for the development of landscape design plans for revegetation, riverbank restoration, slope treatment, and a thirteen mile continuous creation trail. Co-direction a Canyon revegetation program that included vegetation sampling and analysis, preparation of a revegetation design report, design of a test plot program, working drawings, and cost estimates.

Landscape architect for desert highway design in Kuwait and Abu Dhabi. Responsible for final planting design on the Transportation Center approach roads, Riyadh interchange, and Shaab gate Plaza. Preliminary and final design of five highway interchanges in Abu Dhabi with desert species and coordination with trickle irrigation engineers.

COASTAL ENVIRONMENTS, INC., Baton Rouge, LA; Landscape Architect/Environmental Planner, 1976-78.

Project manager for a handbook on environmental impact and constraints related to coastal development in Louisiana; for the Louisiana State Planning Office. Principal author of a handbook for local governments on coastal zone management. Landscape planner for studies of wetlands management in St. Bernard Parish and sedimentation processes in Atchafalaya Bay, Louisiana.

Professional Memberships:

American Society of Landscape Architects
American Society for Aesthetics
American Water Resources Association
Association of American Geographers

American Institute for Pakistan Studies,
American Water Works Association
International Water Resources Association
Water Environment Federation

Professional License: Landscape Architect (CLARB)--Louisiana, no. 223 (inactive)

Foreign Field Research:

South Asia:

India. Taj Mahal landscape conservation project. September 2001.
Smithsonian Foreign Currency Program, Mehtab Bagh Project, Agra, October 1999 and June 1998;
Mughal Gardens Project, September 1987;
Williams College semester in India Program, August 1971-January 1972.

Pakistan. Smithsonian Institution and U.S.E.P.A. projects. 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995.

Bangladesh. Sponsored by Royal Tropical Institute (Neth.). August 1995.

Sri Lanka. American Field Service (AFS) scholarship to Sri Lanka, 1969.

Central Asia:

Turkmenistan. US-USSR Bilateral Environmental Research Program (NCAR). Colorado-Amu Darya Research Project, Ashkabad to Nukus, 1992.

Uzbekistan. Social Science Research Council Aral Sea Conference, Tashkent to Samarqand and Bukhara, May 1998.

Mediterranean:

Italy. American Academy in Rome. 1996-97.

Spain, Morocco, and Turkey. Islamic gardens and waterworks. Summer 2001.

Lectures (1984-2001):

American Academy in Rome
American Society of Landscape Architects
Carnegie Mellon University, SUPA
Clark University
College Art Association
Colorado Water Workshop, Gunnison, CO
Columbia University
Duke University
Dumbarton Oaks

Harvard University, Graduate School of Design
Illinois Institute of Technology, Architecture
Johns Hopkins University
Louisiana State University
National College of Arts -- Lahore
Northwestern University
Oklahoma State University
Rutgers University
Smithsonian Institution
Syracuse University
UCLA--School of Architecture and Planning
UCLA, Department of Geography
U.N. Food and Agriculture Organization
University of California--Berkeley
University of Chicago
University of Colorado -- Denver
University of Colorado Art Gallery.
University of Engineering and Technology--Architecture -- Lahore
University of Idaho
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Iowa
University of Minnesota
University of Oklahoma
University of Pennsylvania
University of Tennessee
Williams College