Chapter 10
Institutions Affecting the Urban Water Environment

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10.1 Introduction

The complexity of the legal framework discussed in Chapter 9 is mirrored by an equally intricate mosaic of legal and political institutions that govern, manage, and otherwise affect the urban water environment. Those include legislative bodies that pass the statutes, ordinances, and other enactments that affect urban water use and management; courts that interpret and enforce those legal rules and obligations; administrative agencies that implement and often further interpret applicable legislation; and governmental, quasi-governmental, and private entities that provide water and related services to end users of water and other beneficiaries of aquatic resources. As is true for the relevant sources of law, institutions affecting urban water resources operate at the local, state, regional, federal, and sometimes international levels. Water institutions can also consist of collaborative mixtures of organizations of various kinds and at various levels of government, working together to address problems of mutual interest, as well as a wide range of private entities not specifically discussed in this chapter.

Although it is not possible to identify every kind of legal and political institution affecting the urban water environment in a single chapter, this chapter will survey the most common and most significant institutions within each of the above categories. It also comments on the manner in which the sheer number and fragmentation of those institutions, and their frequently overlapping or even inconsistent jurisdictions and principles and methods of governance, can impede efforts to promote more sustainable and efficient uses of water in urban areas.

As was true for the legal regime, discussion of the wide array of institutions affecting urban water could be organized in several ways. For some purposes, it is useful to distinguish between institutions that serve largely regulatory functions and those that provide more direct customer services, such as water supply and sewerage. Institutions serving largely regulatory functions operate at all levels of government (local, state, regional, national, and international). Institutions with

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largely service functions more typically operate at the local level. However, as with any organizational structure for complex and variable systems, this distinction between regulatory and service functions can be misleading and overly simplistic, because some entities serve both types of functions, and some kinds of functions are difficult to label one way or the other. Water institutions also serve all four of the major functions discussed in Chapter 9, that is, water supply, water treatment and distribution, wastewater and drainage (or storm water) management and treatment, and recreational and environmental services and amenities.

Because institutions often function and can best be understood in terms of their sources of authority and constituent bases, then, for purposes of this chapter it makes most sense to describe water institutions by level of government. The ensuing sections, therefore, discuss the various kinds of institutions affecting the urban water environment at the federal, state and local, and regional and international levels (including, to some degree, multi-agency and multi-interest watershed or basin management institutions, although those kinds of efforts are also addressed in Chapters 11 and 12).

10.2 Federal Institutions and Agencies

The federal government exercises pervasive but often indirect authority and other influence over urban water issues. In some cases that entails federal regulation of water supply and management issues, to protect public health and safety, environmental integrity, and other values that Congress has deemed to implicate sufficiently important national interests to justify federal intervention. In other cases, the federal government influences urban water issues and environments more through capital investments and related physical infrastructure, and any accompanying conditions of those expenditures and services. Although virtually every federal agency or other institution can affect the urban water environment in one way or another, and one source identified 37 agencies concerned with water issues in some way (Fiero, 2007), and other sources organize federal and other water agency responsibilities in different ways (Cech, 2003; Sax et al., 2000), the following discussion tries to identify and describe briefly federal agencies that address water issues as one or more of their *primary* missions.

10.2.1 Environmental Protection Agency (U.S. Environmental Protection Agency Website)

The U.S. Environmental Protection Agency (EPA) administers and enforces most of the major federal environmental pollution statutes.[1] The most important of

[1]Many federal environmental laws, including those implemented by agencies other than EPA, involve environmental pollution. However, the major statutes implemented and enforced by EPA are those designed specifically to prevent or regulate the release of pollutants into various environmental media, such as air, land, surface water and ground water.

those laws for purposes of urban water systems are the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA), both described more extensively in Chapter 9. Briefly, the CWA is designed to protect the chemical, physical, and biological integrity of the nation's surface waters, and to regulate the discharge of pollutants into those waters from a wide range of sources and activities. The SDWA governs the quality of water provided to consumers by public drinking water suppliers, and various efforts to protect their water sources. However, other statutes implemented and enforced by EPA also help to protect water sources. Those laws include the Resource Conservation and Recovery Act (governing hazardous and solid waste management and disposal), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, more commonly known as "Superfund") (facilitating and regulating the cleanup of hazardous substances, and allocating liability and responsibility for those clean-ups), the Toxic Substances Control Act (TSCA) (governing the manufacture and use of toxic chemicals), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (governing the manufacture and use of those materials), and even the Clean Air Act (CAA) (governing the regulation and control of air pollutants, including those that affect water bodies through atmospheric deposition).

Institutionally, EPA is principally in charge of implementation and enforcement of only some of those laws, including most notably TSCA and FIFRA, because of their national scope and applicability. (It would be difficult and confusing, e.g., for manufacture and use of the same toxic chemical to be governed by 50 different states.) Congress directed EPA to manage many of the environmental pollution laws, however, under a system of *cooperative federalism* in which EPA oversees statutory implementation in conjunction with various state environmental agencies. In the CWA, for example, states have the primary responsibility to adopt ambient water quality standards (WQS) for all surface waters, but EPA reviews and approves those standards, and adopts federal WQS if a state fails to do so or issues standards that EPA deems insufficient. Federal standards are rare, because EPA typically works with states more cooperatively to revise any deficient standards until they can be approved. Conversely, but with the same general result, EPA is charged statutorily with implementation and enforcement of the National Pollutant Discharge Elimination System (NPDES), the program under which all point source discharges to the "waters of the United States" must obtain permits limiting their releases in various ways. However, states have the opportunity to implement their own permitting programs instead, with EPA oversight and review authority, and most states have chosen to do so. Similar arrangements apply under the SDWA, RCRA and CAA. (A more detailed description of the cooperative federalism approach to water pollution control is included later in the chapter.)

Cooperative federalism suggests both benefits and challenges for urban water managers. The system is designed to ensure that minimum national environmental standards and procedures are observed, while allowing individual states the flexibility to implement and attain those requirements and standards as appropriate to more localized and regional conditions and circumstances. This allows those involved in urban water policy to work with state officials who are more likely to be familiar with local conditions and problems than federal officials might be. However, it also

means that both federal and state agencies may be involved in many issues and decisions, which potentially complicates a range of urban water decisions and activities (e.g., CWA permitting of a new sewage treatment plant).

Municipalities and other local water institutions are both beneficiaries of EPA's activities and regulated parties under many of the laws and regulations EPA oversees or implements. Effective pollution control and other environmental programs can safeguard urban water supplies from both a quality and a quantity perspective. They also help to restore and protect healthy aquatic ecosystems, which provide critical ecosystem services and valuable aesthetic and recreational amenities for urban areas. Of course, municipal water entities are also subject to those same laws and regulations when they build and operate urban water infrastructure, such as water storage, treatment and distribution systems, and sanitary and storm sewers and treatment facilities.

10.2.2 Army Corps of Engineers (ACE Website)

The U.S. Army Corps of Engineers (ACE), a branch of the Department of Defense, also has responsibilities for implementing some components of the CWA, as well as other functions that affect urban water issues and policy. Although it may seem counter-intuitive for a component of the military to be involved in water policy, this involvement stems from nineteenth century legislation—particularly the Rivers and Harbors Act—designed to promote national defense as well as interstate and international commerce. ACE was authorized to take steps to ensure that navigable waterways remained unimpaired by physical structures and other alterations built by other parties, and were improved for those purposes with canals, navigation channels, and other structural changes. Under section 10 of the Rivers and Harbors Act (often known as the "Refuse Act"), ACE continues to review and issue permits for projects that might obstruct those waters.

In a series of decisions issued in the 1960s, before Congress enacted any of the modern federal pollution control laws, the U.S. Supreme Court interpreted the Rivers and Harbors Act broadly to apply to discharges of pollutants into *navigable waters* (Rodgers, 1971). ACE adopted a permitting program in response to those cases. When Congress amended the Federal Water Pollution Control Act in 1972 (now commonly known as the CWA), it retained ACE's permitting authority with respect to the discharge of dredge and fill material into the "waters of the United States" embodied in section 404 of the CWA, while transferring to EPA the authority to issue permits for other kinds of pollutants (the NPDES program described above). However, EPA also retains an important role in the section 404 permitting process, because EPA issues guidelines that ACE must follow to protect aquatic ecosystems. EPA writes regulations governing ACE permits issued under this section, and has the authority to veto permits it believes will have an unacceptable adverse effect on the aquatic environment.

ACE has also built, and continues to exercise control over, a large number of water storage, flood control, channelization, and other projects designed, among other purposes, to support urban water needs around the country. Although the primary purpose of ACE water projects is to promote and protect navigation on the nation's waters, they often were designed to provide, and justified economically on the basis of, multiple purposes. Controversy remains, however, about whether many of those projects did more harm than good to aquatic ecosystems and the resources they provide, and whether ACE levees and other flood control programs are properly designed and maintained to serve their intended functions. Failure of ACE levees, for example, is cited as one major contributing cause of the Hurricane Katrina disaster (van Heerden et al., 2007). In addition, especially along major navigational waterways such as the Missouri and Mississippi Rivers, ACE and other agencies often encounter conflicts about how much water should remain in the river to support navigation, and how much may be diverted for irrigation, municipal, and other uses.

10.2.3 Fish and Wildlife Service (U.S. Fish and Wildlife Service Website)

The U.S. Fish and Wildlife Service (FWS) manages a large series of fish and wildlife refuges around the United States, some of which are in or near urban areas. Because one principal focus of the refuge system has been to provide breeding, rearing, and staging areas for waterfowl and other aquatic-dependent bird species, many of those refuges include significant wetlands and other water bodies. Key examples of wildlife refuges in urban areas include the Oyster Bay Refuge on Long Island, the San Francisco Bay National Wildlife Refuge, the San Diego Bay National Wildlife Refuge, and the Bayou Sauvage National Wildlife Refuge in New Orleans.

FWS is also responsible for implementation and enforcement of the federal Endangered Species Act (ESA) with respect to terrestrial and fresh water species.[2] The ESA is one of the most potent federal environmental statutes, with the power to halt entirely any project involving a federal action (including project funding or approval) that might jeopardize the continued existence of any federally-listed threatened or endangered species or impair designated critical habitat for those species, unless "reasonable and prudent alternatives" are available that will allow the project to proceed without resulting in such jeopardy. The statute protects species that might be important components of the urban water environment, and at times can act as a check on urban and suburban development in some areas. The land use implications of those constraints might affect urban water planning. The ESA is also part of the regulatory process that urban water managers may face when planning,

[2]The National Marine Fisheries Service (NMFS) exercises that authority with respect to marine and anadromous species. Technically, Congress assigned that authority to the Secretary of the Interior and the Secretary of Commerce, who delegated that authority to FWS and NMS, respectively.

constructing, and operating various kinds of urban water infrastructure, especially new dams or other water supply projects.

10.2.4 Natural Resources Conservation Service (Natural Resources Conservation Service Website)

Formerly the Soil Conservation Service, the Natural Resources Conservation Service (NRCS) is a branch within the U.S. Department of Agriculture. Formed in 1935 during the dust bowl era to help reduce the massive erosion that plagued American farmers but also impaired waterways throughout the nation, the agency implements a wide range of programs to provide farmers with technical and financial assistance. However, NRCS also built and manages a large number of water projects, largely but not entirely in the Midwest, designed to serve irrigation and other water supply needs as well as flood control purposes. Although agriculture is the primary intended beneficiary of NRCS programs and projects, urban areas can also benefit from water storage in multiple use projects, and be affected (beneficially or detrimentally) by the manner in which the flood control functions of those projects are managed.

NRCS also implements erosion control, wetland protection, and other environmental programs adopted as part of federal Farm Bill legislation. Examples include the so called "swampbuster" and "sodbuster" programs, as well as the more recent Environmental Quality Improvement Program (EQIP) program, in which farmers are given incentives to protect wetlands, steep slopes and other highly erodible areas, and to reduce loadings of nutrients, pesticides, and other pollutants. Where those programs protect water quality upstream from urban regions, they can also benefit urban water quantity and quality, and potentially reduce advanced treatment or other burdens on urban water supply and wastewater treatment systems.

10.2.5 Federal Emergency Management Agency (Federal Emergency Management Agency Website)

The Federal Emergency Management Agency (FEMA) oversees a wide range of emergency management and preparedness programs, to anticipate and respond to events ranging from natural disasters to terrorism. Urban water systems are affected most notably by FEMA's flood control programs, including delineation of floodplain zones within which building limitations might apply. Although the National Flood Insurance Program is based more on incentives than on prescriptive prohibitions on construction within floodplains and riparian areas, cities that wish to protect those areas from excess development can use that authority to limit impervious surfaces and other hydrologic and environmental impacts of development within those areas, as well as to protect property from flooding.

10.2.6 Federal Land Management Agencies

In addition to FWS, which as mentioned above manages the National Wildlife Refuge System—a relatively small percentage of federal land holdings in terms of acreage[3]—several federal agencies manage federal lands in ways that may affect urban water resources. The National Park Service (NPS) and the Bureau of Land Management (BLM) are agencies within the Department of the Interior. NPS manages the specially protected lands within the NPS (national parks, national monuments, national recreation areas, and national historic sites) for ecological, scenic, historic, geological, recreational, and other public values. Like national wildlife refuges, some national parks are in or near urban centers, and many of those have important aquatic ecosystem values. Examples include Golden Gate National Recreation Area and Boston Harbor Islands National Recreation Area. Many other national parks include the headwaters of important watersheds whose downstream drainages affect urban regions and their water supplies, such as Yosemite National Park and the Great Smoky Mountains National Park.

Particularly noteworthy in this category of federal land management agencies, however, is the U.S. Forest Service (USFS) within the U.S. Department of Agriculture, which manages the vast National Forest System throughout the country. Although national forests are now used heavily for both timber supply and recreational uses, when Congress first established the system in the late nineteenth century, it identified preservation of watersheds and downstream water flows as one of the two primary functions of national forest lands. In many parts of the country, the manner in which these critical headwater regions are managed can have significant implications for urban water quantity and quality. As one group of researchers noted, "[t]he watersheds of 3,400 community water systems (CWSs) serving 60 million people in 900 cities are located within National Forest lands" (Sedell et al. 2000).

10.2.7 U.S. Geological Survey (U.S. Geological Survey Water Resources Website)

The U.S. Geological Survey (USGS) is relatively unique among government agencies because its mission is predominantly scientific. Its mission is to conduct scientific research and analysis of many of the nation's natural resources, including water as well as extraction of resources such as minerals, oil and gas. Because of this role, USGS is the source of invaluable data on water resources for urban water managers and other users. For example, USGS maintains an extensive system of stream gages around the country, real-time data from which can be accessed readily on its website. USGS also conducts extensive monitoring of surface and ground water quality, and identifies water quality problems from a range of sources, including urbanization.

[3]This is not true in Alaska, where some National Wildlife Refuges are extremely large.

10.2.8 Council on Environmental Quality (Council on Environmental Quality Website)

The Council on Environmental Quality (CEQ) is within the Office of the President rather than an independent agency like EPA or a branch of a cabinet-level department, such as the BLM within the Department of the Interior or USFS within the Department of Agriculture. As such, it has no independent responsibility for implementing programs, constructing projects, or issuing permits or approvals. However, it does serve an important role in overseeing implementation of the National Environmental Policy Act (NEPA) by every other federal agency. As explained in Chapter 9, every federal agency or office is required to comply with NEPA for every federal action that may have a significant impact on the human environment. While all agencies have their own NEPA-implementing regulations and procedures, they also must comply with minimum requirements adopted by CEQ (40 C.F.R. Part 1500 et seq.). Environmental Impact Statements and other procedures required by the CEQ regulations can have significant impacts on urban water projects and resources.

10.2.9 Bureau of Reclamation (U.S. Bureau of Reclamation Website)

The U.S. Bureau of Reclamation (BOR), another agency within the Department of the Interior, is a regionally-significant force in water resources and politics in the western United States. Under the Reclamation Act of 1902, BOR was authorized to construct water projects in the western states designed to help western settlers "reclaim" arid lands, primarily for agricultural uses. Users of reclamation water were supposed to repay the federal costs of those projects through water payments, but Congress frequently extended payment schedules and lowered project interest rates in ways that rendered reclamation water heavily subsidized. Moreover, initially small, local projects gave way to massive dams and conveyance projects such as the Hoover Dam and the All-American Canal to California's Imperial Valley (Adler, 2007). Those projects were supported in part by revenues from the hydroelectric facilities built into the dams. Electricity and water from those projects also helped to fuel urban growth in Southern California, Southern Arizona, the Colorado Front Range and other regions. Although irrigated agriculture remains the predominant user of BOR water, those resources form an increasingly important component of urban water supply in the west, especially as thirsty cities purchase additional reclamation water from existing agricultural users. Metropolitan areas that use water from the Colorado River Basin, for example, compete for scarce reclamation project water needed to support additional growth, and also negotiate deals to transfer water supplies from agricultural regions.

10.2.10 Native American Tribes and the Bureau of Indian Affairs (Bureau of Indian Affairs Website)

Also primarily in the west, federally-recognized Native American Tribes can play an important role in the allocation of scarce water resources. Tribes are not part of the federal government, but rather independent sovereigns that co-exist with the national government in a relationship analogous to states. However, through the Bureau of Indian Affairs (BIA), the federal government owes a trust responsibility to ensure that Indian needs and interests are protected (*Seminole Nation v. United States*). More important, the Supreme Court ruled early in the twentieth century that when Congress set aside Indian reservations around the west, it reserved sufficient water rights to allow for tribal agricultural and other economic development (*Winters v. United States*). Those "federal reserved water rights", which the Supreme Court later ruled also apply to other federal lands reserved for special purposes (such as national parks, wildlife refuges, and military reservations), are particularly significant in the context of the prior appropriation doctrine of western water law, because they bear a "priority date" (see explanation of the prior appropriation doctrine in Chapter 9) defined by the time in which Congress reserved those lands, which often makes them senior to many urban and agricultural water rights in the system. Quantification and settlement of reserved water rights claims can affect the amount of water remaining for urban uses. On the other hand, cities also might be able to purchase latent reserved rights from tribes, providing needed water for cities and cash for tribal economic development.

10.3 State Institutions

State water management institutions vary greatly with regional climate, hydrology, and other factors (Fiero, 2007). The biggest divide is between the generally wet regions in the eastern parts of the country, and the much more arid states to the west of the 100th Meridian. Intermediate states include moderately or regionally arid states in the Great Plains, or areas with both extremes along the west coast. Eastern states often combine water allocation and water quality within a single, statewide environmental agency (although those functions may be handled by separate offices or other entities within that umbrella agency). Western states employ a range of separate institutions to oversee and administer the prior appropriation doctrine and other laws and programs with respect to surface water and ground water allocation and use (Ayotte et al., 1993).

10.3.1 State Water Quantity Institutions

Both riparian states and prior appropriation states relied initially on self-implementation aided by judicial enforcement of legal rights to implement and

enforce those doctrines (Sax et al., 2000). As the number of users increased and competition for scarce resources intensified, however, most states have moved to some formal institutional system involving permits, recordkeeping, judicial decrees of water rights, or some other administrative means of tracking and enforcing water rights.

Variations in institutional arrangements among states make generalizations difficult, but there are two basic patterns that parallel hydrologic conditions. As noted above, and following the pattern of water rights practices discussed in Chapter 9, in most humid states those functions are usually combined within a single agency. In some of those states, however, responsibilities for water-related issues are divided among state environmental agencies (primarily water quality issues) and state natural resource agencies (primarily water resource allocation issues). In arid states, prior appropriation systems are usually managed by a department of water resources, a state engineer's office, or sometimes by multiple entities serving information, planning, and administrative or regulatory and enforcement functions, respectively. In Utah, for example, the Division of Water Resources within the Department of Natural Resources serves information and planning functions, while water rights determinations are made by the State Engineer. In some states, such as Colorado, water rights determinations are made through a series of basin-specific water courts, and in other states general stream adjudications to determine comparative rights among users in the same system are made by courts of general jurisdiction (courts with the authority to address a wide variety of legal claims).

10.3.2 State Water Quality and Environmental Agencies

Issues of water quality, aquatic habitat and ecosystem restoration and protection are usually addressed by state environmental, natural resource, and fish and wildlife agencies. Although the exact organization of those agencies again vary widely, they often parallel in some way their respective federal counterparts, described above, and all of them may affect urban water resources and aquatic ecosystems in some way. For example, the state water quality agency may be responsible for such varied water-related issues as drinking *water quality standards*, testing sport fish for contaminants and issuing fishing advisories for urban streams, and similarly testing recreational waters for pathogens and issuing appropriate advisories or closings for urban beaches. A state department of fish and wildlife may be involved in urban stream restoration efforts, as well as the regulatory task of administering and enforcing recreational fishing laws.

Probably most important for urban water managers, state water quality and other environmental agencies are usually the first step in complying with CWA and other federal statutory and regulatory requirements involving water (including the SDWA, RCRA, CERCLA, and other programs). Because EPA has delegated administration of the NPDES program to most (but not all) states, most municipalities obtain discharge permits for their sewage treatment, storm water, and other discharges from

the state water quality agency, and are responsible for submitting discharge monitoring reports and other compliance information to both the state and to EPA for compliance and enforcement purposes. Likewise, most states have primacy over the SDWA program that regulates public water supply systems, and implement the wellhead protection and sole source aquifer programs under that law. All states issue permits and otherwise administer regulatory programs governing municipal landfills, and most states do for hazardous waste landfills as well. Compliance with and enforcement of all of those regulatory programs (or lack thereof) can affect the quality of urban water supplies.

10.4 Local and Regional Water Institutions

In most ways, local institutions are at the front line of urban water issues. Local entities usually procure, transport, treat, and distribute water to end users in urban areas (Sax et al., 2000; Arnold, 2005). They collect, treat, and manage sewage and contaminated storm water runoff, and control drainage patterns to protect public and private property, as well as aquatic ecosystems, through land use planning, street design, and other means. Local planning and zoning officials also affect both water use and the hydrological and ecological impacts of development through a range of land use decisions and planning efforts. The specific nature and organization of local water institutions and entities varies greatly, making broad generalizations even more difficult than is true for state institutions. For example, in some cities all water issues from supply, treatment and distribution to wastewater collection, treatment, and discharge are governed by a single water department, whereas other areas separate those functions among different entities. The degree to which those functions are integrated or divided can affect the region's approach to water management in significant ways. Indeed, in some areas the diversity and fragmentation of local water institutions, sometimes with conflicting or overlapping jurisdictional boundaries, can create inefficiencies and other problems for urban water planning and management.

10.4.1 Local and Regional Water Suppliers

As described in Chapter 9, municipalities face increasing challenges in procuring adequate water supplies, especially in areas of rapid growth and short supply (Tarlock and Van de Wetering, 2006). There is also an increasing consensus, based on both actual data trends and modeling results, that global warming will exacerbate water supply shortages (while also increasing the volume and intensity of precipitation in other areas, leading to equally difficult issues of flood control and storm water management).

In many cities, water is procured and supplied by private water companies acting effectively as regulated public utilities much like a local gas,

electric, or telephone company. State law may impose universal service obligations, or regulate the water rates that may be charged to end users in ways that affect water supply and demand. Some states integrate water supply planning with land use planning and zoning in various ways, such as assured supply laws that require developers to demonstrate sufficient water supplies to serve a new development before the necessary permits and approvals may be granted (Davies, 2007; Arnold, 2005; Chapter 12). In other urban areas, water is supplied directly by government agencies such as city water departments, or other institutions such as municipal utility districts. Those institutions may be governed by city employees or officials reporting to the mayor or city council, or they may be managed independently by elected or appointed boards.

Under some state laws, special water districts (and sewer districts described below, or joint water and sewer districts) are necessary to issue public bond offerings to raise sufficient capital to design, build and operate urban water infrastructure. Depending on the particular institutional arrangement, those offerings might be in the form of general obligation bonds that can be repaid out of general tax revenues, or revenue bonds in which investors are paid out of the operating revenues from the specific project. Because general obligation bonds are typically viewed as less risky, they might require lower interest rates, but they also encumber the general local tax base. Revenue bonds may bear higher interest rates, and because they must be paid in full out of water agency revenues, they can affect water rates accordingly. Those arrangements, of course, arguably eliminate general tax subsidies to water users, and may serve as some incentive to increase efficiency of water use as a result. (Because water rates are subsidized in so many different ways, it cannot be said that this factor alone will serve to impose the full cost of water on end users in urban areas or elsewhere.)

Especially in arid western states where urban water supplies often compete with irrigation uses, and where supplies can be concentrated in large storage facilities built and operated by the BOR or other federal or state entities, other water supply institutions can also affect urban water supplies. Irrigation districts or mutual water companies may be formed as the primary holder of water rights in those storage facilities, and then the purveyor of water to various end users. Although designed primarily to serve irrigation users, where a project is designed to serve municipal and industrial end users as well, urban water managers may need to procure water or water rights from those entities, especially as agricultural to urban water transfers become one of the viable remaining sources of new water for growing cities.

As core cities expanded into a mass of sprawling, separately incorporated suburbs, and other smaller cities grew together, many urban areas have faced an increasingly diverse, complex and fragmented array of water supply institutions, often competing for common but limited supplies. This can lead to an inefficient and potentially overlapping management system and infrastructure, sometimes literally including duplicative and criss-crossing conveyance systems, reservoirs and other storage facilities. Some regions either replaced that mélange or combined the existing entities into larger, more efficient regional water authorities designed to deal more efficiently with water acquisition, storage, and distribution on a regional basis.

Examples of this kind of regional authority include the Southern Nevada Water Authority and the Metropolitan Water District of Southern California.

10.4.2 Local Sewerage, Water Pollution Control, Storm Water Management and Flood Control Agencies

The manner in which "back end" water issues are addressed also varies significantly among different states and localities. As noted above, sewerage and storm water management are often handled by the same municipal water department or water and sewer district as is responsible for water supply. This arrangement might promote a more integrated approach to urban water use and management, and might facilitate implementation of some of the potential reforms suggested elsewhere in this book. For example, combined water institutions may be better suited to separate potable from urban irrigation water, because financial savings realized in the wastewater treatment process might help to offset costs of separating urban water systems.

Likewise, some municipalities have separate flood control districts or agencies designed to finance and to operate levee systems, storage facilities, and other flood control infrastructure. Although such entities provide important flood control and property protection functions, it may be that such special purpose entities interfere with more holistic efforts to reduce flooding risks through integrated land use planning, storm water management, and other methods, in favor of traditional structural approaches. Local flood control management districts necessarily operate in coordination with ACE and other federal entities that are responsible for construction and operation of so much of the nation's physical flood control infrastructure.

10.4.3 Local Planning and Zoning Institutions

Finally, decisions made by an equally variable array of local and regional land use planning and zoning institutions can have profound effects on the urban water environment (Thompson, 2005; Waterman, 2004). The density of development, including the percentage impervious surface in developed areas, can affect the hydrology of urban systems dramatically, and intensify storm water pollution and other impacts to urban aquatic ecosystems and water supplies. Cities can choose either to allow development right up to the water's edge, with accompanying loss and degradation of riparian and aquatic habitats and deterioration of water quality, or they can plan to protect riparian areas and flood plains, and to limit the density and nature of development to protect those areas for water supply, environmental, recreational, and aesthetic purposes. In making those choices, urban planners must address issues of private property and development rights discussed in Chapter 9, but also balance them against increased private property values and increased public values of healthy urban aquatic areas that serve important ecosystem functions and provide

valuable amenities to local communities. Development decisions made by planning and zoning officials also affect water supply and demand issues, especially in areas where existing supplies are inadequate to support new urban growth, or where shifts from other water uses or increased efficiency is needed to support that growth.

All of those interactions between land use decisions and urban water systems suggest that land and water institutions either should be integrated structurally, or that procedures should be implemented to ensure that decisions made by both categories of institution are coordinated adequately. Some states, such as Oregon, have adopted statewide planning requirements designed to integrate land use and water decisions in some way, although the manner and degree of implementation of those requirements can vary greatly around the state. Other areas have adopted more comprehensive and integrated land use and water planning at the country or regional levels. In many areas, however, land and water decisions are made with little or no coordination, resulting in unnecessary and often unforeseen impacts on urban water systems.

10.5 Institutional Fragmentation as a Barrier to a Sustainable Urban Water Environment

Fragmentation in water resources programs and institutions has long been identified as a barrier to effective and efficient water use and management, and to the protection and sustainability of aquatic ecosystems (Adler, 1994; Reuss, 1993). One scholar described the "system" as "similar to a marbled cake, with several levels of government intermingled in an irregular pattern" (Whipple, 1989). Another summarized this fragmentation as falling into three broad categories: "(1) political fragmentation—the overlapping and conflicting division of responsibilities among multiple levels of government and agencies; (2) issue fragmentation—the artificial division of related water issues into separate programs (such as water quality and quantity, land and water use, and surface and groundwater); and (3) gaps in program design and implementation" (Adler, 1994). A third source identified "vertical disconnects" (fragmentation among the federal, state, and local levels of government), "horizontal disconnects" (fragmentation within a level of government with respect to water and related land use issues), and "internal disconnects" (conflicting or mutually inconsistent policy goals affecting water resources (Arnold, 2005).

As illustrated above and in Chapter 9, fragmentation is no less evident in urban water programs than in water resources programs more generally. Table 10.1 summarizes—in a necessarily simplified fashion—just the most important institutions (or categories of institutions) designed to address a range of urban water issues:

In addition, because so many entities are, or can be, involved in urban water issues, and because political, hydrological, geographic, and other conditions vary so much around the country, different cities divide responsibility for water resources planning, management, and service provision in different ways. The following

Table 10.1 Examples of institutions involved in urban water issues

	Land Management	Water Supply	Waste Water	Environmental Protection	Dispute Resolution
Federal	Bureau of Land Management; Forest Service; National Park Service; Fish and Wildlife Service;	Bureau of Reclamation; Army Corps of Engineers; Natural Resources Conservation Service	EPA; Army Corps of Engineers	EPA; Army Corps of Engineers; Council on Environmental Quality; Federal Energy Regulatory Commission	Federal courts and administrative agencies
State	State land agencies; state land use planning agencies	Water Resources Departments; State Engineers; Public Utility Commissions	State water quality, natural resource, and fish and wildlife agencies	State water quality, natural resource, and fish and wildlife agencies	State courts and administrative agencies
Local	Land use planning and zoning agencies, boards and commissions	Municipal Water Districts and Companies; Public Utility Districts	Publicly Owned Treatment Works; Water Districts; Public Utility Districts; Stormwater Management Agencies	Local health and environmental agencies	Local courts, boards, and commissions
Private and quasi-public	Landowners and developers	Private water suppliers; Irrigation Districts; Mutual Water Companies; Private Users	Private wastewater treatment entities; Private Customers (residential, commercial and industrial)	Regulated parties (landowners; industry; agriculture)	Arbitration; mediation; facilitation

examples of institutional arrangements from one large Midwestern city (Chicago), and one medium-sized city in the Intermountain West (Salt Lake City), illustrate a trend toward efforts to integrate water resources management within cities in a more coordinated way. However, those institutions vary greatly within and among different regions of the country, due to physical, political, legal, and sometimes purely historical factors.

10.5.1 Example: Integrated Water Institutions in Chicago (Chicago Water Website)

For decades, the "front end" (water department) and the "back end" (wastewater department) of the Chicago urban water cycle were managed separately. Chicago combined its water and sewer departments in 2003 to create the Department of Water Management. Within that combined department, a water department obtains water from Lake Michigan, and handles public water treatment and distribution, while the sewer department handles sewage and stormwater collection and treatment, as well as flood control. In 2004, Cook County ceded authority to a regional entity, the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), an independent government agency run by a board of elected commissioners, to manage stormwater (and combined sewer overflow (CSO)) policy for the entire county (MWRDGC website).

10.5.2 Example: Integrated Water Institutions in Salt Lake City (Salt Lake Water Website)

In Salt Lake City, a unified Department of Public Utilities manages drinking water, stormwater, and wastewater in Salt Lake City. A drinking water branch obtains water supplies from artesian wells, streams and associated reservoirs in the adjacent Wasatch Mountains, and through trans-basin diversions from the Colorado River watershed, and handles public water treatment and distribution. A separate stormwater division was created in 1991 to address stormwater collection and treatment, and flood control. A wastewater division handles sanitary sewage collection, treatment and disposal, through both traditional treatment plants and wetlands treatment. In cooperation with the U.S. Forest Service, the department also administers a comprehensive watershed protection program designed to protect the significant portion of the city's water supply that comes from canyons streams and reservoirs.

10.5.3 Competing Policy Factors in Allocating Responsibility for Urban Water Quality

Finding optimal solutions to water resources fragmentation, and especially solutions that work universally throughout the country, has been a difficult quest, and involves difficult tradeoffs with no presumptively "correct" answers. The issue of water

pollution control illustrates the competing policy factors involved in deciding how to allocate regulatory and other governmental authority. What entities and levels of government are best suited to address problems of surface water quality? In 1972, Congress passed comprehensive amendments to the Federal Water Pollution Control Act (now known by its popular name the Clean Water Act (CWA)), in response to the widespread failure of individual states to reduce serious water pollution around the country (Adler et al., 1993). In allocating pollution control authority and responsibility among the federal, state and local governments, Congress employed a strategy known as "cooperative federalism". Through this approach, it is fair to say that Congress expressly addressed several key issues of political fragmentation (whether or not one agrees with the manner in which that was accomplished), but was far more ambiguous with respect to issue fragmentation.

10.5.4 Addressing Issues of Political Fragmentation

For some purposes, Congress centralized water pollution control in the federal government (EPA and the U.S. Army Corps of Engineers (ACE)). Congress gave EPA the task of adopting relatively uniform discharge requirements for particular classes and categories of discrete (or "point source") dischargers (e.g., certain kinds of steel mills or POTWs), tied to best available control technologies rather than variable water quality conditions (CWA §§301, 304). The decision was designed to level the economic playing field among dischargers across the country, to establish minimum applicable control requirements, and to prevent states from competing for jobs by lowering treatment obligations. Similarly, Congress assigned to EPA and ACE the presumptive authority to issue permits to discharge pollutants into the "waters of the United States" (CWA §§402, 404). However, states have the option to assume permitting responsibility for municipal and industrial discharges (which most states have exercised), and for discharges of dredge and fill material into wetlands and other waters (which most states have not exercised), subject to federal government approval, review, and ongoing oversight (including potential veto power over individual permits or, in the extreme, withdrawal of state permit program delegation). This system is designed to provide flexibility to states while ensuring that national water quality and economic equity goals are met.

At the same time, Congress directed states to adopt ambient surface water quality standards tailored to variable uses and conditions around the country (CWA §303). EPA must review and approve those standards as sufficient to meet the broadly-defined water quality goals set by Congress, but states have considerable flexibility under the statute and EPA regulations (40 C.F.R. Part 131) to account for different uses of water bodies, and different ecological, hydrological, and other physical conditions. However, EPA retains the responsibility to issue water quality standards for any state that fails to do so, or to do so adequately. Through this approach, Congress required states again to meet minimum federal goals and requirements, but allowed them to do so in different ways, and to exceed federal requirements if they choose to do so.

Likewise, Congress chose a more deferential strategy vis-à-vis the states with respect to more diffuse, "nonpoint source pollution" (or "polluted runoff") from agriculture, development and other land disturbance activities (CWA §§208, 319). States are required to develop and implement nonpoint source pollution control plans, subject to EPA review and approval. However, EPA's only remedy in the case of inadequate state programs is withdrawal of relatively small amounts of federal funding. Unlike the point source permitting or water quality standards programs, EPA has no authority to adopt a federal nonpoint source pollution control plan or program in the face of inadequate state programs. Here, despite the significant nature and scope of the problem, Congress deferred to state and local preferences because nonpoint source pollution is far more tied to land use planning and economic policies traditionally reserved to states and localities. Ultimately, there is some accountability because states are required in theory to ensure that the combination of point source and nonpoint source controls are sufficient to meet their ambient water quality standards through a process known as *total maximum daily loads* (TMDLs; CWA §303(d)). However, implementing the TMDL process has been both scientifically complex and fraught with tension between EPA, the states, end environmental groups that have tried to force that process along through litigation (Houck, 2002).

Allocating responsibility for pollution control becomes even more challenging when one adds the municipal dimension. Cities are responsible in some way for both compliance with CWA requirements and for regulating other sources of municipal water pollution, in compliance with the CWA and EPA rules. For many years, Congress has provided either direct federal grant funding or loans to help cities to meet those significant financial burdens. However, whether or not they have received federal financial assistance, municipal POTWs must acquire and comply with discharge permits issued by either EPA or the state. And, when the POTW receives potentially toxic wastes from commercial or industrial customers, they must implement a regulatory program designed to protect the POTW itself, the sewer system, workers, and the quality of both the resulting treatment plant effluent and solid waste material (sewage sludge or "biosolids"). Likewise, municipal stormwater discharges require permits from EPA or the state, but compliance with those permits requires the city to implement its own education and regulatory programs to prevent or to clean up pollutants that might contaminate those discharges into urban waterways.

10.5.5 Remaining Problems of Issue Fragmentation

Congress' main focus in enacting the 1972 CWA was surface water pollution. As a result, in that legislation and in subsequent amendments it has painted with a much broader brush with respect to three key areas of institutional issue fragmentation in water resources law and policy: surface water versus ground water; water quality versus water quantity; and water quality versus land use. In defining the "waters of the United States", Congress did not expressly discuss the issue of groundwater, but the CWA is generally interpreted as applying largely to surface water. Thus, for the

most part groundwater protection is left largely to other federal statutes (discussed in Chapter 9), or to the states.

As discussed above, Congress adopted a deferential policy toward the states with respect to the land use implications of nonpoint source pollution control (and to a large degree, municipal stormwater control programs). Likewise, Congress has been reluctant to infringe on traditional state authority over water quantity (water supply and allocation decisions), even in the guise of protecting water quality and aquatic ecosystem health. Thus, in the 1972 legislation Congress provided: "It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities of States to prevent, reduce, and eliminate pollution, [and] to plan the development and use . . . of land and water resources . . ." (CWA §101(b)). In 1977 amendments, Congress added the following policy statement regarding the relationship between water quality and water quantity:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated, or otherwise impaired by the [Act]. It is the further policy of Congress that nothing in this [Act] shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources. (CWA §101(g)).

Despite those general policies, as discussed in Chapter 9, the Supreme Court has ruled that *states* may use their own water quality standards to require minimum water flows to protect salmon and other resources and uses (PUD No. 1 of *Jefferson County v. Washington Department Ecology*). And water volumes clearly affect water pollution control efforts, for example, where low flows result in higher concentrations of pollutants, higher temperatures, and similar problems. In general, however, the CWA does not establish clear and effective linkages between water quality and water quantity, a policy that has been defended by some (Hobbs and Raley, 1989) and criticized by others (Benson, 2005).

10.5.6 Working Toward Solutions: Interstate, International, Watershed Management and Other Collaborative Institutions

Various inter-jurisdictional and other watershed-based initiatives have also evolved as one potential way to address fragmentation in water resources planning and management, and to address urban and other water issues in a more holistic, coordinated way. Some of those initiatives are described briefly below, but are the main subject of Chapter 11.

Few urban water systems are in isolated watersheds that cross no geopolitical boundaries. Geographic linkages between urban water uses and water users can span multiple municipalities, counties, states, and even cross international borders. Moreover, in addition to the remarkably wide range of governmental and

quasi-governmental institutions involved in urban water policy, a large number of private businesses, landowners, nongovernmental organizations, and other entities either play a significant role in urban water issues, or are affected by urban water decisions and policies. This more complex level of interactions can be addressed at a wide range of levels, both geographically and institutionally.

Geographically, a large and diverse set of interstate and international entities have been formed to address trans-boundary water pollution, water supply, and other water issues. Examples of interstate institutions include the Chesapeake Bay Commission, the Delaware River Basin Commission, the Ohio River Basin Sanitary Commission, and the Colorado River Basin Salinity Control Forum. International institutions include the International Joint Commission between the United States and Canada, and the International Water and Boundary Commission between the United States and Mexico. Interstate and international water disputes can also be addressed through interstate compacts, such as the Colorado River Compact, and international treaties, such as the U.S-Mexico Water Treaty.

There is also a long but checkered history of efforts to implement comprehensive basin-wide or watershed-based planning and management in the United States. A nationwide program of basin-wide planning established by Congress in 1965 was abandoned in the 1980s, but has been replaced by a more ad hoc collection of watershed-based programs around the country, ranging geographically from small urban stream systems to interstate and international basins such as the Great Lakes and the Chesapeake Bay. Although those institutions again vary very widely in composition, organization, operational structure, authority, and implementation, they share the common idea of bringing together multiple stakeholders to work collaboratively to restore, protect, and manage urban and other water resources and aquatic ecosystems. Those kinds of institutions are highlighted in the next chapter.

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