Blue water
green cities
An initiative from the World Bank
for integrated urban water management






Tegucigalpa
Bogota
Aracaju
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Integrated Urban Water Management

A summary note

THE WORLD BANK

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04 Executive Summary

The Case for Integrated Urban Water Management

As a result of rapid and unplanned urban growth, heightened vulnerability to climate change, and relatively poor water management practices, a growing number of cities in Latin America and the Caribbean (LCR) are struggling with problems of water scarcity, watershed pollution, inadequate service provision, and increased flooding, directly affecting their population's quality of life and economic prospects. These problems are often compounded by the fact that they are being addressed in a disconnected way, by different actors across neighboring jurisdictions.

Water plays an integral role in the green growth agenda as a fundamental requirement for human health, economic development, and environmental sustainability. It is impossible to imagine a green future without clean drinking water, sanitation for all, water for commerce and industry, protection against urban flooding, vibrant rivers, lakes, wetlands, and marine coastal areas. This vision of the water sector is achievable for most Latin American countries and cities within a generation—if they make sound decisions on institutional reforms and if investments are made now. The challenges confronting this vision of the future, however, are daunting and include:

- ***Rapid Urbanization*** – Growing water demand, disorganized land use and unchecked contamination threaten water supply, increase flooding risks and affect life quality of urban dwellers;

- ***Climate change vulnerability*** – Water management must take into account water stress stemming from rising temperatures, changes in precipitation patterns, and weather variability; and

- ***Inefficient water management*** – Current approaches are predominantly local and sector-specific, lacking the innovation and scope to address cross-cutting challenges. Watershed approaches, when they exist, are not well coordinated with urban realities.

Fortunately with economic growth, sound legal systems, democratic political systems, and flourishing environmental movements, most countries and many cities in Latin America are well positioned to address these challenges, and in fact, many have started to develop best practices.

The World Bank's Blue Water Green Cities *initiative*

The World Bank's *Blue Water Green Cities* initiative seeks to learn from the tremendous experience of Latin American cities, many of them World Bank clients, in dealing with these challenges; and propose a concrete approach – Integrated Urban Water Management (IUWM) – to support municipal actors in addressing these urban water challenges in a cleaner, more efficient, more resilient and more equitable manner by working across sectors and spatial boundaries.

There are many ways to describe IUWM, and the Blue Water Green Cities Initiative has adopted the following definition:

> "Integrated Urban Water Management (IUWM) is a flexible, participatory and iterative process which integrates the elements of the urban water cycle (water supply, sanitation, storm water management, and waste management) with both the city's urban development and river basin management to maximize economic, social and environmental benefits in an equitable manner."

The first phase of the World Bank's *Blue Water Green Cities* Initiative started in 2009 and culminated in a large regional workshop in Sao Paulo in December

2012. The Initiative was generously funded by the Water Partnership Program, a multi-donor trust fund managed by the World Bank that aims to improve water resource management and water service delivery. The Initiative was seamlessly incorporated into the World Bank's operations and technical assistance to help leverage the impact of the trust funds. All of the documents produced by the Initiative can be found at the Initiative website (http://www.worldbank.org/laciuwm).

Lessons Learned

A few basic principles emerged in the process of analyzing the literature, examining best practice throughout the world, and engaging in IUWM activities in the region:

- *IUWM needs to be tailored to the specific and dynamic challenges of each urban area.* IUWM approaches can vary greatly depending on the institutional arrangements of urban and water management in a particular urban area as well as the specific water challenges.

- *IUWM involves a set of participatory approaches and instruments* to help relevant institutional and non-institutional stakeholders develop an agreed diagnostic of urban area challenges as well as a shared vision of future development on the urban area of influence.

- *IUWM is not a one-time action, but an iterative, long-term process.* The characteristics and challenges of urban areas are bound to change with time. This is why planning becomes a cyclical process that continuously revisits urban area challenges and priorities, as well as means and actions to address these challenges.

- *IUWM is as much about institutions and processes as it is about infrastructure and investments.* Integrated management of water in an urban setting tends to be challenging since it involves a wide array of systems and institutions, both within the city and at the river basin level.

- *IUWM must be informed by sound science and technical analysis.* Although IUWM is highly political by nature, decision-making by key stakeholders must be informed by sound technical analysis.

- *IUWM requires moving away from segmented, linear thinking to a more holistic approach.* A key objective of IUWM is to progress from a linear approach to water problems- which relies on an unrestricted availability of resources and is not able to tackle adverse impacts of waste and other outputs on the environment and society - to a cyclic metabolism aimed at avoiding, minimizing, cycling and transforming inputs within the city in order to reduce or eliminate outputs, i.e., negative impacts on quality of life of urban dwellers and the environment (Novotny 2010).

- *IUWM seeks to address today's challenges without losing sight of the future.* Many cities in Latin America are far from being able to realize the ideal vision of a Green City. However, it is important that today's water challenges be addressed in a way that reflects an integrated approach, and keeps in mind the long-term vision towards which the city and region should move. ■

06

1. Introduction

The world is urbanizing at an increasing rate, with four out of five persons in the Latin America and Caribbean (LCR) region living in Cities (UN-HABITAT 2010). Rapid and disorganized urbanization is having substantial impacts on water availability and quality both inside and outside city boundaries, including through overexploitation of water resources, decreased water security, increased flood vulnerability, and water-related health impacts. Meanwhile, climate change threatens to further reduce water availability and to impose sizeable economic costs on national and global authorities. These trends sharpen the need for a more systematic and comprehensive approach to urban water management.

To provide answers to increasing water-related difficulties within urban areas, several approaches have emerged to improve the manner in which cities carry out urban water management. These approaches generally seek to manage the different elements of the urban water cycle – water supply, sanitation, stormwater, and waste management – in integration, while minimizing disruption to natural systems (Brown 2007). These efforts have been referred to as *Low Impact Development*, *Cities of the Future*, *sustainable cities*, or *eco-cities*, and typically involve redesigning the urban landscape and managing water in a closed loop, by promoting reusing and recycling of natural resources, mimicking nature in reproducing the hydrological cycle, and attenuating and transforming inputs within the city.[1]

In parallel, at the river basin level, approaches such Integrated Water Resources Management (IWRM) have been instrumental in managing, in a given river basin, the tradeoffs between water uses such as agriculture, hydropower, water supply, and ecosystem demands as well as identifying management options to maximize the basin's economic, social and environmental outcomes.[2]

Integrated Urban Water Management (IUWM), the subject of this note, lies at the intersection of these two disciplines: it considers the city's urban water services in close relation with its urban development dynamics on the one hand, and with the broader basin context on the other. In rapidly urbanizing areas, improving sustainable provision of water services, reducing disaster vulnerability, and creating urban spaces for both city dwellers and the environment increasingly requires working across sectors and jurisdictions. This entails not only creating institutional setups, investment strategies, and coordination mechanisms capable of addressing water management, treatment and service provision systems as a whole, but also planning the elements of the urban water cycle in synchronization with urban land use and basin management (GWP 2011).

In that sense, IUWM is an approach that aims at supporting cities seeking to become clean, efficient, and resilient, in a word, green – the foundation of the World Bank's *Blue Water Green Cities* initiative described in this document. The initiative aims to build on and consolidate the Bank's experience working with urban clients on water challenges, and originates from the observation that while some cities have developed outstanding experience in integrating the management of the urban water cycle and services, others face severe challenges in balancing water availability for human consumption, environmental needs, and productive uses. ■

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1 These terms have been used respectively by the Prince George County and the U.S. Environmental Protection Agency; Novotny and the International Water Association; Beatley and University of Virginia; Biello and UNIDO. Please refer to the references section for more details.

2 IWRM is the coordinated management of water and related resources to maximize economic and social outcomes in an equitable way without compromising the ecosystem's vital sustainability (GWP, 2000).

Box 1. The World Bank's Blue Water Green Cities initiative

The objective of the *Blue Water Green Cities* initiative is to document, validate and disseminate approaches to support urban areas in the Latin America and the Caribbean region (LCR) in developing integrated urban water management (IUWM) strategies and planning their implementation.

The World Bank's initiative consisted of: i) analyzing and drawing lessons learned for urban water management in a sample of emblematic LCR cities; ii) developing an approach for IUWM implementation, to guide World Bank assistance to clients and to be used by policymakers at national and local levels; iii) informing and improving the approach based on work in a series of flagship including Sao Paulo, Vitoria and Aracaju (Brazil), Bogota (Colombia), Buenos Aires (Argentina), Asuncion (Paraguay) and Tegucigalpa (Honduras); and iv) documenting and disseminating the experience gained.

The following documents were produced as part of the initiative:

- The present document is intended as an introduction to the concept of IUWM and of its relevance in the LCR context, as well as repository of good practices for IUWM implementation. As such, it puts forward a definition of IUWM and lays out key principles on which the approach is based (Chapter 3), introduces a step-by-step description to actors seeking to engage in IUWM (Chapter 5), and includes some concrete examples of good practices in urban water management, based on regional case studies (Chapters 4 and 6).

- A series of short cases studies were also published for each one of the flagship cities involved in the initiative, focusing on the challenges, successes and setbacks of each city in its attempts to address water challenges in an integrated way.

- Complementary tools, presentations and resources, providing support to teams and cities engaging on IUWM approaches in line with this document's chapter 5, were also collected and are available online on the initiative's website.

The *Blue Water Green Cities* initiative was financed in a large part by the World Bank's Water Partnership Program, a partnership for improved water resources management and water services delivery. More information and electronic versions of all documents can be obtained on the initiative's website http://www.worldbank.org/laciuwm

2. The Water Challenges of Today's Cities

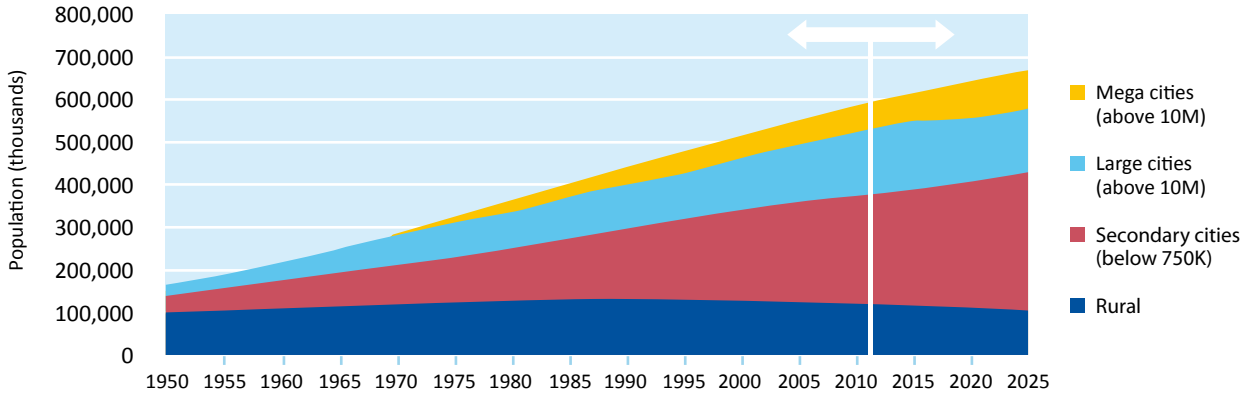
As a result of rapid and unplanned urban growth, heightened vulnerability to climate change, and relatively poor water management practices, a growing number of cities in Latin America and the Caribbean are struggling to address the gap between the demand of a rising population and the limited availability of a competed resource; to deal with significant environmental and public health risks created by worsening water pollution; to protect their citizens against increasing flood risks stemming from misplaced urbanization; and generally to create an urban environment that responds to their dwellers increased demand for improved wellbeing and life quality.

While Latin America is already the most urbanized region in the World, UN-HABITAT projections show that the urban population will continue to grow, in part as a consequence of rural dwellers being attracted to the economic perspectives offered by cities. The net effect of urbanization and population growth for water availability are clear: global water withdrawals have tripled in the last fifty years due to population growth, with annual water withdrawals per person averaging 600m3; furthermore, domestic water consumption in the urban sector accounts for 19% of total water withdrawal in Latin America, and industrial use, currently accounting for 10% of total withdrawal in the region, is steadily increasing in urban areas (WWDR 2009). These numbers are significantly higher in watersheds home to large metropolitan areas; for example, more than 60% of all water use in the Mexico Valley is derived from urban consumption. In parallel, climate change is likely to have particularly significant economic and environmental consequences in LCR, as the region's biodiversity, economic activity, and water resources and forests are especially climate-sensitive (ECLAC 2010).

Rapid urbanization – Growing water demand, disorganized land use and unchecked contamination threaten water supply, increase flooding risks and affect life quality of urban dwellers

Urban population in LCR reached 79.4% in 2010, and the percentage of the population living in the region's densely populated urban areas is expected to increase to 82 % by 2025 (UN-HABITAT 2010). Much of overall population growth in Latin America will be in secondary cities as rural areas empty out (Figure 1). The impact of population growth will have implications for how

Figure 1. Past and projected population in Latin America



Source: United Nations Department of Economic and Social Affairs.

water is managed in the region's cities: in the absence of water-saving measures for example, projected population expansion in Central America is expected to increase water demand by almost 300% by 2050 and by over 1600% by 2100 in a trend scenario (ECLAC 2010).

Furthermore, urbanization in LCR has been accompanied in many countries by rising poverty and under-provision of basic services: of the region's 471 million urban dwellers, 110 million live in slums, 13 million lack access to an improved water source, and 62 million do not have access to improved sanitation (UN-HABITAT 2010). As a result, quality of life is decreasing in many urban agglomerations, and the impact of these unsustainable cities is felt in hours lost in traffic, human and property losses in floods, health hazards, environmental degradation, and other economic and social costs. The negative impacts of large cities on water resources are particularly significant, with basins frequently water-stressed, and large-scale transfers of untreated wastewater into rivers and oceans. Furthermore, urban expansion and the associated land conversion eliminates key functions of the aquatic environment, alters runoff patterns, and inhibits natural recharge, with negative consequences for water quality (UN WWDR 2003).

Climate change vulnerability – Water management must take into account water stress stemming from rising temperatures, changes in precipitation patterns, and weather variability

The average annual rate of increase in carbon dioxide emissions in LCR for 1990-2005 exceeded the global rate (2.6% and 1.8% respectively), in keeping with a rising trend in energy production (ECLAC 2010). Meanwhile, climate projections for LCR indicate that average temperatures will rise steadily across the region, with the likely mean increase by 2100 ranging between 2°C and 4°C. Precipitation patterns will change in quantity, intensity and frequency, with projections ranging from a 20-40% reduction to a 5-10% increase for the years 2071-2100. This greater variability in weather patterns is expected to increase the risk of extreme temperature events and to decrease raw water supply reliability (ECLAC 2010). Compounding the effect of urbanization, cities are likely to become more vulnerable to flooding, droughts and to other natural disasters, due to less frequent and more intense precipitation. Other water threats resulting from climate change in the region include severe reduction of hydroelectric generation due to glacier retreat, increases in aridity of water sources, and overexploitation of natural resources (ECLAC 2010).

These trends will require adjustments to the way water is managed, to account for growing scarcity and uncertainty. Once the effect of climate change is accounted for, expected changes in water demand and availability result in a predicted water use intensity index (defined as water demand over available renewable water) of 140% in Central America in 2100, and over 370% in the absence of adaptations and savings measures. Even projections based on the most conservative scenarios suggest that all countries in Central America (with the exception of Belize) will breach the 20% water use intensity threshold internationally recognized as critical for water stress by 2100 (ECLAC 2010). The economic costs associated with these changes are non-negligible; temperate zones in the region may lose up to 1% of annual GDP for each year up to 2100 (ECLAC 2010).

Inefficient water management – Current approaches are predominantly local and sector-specific, lacking the innovation and scope to address cross-cutting challenges

Water resources are not being managed in an efficient or sustainable manner. As a simple example, Latin America loses at least 30 percent of water collected and treated for public consumption,

amounting to approximately nine trillion cubic meters of water every year. A recent World Bank study shows more than 25% of water in the Mexico Valley is being used in an economically inefficient manner; leading to aquifer depletion, costly soil settlements in many parts of Mexico City, and the need for significant imports from other water basins (World Bank 2012). Amongst common management hurdles in LCR, the efficiency of urban water management typically suffers from insufficient piped water coverage rates; poor economic valuation of water resources; misallocation among competing uses; and lack of operation and maintenance funds (IADB 2002). Many of these shortcomings stem from an overreliance on partial approaches to water management and a narrow conception of the water cycle, which fails to capitalize on the common issues faced by different urban services (see Box 3).

The interrelated nature of these underlying challenges demonstrate a clear need for a more integrated approach to water management, as a means of ensuring the renewal of resources needed for long-term sustainability in an urban world.

In practice, while urban water services and urban planning are interdependent fields with many overlapping issues, they are usually managed by entirely different systems and institutions. Oftentimes, in large metropolitan areas, there are distinct administrative jurisdictions providing services or regulating urban development in different parts of the metropolitan region. Similarly, different urban water services are rarely implemented, managed and operated by the same institution. The consequences are reflected in the absence of integrated management, eco-systemic approaches, and institutional innovation (IADB 2002). An integrated approach to urban water management must therefore take account not only of the urban context in planning water policy, but should also coordinate provision of the city's various water services. ■

Box 2. Examples of interrelations between urban planning and water services

- **Zoning:** Zoning is a key instrument in urban planning and should be coordinated with the provision of water services; through zoning, floodplains can be maintained free of critical infrastructure; urban development can be directed to denser, easier and more cost effective to serve users.

- **Water-smart urban landscaping:** Cities such as Las Vegas have adopted urban landscaping that minimize water consumption for green areas (public and private), going as far as paying private owners to replace their lawns with climate-appropriate landscaping; concepts such as Low Impact Development ensures the natural water cycle is maintained as natural as possible, for example by encouraging local infiltration or retention of rainwater.

- **Valorization of urban water assets:** Cities as diverse as Sao Paulo, Bogota or San Diego have recognized the significant urbanistic value of water bodies within the urban fabric and have sought to transform previously disconnected and polluted rivers, lakes and or ponds into urban spaces, often fulfilling public recreation functions as well as ecological, flood protection or stormwater management functions.

3. IUWM – An Approach for Tomorrow's Cities

INTEGRATED URBAN WATER MANAGEMENT

Integrated Urban Water Management (IUWM) is a flexible, participatory and iterative process which integrates the elements of the urban water cycle (water supply, sanitation, stormwater management, and waste management) with both the city's urban development and river basin management to maximize economic, social and environmental benefits in an equitable manner.

Figure 2. Integrated Urban Water Management (IUWM)

Source: Authors based on Tucci (2010).

As shown in Figure 2, IUWM seeks to coordinate three usually distinct dimensions (and the related institutions, planning instruments and financing mechanisms) within one integrated approach:

- **Urban water services** (water supply, stormwater management, sewerage and wastewater management, and solid waste management). In the context of IUWM, the linkages between these services are seen as an important dimension as well.

- **Urban Development.** IUWM does not limit itself to seeking coordinated planning for city development and water services; urban development itself can and should be an instrument of better urban water management, since the way cities develop is both influenced by, and impacts water service provision.

- **Watershed management**. IUWM does not seek to replace traditional IWRM approaches; but rather to ensure that watershed level management is well coordinated with the specificities of city level realities, especially in the case of watersheds with significant urban water use.

IUWM also acknowledges that the responsibilities for these various dimensions often lay with different actors across a number of neighboring jurisdictions at municipal, regional and national levels in most metropolitan regions. Those actors must find mechanisms to coordinate their work to achieve IUWM.

In practice, IUWM is a multifaceted approach that varies depending on the nature of a city's specific water challenges and the level of development of its water management institutions. Likewise, the outcome of an IUWM approach is not pre-determined, and will be different in every city. Nevertheless, there are general hallmarks of an integrated approach to water challenges, which are described in greater details in Chapter 4.

Box 3. Examples of interrelations between urban water services

- **Water supply and other water services:** (a) wastewater and stormwater discharges pollute the water supply source; (b) leachate from landfill sites pollutes groundwater and/or downstream rivers; (c) erosion may affect the quality of water supply sources;
- **Sanitation and stormwater:** (a) combined networks for wastewater and stormwater affects the efficiency of treatment; (b) in separate systems the major challenge is to avoid the connection of rain water in the sewer network and also of sewage in the stormwater network; (c) lack of sewage collection coverage will impact stormwater systems because they are likely to receive sewage through illegal connections;
- **Stormwater and solid waste:** (a) stormwater network efficiency is affected by lack of street cleaning and solid waste services, since litter is the most common cause of contamination and clogging in stormwater pipes and channels; (b) drainage and erosion control require common strategies because sediments affect the performance of the drainage system.

WHY IUWM MAKES SENSE

In an era of greater environmental risks and tighter financial conditions, adopting an integrated approach to urban water management is not only essential to enhancing the environmental sustainability of cities, but it can also provide considerable cost savings by improving quality of life and reducing disaster vulnerability of urban dwellers, by increasing the efficiency of water services, and generally by reducing the economic cost of poor water management, paving the way for a green and inclusive urban growth.

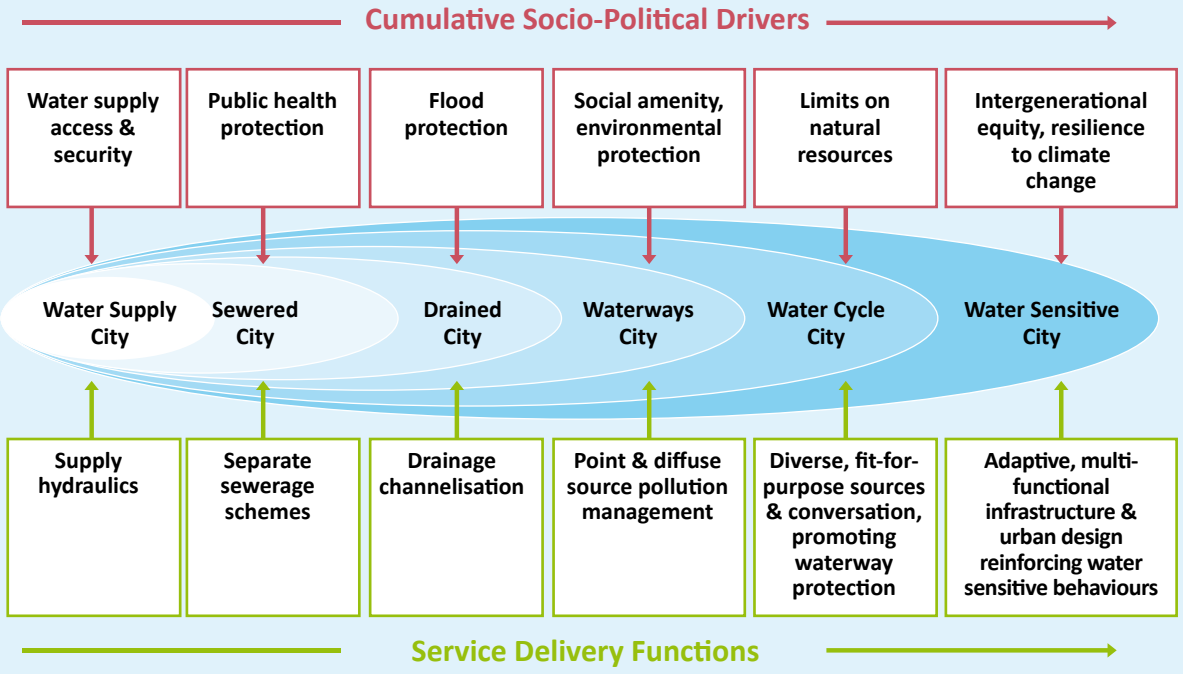
Frequently, urban planning is disassociated from urban water services and does not take into consideration health and environmental goals; this situation is compounded by fragmentation in the development and management of urban water services, so that water supply, sanitation and drainage interventions are undertaken without common goals and often with conflicting impacts. Several factors explain why it is uncommon for urban water to be managed under an integrated arrangement. Firstly, these services are traditionally provided by different institutions and it is difficult to change and create a newly integrated institution, or to make institutional actors realize the benefits of working together, as a result of conflicting agendas. Secondly, the public perceptions of the importance of certain urban water related services tend to be low, especially in the case of stormwater and solid waste. As a result, there is a low willingness to pay for operation, maintenance or for cost recovery of investments, compromising the feasibility of charging for these services. Thirdly, the absence of measurement of utility performance results in higher costs and tariffs on the one hand, and in low efficiency in service provision on the other.

Deficient urban services resulting from poor urban water management practices generate a significant economic burden. In Tegucigalpa for example, the annual cost of deficient services is upward of US$160 million or 2.4% of national GDP (World Bank 2010). Unreliable water supply and lack of basic sanitation in cities pose severe costs in terms of productive time lost to illness, health and patient costs incurred in treatment of diarrheal diseases, cost of preventable deaths, and time costs arising from poor access to facilities (WHO 2004). Total economic benefits from increasing access to improved water and sanitation for everyone for one year would provide a combined economic benefit of $3.33 billion in the Americas region, and providing regulated piped water supply in house and sewage connection with partial sewerage for everyone for one year would yield benefits of $9 billion (WHO 2004). Further cost savings could be gained through reduced transaction costs and the economies of scale associated with integrating different aspects of water service delivery at the city level.

Furthermore, there is a growing recognition of the tight relationship between a city's urban fabric and growth pattern; and the provision of water-related services (see Box 2). For example, despite roughly similar populations, the cities of Atlanta and Barcelona differ starkly in their development model. Barcelona occupies only about 1/20th of land, making service provision much more cost-effective, but also, potentially, creating different risk profiles in terms of flooding. The growth of informal settlements around the main reservoirs of cities such as Sao Paulo or Tegucigalpa, leads to decreased water quality and potentially significantly higher treatment costs. A decision by the City of Las Vegas in 2000 to regulate landscaping on public and private grounds, and financially encourage homeowners to abandon green lawns and replace them with native species, led to savings of around 17M m^3 per year, a 20% reduction despite a half million new inhabitants in the same time span. Likewise, the Brazilian city of Porto Alegre adopted, in 2006, a stormwater management plan that created regulation for urban developers to minimize runoffs from new constructions, and encourage infiltration or on-site retention instead; the city estimates that by promoting such measures it saves around 90M USD in downstream flood protection measures, at a cost of around 15M USD for urban developers. Cities such as Bogota or Buenos Aires are taking the opportunity of large scale flood mitigation and river cleanup efforts, to create new public recreation areas and improve both the quality

Box 4. A historical perspective on IUWM

Authors such as Brown have sought to present IUWM as the logical evolution of cities that were initially focussed on water services delivery and gradually recognized the interconnections and interdependencies of urban design, natural resources management, and service delivery (Brown 2008). In that sense Brown's concept of water sensitive cities is close to this note's concept of green cities – cities that develop in an efficient, clean, resilient and equitable manner.



Source: Brown et al (2008).

of life of urban residents, and the environmental values of these water bodies.

An additional challenge in many large metropolitan areas in Latin America is the presence of multiple administrative jurisdictions and the absence of effective metropolitan governance mechanisms. In the case of the MRSP (Metropolitan Region of Sao Paulo), for example, there are 39 different municipalities, each with its own land use and urban planning vision, institution and regulations; some have issued concessions for their WSS service provision to the State utility, SABESP, but not all. And solid waste management is largely handled at municipal level. Despite a legal framework that created some metropolitan-level governance structure, overall metropolitan planning and coordination very much depends on ad-hoc agreements. The same can be said of the Greater Mexico City area, which encompasses several States, a federal district, more than 70 municipalities and a federal government that manages most of the primary water supply, stormwater and wastewater treatment infrastructure.

Finally, the relationship between a City and its Watershed, especially in the case of larger metropolitan area, is a defining feature of urban water management (see Box 5). Several Latin American metropolises are breaking new ground with exemplary best practices in this area. In Brazil, the State of Sao Paulo's Total Urban Water Management (TUWM) program synchronizes urban upgrading with water resource management policies, water quality targets and land use regulation; integrates quality targets for several water catchment areas; and fosters interconnections between water-stressed metropolitan regions to resolve conflicts (State Government of Sao Paulo, 2010). Other forerunners include the Metropolitan Area of Medellin, Colombia, where IUWM addresses landslide and stormwater erosion risks in the densely urbanized Aburra-Medellin Valley, and the cities of Monterrey in Mexico and Vitoria in Brazil. These models of effective IUWM are rapidly turning the challenges of urbanization and climate change into opportunities for smarter resource management and sustainable growth.

GOOD PRACTICES FOR A SUCCESSFUL IUWM APPROACH

Certain central characteristics are common to successful IUWM strategies in most settings, and the principles laid out in the following list reflect generally accepted good practices; others have developed and proposed principles for the outcome of an IUWM approach, which are not listed here (World Bank 2012).

Box 5. Examples of interrelations between a city and its watershed

- **Water supply:** Large cities have a strategic interest in their watersheds. Mega-cities, or even larger cities, very often represent a significant consumer of raw water in their watersheds and sometimes in watersheds further away. Sao Paulo, Mexico City and Monterrey all derive significant proportions of their water from external watersheds. Cities generally seek to maintain water quality of their resources, often requiring trans-jurisdiction or watershed-wide mechanisms to do so. Watershed-level mechanisms are also essential in the face of climate uncertainty, to ensure adequate water supply in drought situation, for example through water rights trading or emergency purchases from irrigation or other users.

- **Pollution control:** Conversely, cities also significantly affect downstream water bodies, generating very significant organic loads that often go untreated into nearby water bodies, severely limiting their usage for recreation, urban water supply and sometimes irrigation. Holistic water quality management, which looks at cost-effectively controlling all sources of pollution to meet water quality objectives, can only be done at watershed level.

- **Regional flood management:** Flood profiles of urban rivers can be significantly affected by developments in their upstream watersheds.

- **IUWM needs to be tailored to the specific and dynamic challenges of each urban area**. IUWM approaches can vary greatly depending on the institutional arrangements of urban and water management in a particular urban area as well as the specific water challenges. The scope of IUWM in a particular case can also differ depending on the type of influence on the urban area within the river basin (a city could: overlap an entire basin, represent a fraction within a river basin, and even influence more than one basin). The multifaceted challenges and scope for IUWM highlight the importance of a good assessment to better understand local city challenges.

- **IUWM involves a set of participatory approaches and instruments** to help relevant institutional and non-institutional stakeholders develop an agreed diagnostic of urban area challenges as well as a shared vision of future development on the urban area of influence. Participatory approaches could certainly result in a lengthier process, but once agreed, participatory diagnostics and planning become powerful tools with higher chances of sustainability and compliance over time.

- **IUWM is not a one-time action, but an iterative, long-term process**. The characteristics and challenges of urban areas are bound to change with time. This is why planning becomes a cyclical process that continuously revisits urban area challenges, priorities, as well as means and actions to address these challenges. An iterative and participatory IUWM process also allows combining both short- and long-term agendas, using a long-term vision to inform the actions taken today.

- **IUWM is as much about institutions and processes as it is about infrastructure and investments.** Integrated management of water in an urban setting tends to be challenging since it involves a wide array of systems and institutions, both within the city and at the river basin level. This condition can create challenges in managing common issues such as wastewater and stormwater discharges that pollute the water supply source, or the impact of disorganized urban growth on drainage. Cities able to coordinate water management institutions, or to have them operating under the same plans, guidelines or goals tend to show better performance than cities that do not (Porto and Tucci 2010).

- **IUWM must be informed by sound science and technical analysis.** Although IUWM is highly political by nature, decision-making by key stakeholders must be informed by sound technical analysis. The analysis must include not only engineering and sectoral aspects but also solid financial, economic and social assessments to inform the decision-making process in a meaningful way.

- **IUWM requires moving away from segmented, linear thinking.** A key objective of IUWM is to progress from a linear *urban water metabolism*[3] - which relies on an unrestricted availability of resources and energy and is not able to tackle adverse impacts of waste and other outputs on the environment and society (see Kennedy et al. 2007) - to a cyclic metabolism aimed at avoiding, minimizing, cycling and transforming inputs within the city in order to reduce or eliminate outputs, i.e., negative impacts on quality of life of urban dwellers and the environment (Novotny 2010).

- **IUWM seeks to address today's challenges without losing sight of tomorrow's.** Many cities in Latin America are far from being able to realize the ideal vision of a *City of the Future*, the term coined for sustainable, green cities by the International Water Association (IWA 2011). However, it is important that today's water challenges be addressed in a way that reflects an integrated approach, and keeps in mind the long-term vision towards which the city should move. ■

3 The sum of technical and socio economic processes that occur within cities, resulting in growth, production of energy and elimination of waste (source: Kennedy et al., 2007)

4. IUWM Practices

This chapter compares the expected outcome of traditional and isolated responses to urban water challenges to those encouraged by an IUWM perspective where challenges are understood and addressed by all stakeholders in a coordinated manner.

Table 1. Key IUWM Challenges and Comparison of Common Responses

City Services/ impacts	Challenges	Traditional Approach	IUWM approach
Water supply deficiencies	• Lack of water sources due to climate conditions, excessive use or contamination. • Lack of coverage. • High water losses. • Lack of demand management leading to excessive use.	• New sources are identified and connected to the system, focusing on water treatment to address possible contamination issues.	• Protection of existing water sources (at watershed level) to maintain quality and quantity - regulated and enforced land use in the water supply basin. • Demand management: individual metering, use of economic incentives for water use reduction to all users, use of a sustainable tariff structure. • Water loss control; reduction of financial and physical losses. • Incentives for water reuse and recycling, payment for environmental services. • Next source must be viewed as the “last resource”.
Lack of Sanitation	• Lack of collection systems or connection to sewer network. • Lack of wastewater treatment plants. • Illegal discharges. • Sewage in stormwater network and stormwater in sewer network.	• Implementation of large centralized collection and treatment systems is preferred, without considering efficiency in collection, and with high implementation and maintenance costs.	• Consideration of on-site sanitation and decentralized treatment and reuse systems (especially in industry and agriculture) as an alternative to centralized treatment. • Recycling treated wastewater for potential reuse within or outside of the city. • Incentives for household connections.

City Services/ impacts	Challenges	Traditional Approach	IUWM approach
Surface water contamination	• Reduced availability for most uses. • Impact on ecosystems. • Impact on aesthetics. • Severe health issues mainly during flood events.	• Large wastewater treatment investment underused or abandoned. • Levels of pollutant discharge standards set without consideration for water quality of the entire river system.	• Planning for water quality goals of the entire river basin, and definition of treatment levels on the basis of desirable and achievable water quality targets in receiving water bodies. • Use of command and control instruments together with economic instruments to reduce pollution. • Inclusion of non-point pollution as part of water quality targets. • Development of sound financing strategies for wastewater treatment operation and maintenance.
Solid waste and sediments	• Lack of collection of solid waste. • Lack of erosion control and presence of sediments in construction sites. • Lack of participation of citizens to control disposal of solid waste in public spaces. • Absence of reuse. • Ill-managed solid waste and sediment production clogs channels and stormwater pipes, reducing efficiency and increasing maintenance costs.	• Solid waste management is completely separated from management of other urban services. • Areas of poor informal settlements are not usually serviced because it is difficult to collect waste using traditional trucks. • No incentives for waste control, reuse and recycling. • Land use control does not enforce erosion control in open and bare land.	• Solid Waste Management viewed as a part of the environmental management of the city, together with drainage and sanitation. • Solid Waste Management strategy to cover entire urban area; incentive measures in place to control production and increase recycling. • Education campaigns to all segments of the population. • Implementation of charging for the service by volume or weight in order to decrease waste production. • Control of erosion in open land areas.

City Services/ impacts	Challenges	Traditional Approach	IUWM approach
			• Control of sediments in construction sites, with regulation and enforcement, and disincentives for the use of plastic bags and containers. • Financing mechanisms to ensure appropriate investments and operation and maintenance.
Stormwater	• Occupation of flood-prone areas. • Excessive imperviousness with consequent increase in peak flows. • Low water quality since higher velocities have an increased capacity of carrying pollutants, sediments and solid waste.	• Channels, pipes and other structural measures built to send away flood waters as fast as possible downstream impacts are not considered. • Structural measures are dominant.	• Watershed perspective is most important. • Preventive measures (low-impact development, urban planning regulations, upstream retention) preferred over corrective measures – for example, on site measures of infiltration and green building practices. • Disruptions to natural water cycle minimized. • Urban planning seen as an important instrument to control urban development in flood-prone areas; imperviousness and water retention controlled in new urban developments, for example through storage and reduction of runoff; rules and practices integrated into urban land use and environmental policy.
Urban Development / Land Use	• Lack of integration of urban planning with environmental and sanitary issues. • Flood-prone areas are occupied. • Investments needed for upgrading informal settlements are high.	• Urban planning does not consider impacts over stormwater systems. • Urban planning does not consider the burden on water and sanitation systems in new areas of development.	• Flood zoning is related to the different levels of risk available for the entire community. • Sensitive activities placed outside flood-prone areas; a balance is sought between densification and protecting impervious areas. • Verticalization vs. sprawl must be considered, since impacts on water infrastructure and runoff are significant. • Urban planning and planning of green spaces coordinated with water systems planning, and climate-sensitive landscaping. • Regulations in place to incentivize low-impact development and tax flood impact of new urbanizations.

City Services/ impacts	Challenges	Traditional Approach	IUWM approach
			• Restrictions and economic incentives to protect municipal water basin, and incentives for green buildings construction. • Development of water bodies as part of urban landscape with multiple functions (environmental regeneration, leisure, flood prevention etc.)
Watershed Management	• Conflicts for water use within over-exploited water basins. • Economically inefficient allocation of water resources. • Contamination of water bodies by upstream users create significant costs to downstream users. • Flood management is "pushed downstream".	• Basin management authorities with limited financial and institutional weight. • Rigid water quality standards issued regardless of actual or potential use of water bodies.	• Protecting watersheds for municipal bulk water supply; Payment for Environmental services schemes. • Water allocation among competing users and dealing with droughts. • Regional flood management-cities often get flooded by rivers from upstream flow. • Holistic water quality management which looks at cost-effective control of all sources of pollution to meet water quality objectives.
Institutional framework	• Municipal service providers operate in an uncoordinated manner. • No clear cost recovery mechanisms exist for some services. • There is no mechanism for city-wide water management, or for city/basin integration. Multiple municipalities and jurisdiction work in an uncoordinated manner. • Stormwater management is often no one's responsibility.	• Strengthening activities focused on individual service providers. • Watershed agencies are installed with limited capacity (financial and technical). • Stormwater management is addressed mostly through the construction of drainage systems.	• Mechanisms are created to ensure effective water management within the city while the relationship between the city, the basin and their watershed committees is clarified. • When possible, metropolitan governance mechanisms are used to ensure multiple municipalities and jurisdiction. work in a coordinated manner • Services are consolidated in a single provider; coordination mechanisms between services are improved; the relationship with urban planning and development is strengthened. • Cost recovery mechanisms are designed in a way to provide the correct incentives with regards to water management; subsidies are targeted to the poor. • Enforceable laws and regulations are esta blished. • Public participation and capacity building initiatives.

Figure 3 and Figure 4 show further examples of how an IUWM approach can lead to a much more holistic view of the urban water cycle. The traditional approach shown in Figure 3 would be to focus on a limited set of physical infrastructure options for meeting a single city's water needs. In order to meet growing water needs, a city would invest more to build more costly infrastructure in an effort to reach more distant water supplies and/or increase capacity. Wastewater, sometimes, would be collected, treated, and discharged—sometimes, back into the receiving water body. Stormwater, in ever increasing quantities due to urbanization, would be collected and conveyed with larger pipes and pumping stations. Water investment and management decisions would be made by water utilities under the control of a single municipality, without taking into account the broader regional context, environmental objectives, or urban planning and management processes. This traditional approach to urban water services is no longer viable due to increasing financial and environmental constraints that come with this inherently inefficient process.

Figure 3. Traditional water management for cities

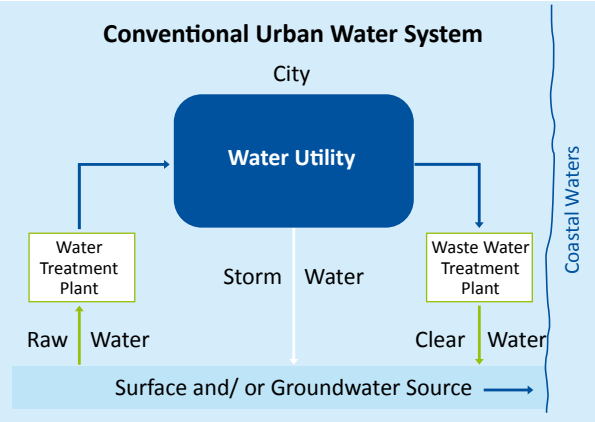
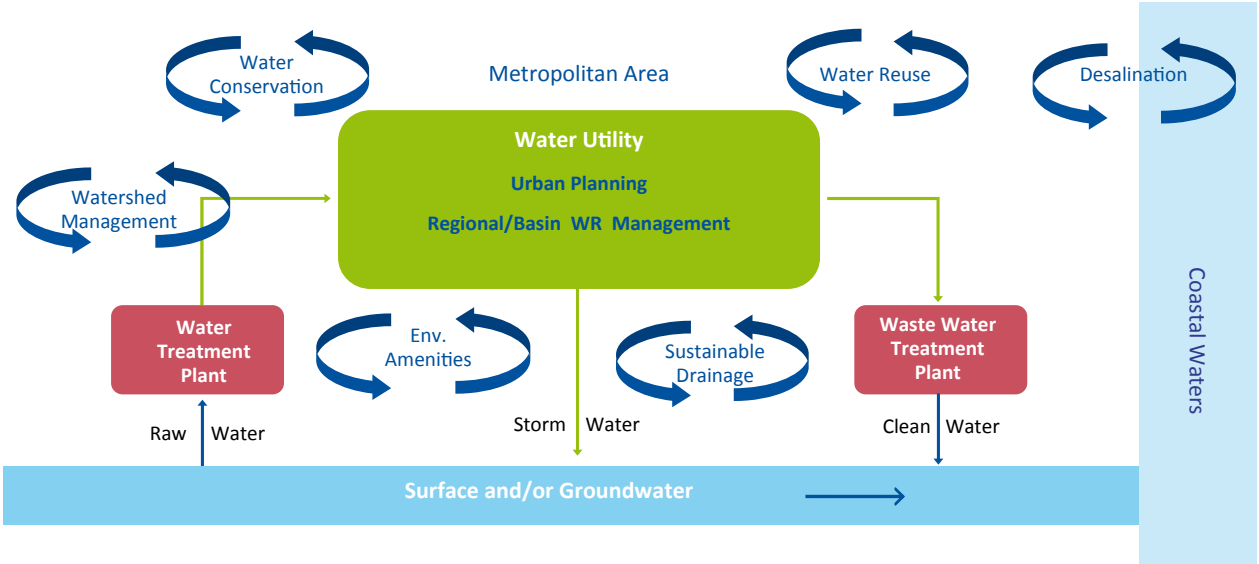


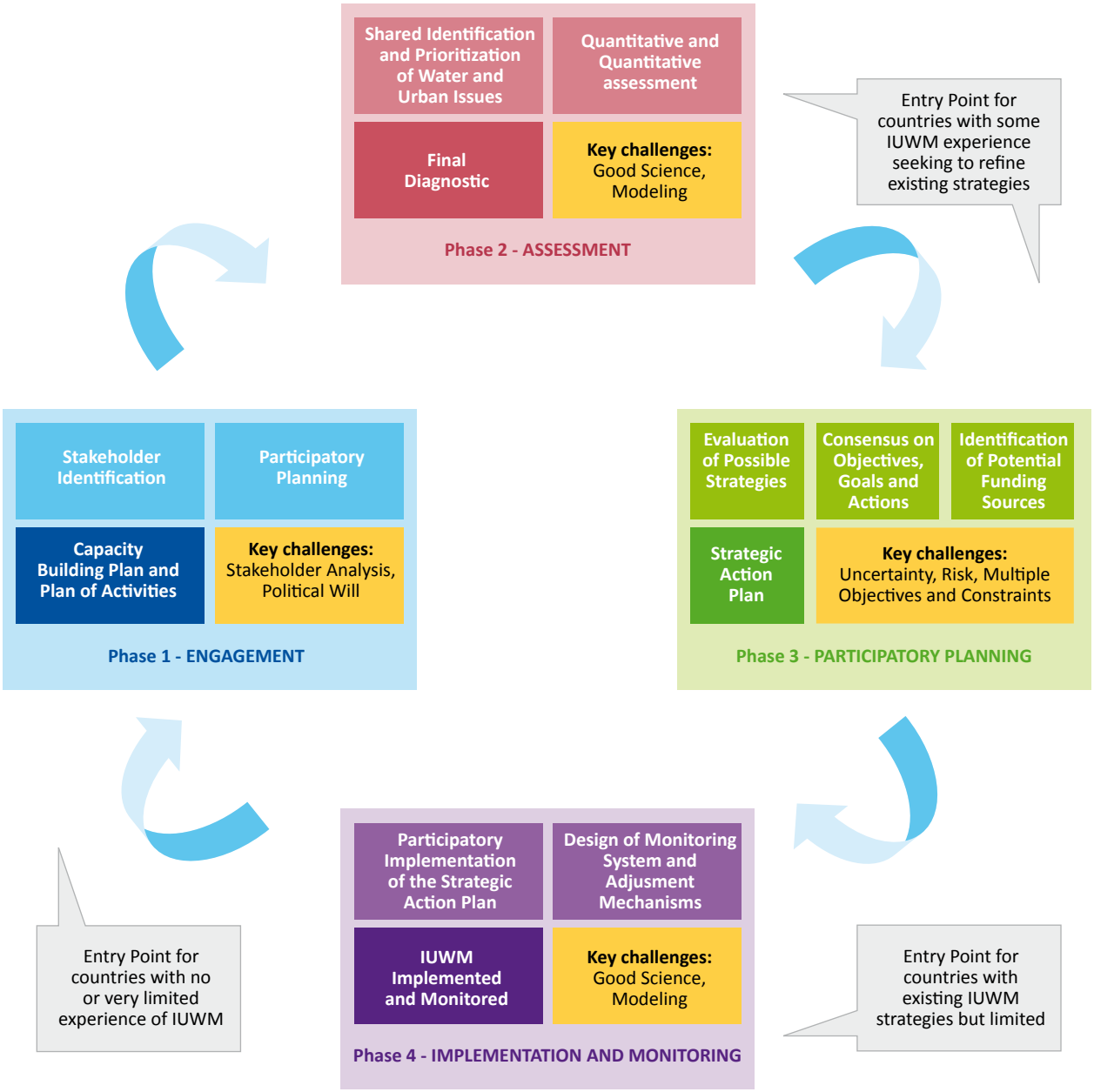
Figure 4, in contrast, graphically represents the emerging concept of IUWM. Solutions are not only provided by infrastructure investments, but also by new management and planning practices. The "tool-box" of possible interventions is greatly expanded and instead of only traditional infrastructure to augment supply, there are new practices such as water conservation, wastewater reclamation and reuse, and desalinization to augment water availability; sustainable urban drainage is employed to reduce runoff quantity and improve quality; and watershed management is enhanced to protect raw water quality and availability. Most importantly, water utilities are not working independently but rather embedded in a process of watershed and metropolitan area planning and management where actions are coordinated to reduce costs and improve outcomes. ■

Figure 4. Integrated Urban Water Management for green cities



5. The IUWM Process

Figure 5. Step-by-step process to develop and implement an IUWM strategy



OVERVIEW

This previous chapter highlighted some of the emerging practices related to IUWM. This chapter presents an approach for identifying how those practices can be identified, developed and applied in a specific urban setting. This general process can be used by actors assisting cities and metropolitan areas in developing or strengthening IUWM strategies, as well as other stakeholders at the municipal or national levels in planning and prioritizing investments in Latin American cities and elsewhere.

The approach is developed in four main phases, as follows (Figure 5):

- Engagement Phase
- Assessment Phase
- Participatory Planning Phase
- Implementation and Monitoring Phase

These phases are flexible and need to be tailored to a city's primary challenges and level of institutional development. Indeed, while this guide is intended primarily for cities for which IUWM is a new concept, the proposed structure allows for several entry points at different steps in the process for cities where IUWM involvement is already somewhat advanced. Moreover, it is possible to go back and forth among the different phases along the process, which is iterative and continuous by nature. Further information and operational tools are provided on the initiative's website http://www.worldbank.org/laciuwm

PHASE 1. ENGAGEMENT

Objectives	• Identify stakeholders and foster commitment • Establish adequate participatory mechanism • Present IUWM and ascertain interest of key stakeholders • Provide initial training on IUWM
Activities	• Create a Stakeholder Engagement Plan • Conduct a first workshop to interact with stakeholders, present the scope and limit of the Bank's support and define the process for following phases
Tools	• Traditional Planning: Capacity Assessment, Needs Assessment • Stakeholder Engagement: Stakeholder Assessment and Analysis, Stakeholder Engagement Plan • Hybrid: Dhared Vision Planning
Outcomes & Outputs	• Stakeholders identified and committed • Plan of Activities drafted and first assessment organized • Capacity Building Plan designed

Box 6. Engagement Phase in Practice – Asuncion and Aracaju

In the case of Asuncion, the engagement phase was coordinated by the Ministry of Public Works and Communications (MOPC), with the participation of the municipalities of Asuncion, Mariano R. Alonso, San Lorenzo, the National and Catholic Universities, the Ministry of Environment and other institutions of the sector. In August 2010, the Bank team held several meetings with key stakeholders at a municipal level and as a result an agreement was reached to develop a strategy for Integrated Urban Water Management in Greater Asuncion. The Municipality of Asuncion committed to assign technicians to serve on the local planning team. The agreement led to the definition of a proposed Plan of Activities and a schedule of future activities.

In Aracaju, the engagement of the Municipality and the State culminated in a workshop held in August 2010, coordinated jointly by the Municipality and the Secretariat of the Sergipe State for the Environment and Water Resources (SEMARH). The event was attended by representatives from the Government, technical institutions and NGOs, who discussed the methodology presented by the Bank and agreed on a proposal for the Plan of Activities and a calendar of upcoming activities for strategy development.

The engagement phase has the objective of identifying which government levels must be involved in the process (municipality, county, state, national) as well as other stakeholders that may provide input as partners (private sector, NGOs, universities) in developing an IUWM strategy. It is also necessary to identify the government representatives from the municipality or from other government levels that will take the lead and undertake a coordinating role in the development of the strategy.

Among the main stakeholders that should be involved in this phase are representatives from:

The public sector – at municipal, basin, regional and, depending on the size of the country, national level, due to its responsibility over the common good represented by the environment; in the common case that multiple jurisdiction are present in the same metropolitan area, fair representation from not only the main one should be sought.

- The direct users / polluters, usually represented by the economic sectors involved in the problem.
- The local civil society, to represent the common perception of the problem.
- Depending on the region, local universities and research institutes might be interested and could lend technical credibility to the process.

The major outcomes of this phase are the identification and engagement of stakeholders, and the preparation of a Plan of Activities and Capacity Building Plan. Initial training on IUWM might be provided with the purpose of eliciting stakeholder interest and buy-in.

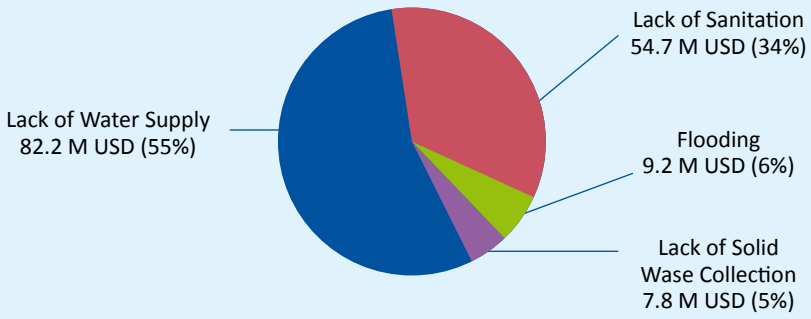
PHASE 2. ASSESSMENT

Objectives	• Develop a common understanding of the challenges linked with water in the Metropolitan Area • Identify and prioritize the issues or main urban challenges • Evaluate the consequences of inaction
Activities	• Identify existing studies and data • Conduct qualititave and quantitative assessment • Draft and validate diagnostic study • Evaluate the economic cost of inaction • Continue providing training to stakeholders as needed
Tools	• Traditional Planning: Institutional and Regulatory Assessment, Environmental Assessment, Economic and Financial Assessment, Social Impaact Assessment • Technical Modelling Studies: Water Balance, Water Pollution, Land use, Drainege, Characterization of the Urban Area • Qualitative Matrices of Issues • Indicators for Diagnostic and Assessment • Stakeholder Engagement: Participatory Diagnostic
Outcomes & Outputs	• Main issues and strategies identified • Final Diagnostic drafted and validated

This phase is intended to identify, in a participative manner, the main issues that the City faces in terms of urban water management, and quantify (if economically possible) their importance and impact. It must produce (i) a qualitative assessment based on secondary information that can be gathered quickly, usually developed by local partners and supported by the main financial institution, and (ii) a quantitative assessment of the issues identified, as far as possible without significant studies.

Box 7. Assessment phase in Practice – Tegucigalpa

In the case of Tegucigalpa, the analysis showed for example that while the population was paying – through tariffs – about 38M USD a year for water services; the economic cost of coping mechanisms for deficient services amounted to close to 150M USD a year. Under this light, the possibility of financing part of a strategy through tariff adjustments became more realistic.



Within qualitative and quantitative assessments alike, it is important that three major components be considered: (i) the *urban water services* (water supply, sanitation, urban drainage/stormwater management and solid waste) and impacts that will be produced by either having or not having proper services on health, environment, vulnerability to floods or natural disasters and amenities; (ii) the *urban development situation*, including investment capacity, institutional arrangements and desirable goals; and (iii) the *watershed dimension*, including other uses, potential or existing conflicts on water quality or quantity, existing coordination and planning mechanisms etc. It is particularly helpful to define Urban Scenarios, including an assessment of the city expansion that accounts for slum expansion and for informal city dynamics over time spans of 10, 20 and 30 years, considering the local economic and social changes as well as regional and national development. Such scenarios should also include a risk assessment for extreme events, natural disasters when pertinent, and other risks that may impact the region. The final output of this phase is an identification of main issues, and the validation of a final diagnostic report.

In parallel with the participatory diagnostic, provision of technical training on relevant topics and exposure to international good practices, is often helpful to inform the discussions.

PHASE 3. PARTICIPATORY PLANNING

Objectives	• Evaluate possible strategies within the institutional, social, economic and technical settings • Develop a consensus around short, middle and long-term activities in order to improve IUWM
Activities	• Prioritize the identified issues • Set objectives, goals and actions • Analyze and compare scenarios • Draft and validate a Strategic Action Plan
Tools	• Stakeholder Engagement: Preliminary Strategic Plan of Action, Strategic Report, Strategic Urban Water Plan • Participatory Strategic Planning
Outcomes & Outputs	• Strategic Action Plan finalized and validated • All Stakeholders informed about IUWM agreed strategy • Potencial funding sources identified for short-term activities

Once key issues have been identified, agreed upon and assessed, the participatory planning phase will typically include discussions about broad strategies to address the main issues identified. These strategies must be refined in light of the assessments carried out in order to select the most viable options, and must take into account the selected goals and expected implementation difficulties. Therefore, during this phase, the issues identified during the previous phase are prioritized on the basis of the technical and economic assessments carried out, and strategies to address these (including objectives, goals, actions and timeline) are agreed upon through a series of participative meetings. These strategies should include both non-structural and structural measures, as well as further studies and research in those areas where the current level of knowledge is insufficient to make sound decisions.

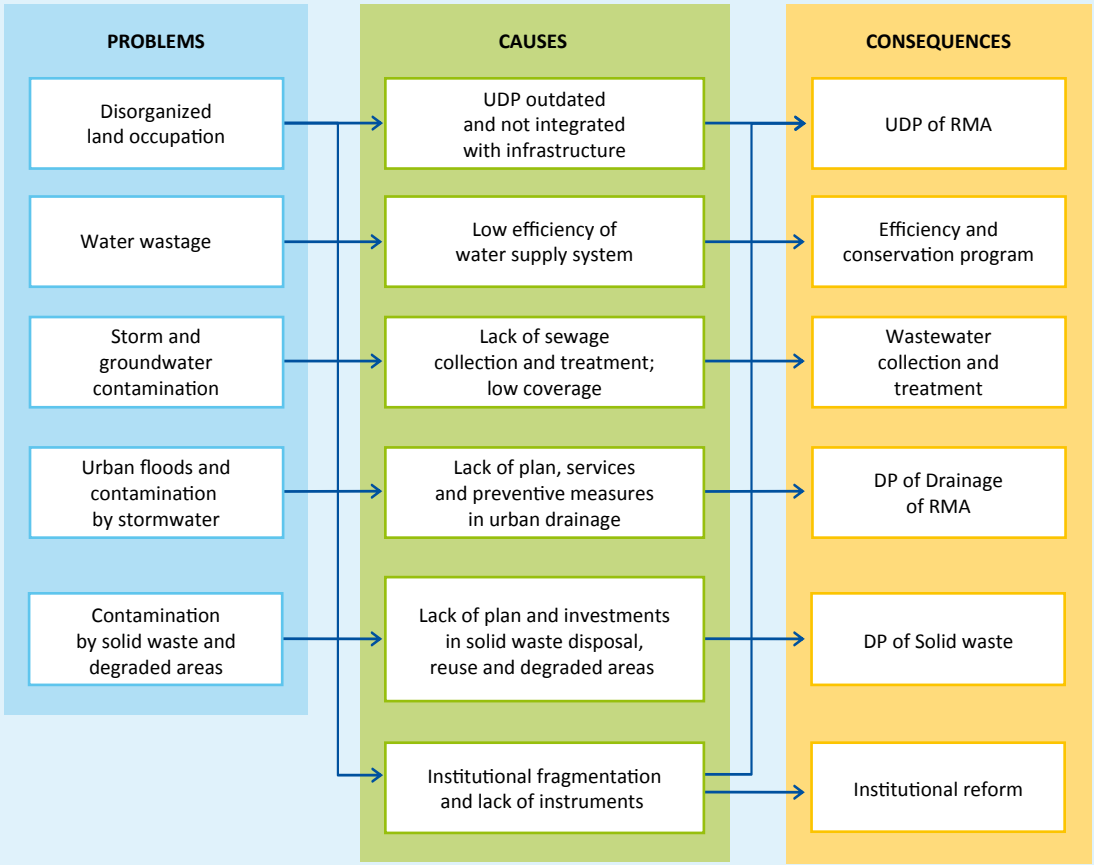
Typically, the participatory planning phase should entail discussions about broad, policy-level alternatives (for both structural and non-structural measures) even though in some cases the information available might not be sufficient to reach a final decision. Those discussions should start from technical, financial and economic evaluations of

the various alternatives, to look into issues such as investment and operation costs, economic rate of return, and financing options. However, it should be made clear that the decision on following one scenario rather than another depends on a number of different considerations, such as the political cost associated with each scenario, the viability of mobilizing the necessary investments, and the feasibility of each scenario, rather than only on economic and financial aspects.

Box 8. Participatory Planning Phase in Practice: Aracaju

The preparation of the strategy in the city of Aracaju started in March 2011 with two days of training and a workshop where the Diagnostic was presented and the proposed strategy discussed. Two months later, another workshop was held in order to discuss the report and to consolidate the strategies and goals of the project. This report summarizes all information obtained at all stages of work obtained through consultations with the public sector responsible for urban water management in cities of the RMA (Metropolitan Region of Aracaju).

The process developed through the workshops led to the identification of a set of problems summarized in the Table below, seeking to identify the issues that have an impact on quality of life and city management. For each aspect (Urban Planning, Urban Water Services -Water Supply, Sanitation, Urban Drainage, Solid Waste- and Institutional Organization), problems, causes, consequences, and key strategies and goals were identified.



The strategy should then be extensively validated and adjusted to incorporate stakeholder comments. The output of this phase is a finalized and validated Strategic Action Plan that proposes alternatives appropriate to the city's institutional, social, economic and technical settings and considers investment priorities and potential funding.

PHASE 4. IMPLEMENTATION AND MONITORING

Objectives	• Successfully implement the projects defined in the IUWM Strategic Action Plan • Monitor and review implementation progress, and adjust as needed
Activities	• Implement the projects according to the strategic plan • Design the monitoring system in a participatory manner • Monitor results and develop adjustment mechanisms • Document monitoring of Strategic Action Plan • Perform yearly evaluation of the urban development and achieved goals
Tools	• Urban water impacts and goals Indicators • Results framework
Outcomes & Outputs	• IUWM implemented and monitored

The Implementation phase occurs when projects are detailed and implemented following the Strategic Action Plan. This phase is open-ended and iterative, and the monitoring process is designed with active participation of key stakeholders, defining the criteria that will be used for monitoring implementation of the strategy. The *Blue Water Green Cities'* website (http://www.worldbank.org/laciuwm) presents tools intended to provide further guidance for this phase, particularly a section on urban impacts and goals indicators, and a template results framework. A yearly evaluation of the progress in implementation is also recommended, in addition to reviewing the goals laid out in the Strategic Action Plan; as signaled earlier, an IUWM process is meant to be highly iterative. ■

6. Lessons from Latin America' Cities

This chapter summarizes some of the lessons from a series of case studies prepared under the Blue Water Green Cities initiative for the Cities of Sao Paulo (Brazil), Buenos Aires (Argentina), Bogota (Colombia), Tegucigalpa (Honduras), Aracaju (Brazil), Asuncion (Paraguay), Medellin (Colombia) and Monterrey (Mexico). These cities were selected for having developed a certain level of management practices aligned with the main principles of IUWM. Some cities were more successful than others in their pursuit of a more integrated water management, but lessons can be learned from all. The complete case studies can be found under http://www.worldbank.org/laciuwm

The chapter is structured around common challenges that were faced in several of the case studies, and responses brought by the different cities to these challenges. Although this chapter does not explicitly outline the processes by which those responses were developed, in many cases they came about through efforts that follow the general IUWM concepts highlighted in chapter 3. Further details are included in the detailed case studies published separately.

Challenge: Urban growth places stress on water availability

Water supply deficiencies are problematic for most of the cities studied, with direct socioeconomic costs. In the Metropolitan Region of Sao Paulo for example, population growth (in particular through informal settlements) is threatening the water quality of several of the city's main reservoirs, and has led water demand in the city's main watershed to be 440% over natural availability. Likewise in Tegucigalpa, year-to-year storage capacity has not kept up with population, which has increased sevenfold in the last 50 years. This leads to widespread water shortages during the dry season. In Aracaju, where demand exceeds available renewable water by 65%, there are frequent water conflicts between urban and agricultural demand; climate change is expected to further increase the deficit (World Bank 2011).

Population growth may not necessarily imply water scarcity in these cities. There is scope for further water conservation in Sao Paulo, where average per capita water use remains relatively high at 180 liters per capita per day (World Bank 2010). In Aracaju, the problem is one of service efficiency. Non-revenue water losses reach nearly 50%, and existing irrigation infrastructure could generate more effective use if it were modernized and service delivery improved. Similarly in Tegucigalpa, the water utility SANAA estimates that in a city of approximately 200,000 households, there are only 62,000 installed water meters, and of those, only 23,000 are functional. As a result, it has been suggested that SANAA is only charging customers about 20% of the true cost of the water service it provides (World Bank 2010), and end users have no incentive controlling their water use. In each of these cities, water scarcity could be considerably alleviated by more efficient resource management and service delivery.

Response: Promote water conservation, increase water service efficiency and adopt a basin-wide water management approach

A starting point for mitigating water availability challenges in an urban context is to reuse wastewater and adopt pricing policies encouraging water conservation. Within the MRSP for example, the Municipality of Sao Paulo has issued its own regulations mandating the use of reused water for the washing of streets, sidewalks and plazas and irrigating parks, gardens and sports fields. Other creative forms of water reuse include the arrangement established between farmers and the municipality of Monterrey, whereby farmers grant the use of their water rights from the nearby Cuchillo reservoir to the municipal water utility SADM. SADM then returns used and treated water to farmers for irrigation. Such beneficial trades must be sought out across actors and between sectors and municipalities, so as to optimize the use being made of existing water resources.

An equally powerful tool for fighting water scarcity is the implementation of efficiency enhancing measures in water service delivery. In Medellin, the Medellin River Sanitation Program approved in the 1980s objectives for the optimization of the water distribution system, and management of consumption and reduction of unaccounted-for water losses. Likewise in the MRSP, the water utility SABESP has implemented a ten-year program (2008–2018) to control and reduce non-revenue water by enhancing infrastructure, combating fraud and illegal connections, and improving staff training. The city of Monterrey's water use policy, described below in Box 9, is a particularly revealing example of how economic incentives can be built into water pricing and service delivery mechanisms to both encourage water conservation and improve the efficiency of water services.

Challenge: Poor service delivery in low-income areas intensifies threats to water quality

Poor service delivery causes severe surface water contamination in many of the cities studied. Informal neighborhoods often lack adequate sanitation or waste collection and treatment services, which typically leads to substantial disposal of waste into water bodies. Sanitation can be a major threat to water quality, as the non-treated-load is frequently one of the main causes of contamination of water sources. Barely 39% of the population of Aracaju has access to sewerage on average, and solid waste removal services do not ensure adequate disposal. In Bogota City, all wastewater is discharged into the river, primarily by way of illegal connections to storm drains. In Medellin, poor neighborhoods are in need of special attention and subsidy policies, due to the specific conditions of

Box 9. Incentive-based water demand management in Monterrey

CONAGUA, the federal body in charge of the management and conservation of the national waters in Mexico, is also in charge of pollution control. CONAGUA is organized in central offices, watershed commissions (*organismos de cuenca*) and local offices. Surface and groundwater water abstraction must be authorized by CONAGUA.

CONAGUA's water pricing policy is explicitly designed to encourage water conservation. Domestic uses have priority over other uses. No extraction rights are charged for irrigation (greater user), whereas domestic, industrial and other uses are charged. Every user prepares a statement of use every three months and the payment is based on the volume that is used exceeding the authorized volume. This requires a metering system, but it is perceived as more acceptable by the user. The *Organismo de Cuenca* performs routine checks for compliance and uses fines and penalties to punish unauthorized consumption. In the area of the *Organismo de Cuenca del Rio Bravo* where there are 1,000 users, compliance is above 96% both in declaration and payment (in the rest of the country, only 60% of the users pay water charges). The officers credit the *Cultura del Agua* (program developed by SADM - *Servicios de Agua y Drenage de Monterrey*) for this very high rate, as well as the certification process that industries seek in return for complying with authorized consumption volumes. Similar pricing and incentive schemes exist for wastewater discharges.

these areas; a small part of the population still lives near creeks, where the cost of introducing sanitation may be high, or where improvements can be very difficult to implement. The threats that rapid urbanization poses to water quality and availability are often massively increased by the inadequacy of urban services in low-income areas.

Response: Design service delivery strategies to cater to the specificities of poor neighborhoods and include urban upgrading aspects

Box 10. Sample of pro-poor service provision strategies implemented by the Empresas Publicas de Medellin (EPM) and the Municipality of Medellin

Network Connection Financing Program (NCFP) is an EPM initiative designed to provide access to water services to low-income households in peri-urban areas of the Aburra Valley. The program offers long-term credit at low rates to people who have no access to credit.

Financing and Re-financing Consumption (RFWC) helps households with low capacity to pay for water, sanitation and energy bills, to have access to low cost financing with minimum guarantees to prevent delinquent accounts and service disconnection.

Prepaid Program (PP) targets customers with delinquent accounts or that are at risk of having an illegal connection. The program allows reconnection of services and debt payment over 120 months charged at the DTF (*Depositos Termino Fijo*) interest rate.

Social Financing Program (SFP) / Grupo EPM card offers households in the Antioquia Region credit at competitive rates that vary according to the type of product or activity financed.

Minimum Potable Water Consumption Amount for Life is a Municipality of Medellin initiative launched in 2009 providing subsidies paid by the municipality to cover the cost of 2.5m3 /month per person.

Service delivery strategies specifically targeted to the topography and needs of low-income areas are an important element in the design of adequate urban water management in such cities. A particularly successful example of such a strategy is the Medellin River Sanitation Program, approved in the 1980s, which included as one of its objectives the extension of the potable water networks and sewer system to all areas lacking these services to reach near full coverage. The Water Management Plan of the Aburra-Medellin river basin, currently being implemented by the Medellin government's office of Metropolitan Development, additionally contemplates design and construction of sewerage in several municipalities. These municipal strategies have benefited considerably from the support of the main public services provider, *Empresas Publicas de Medellin* (EPM), which has designed a series of exemplary measures to increase access to water and sanitation services, prevent services disconnection, and improve the quality of life of its customers, with specific focus on low-income users (See Box 10). In the case of the MRSP, a joint program of the State water utility (SABESP), the State Secretariat for Sanitation and Water Resources and concerned municipalities implemented integrated urban upgrading solutions to communities bordering Sao Paulo's main water reservoirs, providing not only basic services, but also significantly improving the quality of life of low-income residents through housing and public spaces improvements (see Box 11).

Box 11. Sao Paulo's integrated urban upgrading program

70% of Sao Paulo's water supply depends on reservoirs which water quality is threatened by the growth of informal settlements on their shores. The Mananciais Program (2010-2015) builds on the cutting-edge work initiated under the World Bank –funded Guarapiranga Project, tackling the inter-related issues of urban water pollution, social exclusion and appropriate land use, and doing so in a way that brings together, in the MRSP, state and municipal government efforts. It supports cross-sectoral interventions to improve the quality of the water as well as the quality of life of low income residents in the headwater area, through measures to increase the efficiency of the water supply and sewerage systems in the region while also improving and expanding access to housing and basic services.

Before

After

Buffer zones

This 160M USD Program includes three main lines of activities, implemented by different actors in a coordinated manner.

- The Government of the State of Sao Paulo project coordinates the broader program, and implements important studies (including sub-basin Environmental Development and Protection Plans, and water demand management); strategic activities to promote sustainability of the interventions, including a seminar of metropolitan governance and water in the MRSP; and physical interventions in urban environmental infrastructure and urban upgrading.

- The SABESP -State Water Utility is focused on wastewater collection and treatment and water supply management work; the program also includes capacity building to improve the utility's operational and management capacity in the program area.

- The Sao Bernardo do Campo and Guarulhos municipalities (part of the MRSP) focus on improving the quality of life and service through urban upgrading in selected irregular and precarious settlements.

Challenge: Flood vulnerability is exacerbated by institutional weaknesses in stormwater and flood plain management, and by insufficient coordination with urban planning authorities

Stormwater floods inflict significant economic losses in most of the cities studied each year, due to the absence of stormwater services. Commonly, cities do not have specialized institutions in charge of stormwater management, there is no specific budget for this purpose, and there is a complete absence of strategic plans. In Monterrey for instance, various institutions share responsibility for stormwater and flood plains management. EPM focuses mostly on stormwater, whereas the Municipal Secretary focuses on the creeks and rivers in the sub-basins, with the EPM occasionally assisting the Municipal Secretary with various service provisions relating to drainage. The lack of clarity on such institutional arrangements across the region may lead to higher storm impacts in the future by delaying the implementation of prevention policies, especially in terms of land use planning and zoning.

Another central factor in flood vulnerability in many Latin American cities is the lack of coordination between authorities in charge of drainage and of urban planning. In the MRSP, the densification and verticalization of urban settlement has resulted in increased impermeability of soil, such that urban areas become both the causes of increased flooding and its main victims. As a result, stormwater floods paralyze the city of Sao Paulo every summer, generating high economic losses. Moreover, while a Macro-Drainage Plan for the Alto-Tiete basin has been under preparation since 1998 to diagnose problems and devise technical, economic and environmental solutions to flooding, this plan does not take into consideration the need for a change in urbanization patterns. Similarly in Medellin, urbanization is developing from downstream to upstream, increasing the peak flood and the impacts in many creeks of the city's sub-basins. In Monterrey, growth of the urban area is also occurring upstream of sub-basins and on the hillsides, heightening the risk of stormwater flooding. In Buenos Aires, the Matanza-Riachuelo River (MR) basin is home to Argentina's largest concentrations of urban poor. Due to rapid urbanization, topographic elements, and the occurrence of severe storm events, flooding has become one of the most serious problems affecting the everyday life of Buenos Aires citizens. The issue in most cities is that the underlying problem is one of land-use planning and enforcement, which is generally the responsibility of different institutions, government levels or authorities than (storm) water management.

Response: Elaborate Stormwater Management Strategies that clearly set out the institutional responsibility for this service and facilitates coordination with urban planning authorities

Experience in several municipalities suggests that flood risks are best controlled using both non-structural and structural measures, coordinated for example through the elaboration of a Stormwater Master Plan, developed in concert with all the relevant institutions. In implementing an integrated approach to flood risk management, it is essential for both the institutional structure responsible for flood management be clearly defined, and the flood management strategy to explicitly allow for systematic coordination with urban planning authorities. The involvement of well-functioning institutions, the participation of stakeholders, and the engagement of affected communities are also vital to the elaboration of a successful plan (GFDRR 2012). Box 12 describes the example of Buenos Aires' Urban Flood Prevention and Drainage Plan, developed since 2005 with World Bank assistance, which places considerable emphasis on a multi-sectoral and basin-wide approach and considers land use planning, building codes, and education as part of its risk identification and reduction strategy.

Box 12. Buenos Aires Urban Flood Prevention and Drainage Program

The City of Buenos Aires has started addressing flooding issues since 1992 with strong commitments expressed through an ambitious investment financing and a renewed institutional organization. The strategy was aimed at evolving from a disaster response to a risk prevention approach, introducing a water basin approach and strengthening relevant institutions on the provincial level.

Specifically, the 200M USD, World Bank-funded Urban Flood Prevention and Drainage Program is the City government's commitment to flood prevention and risk management, and falls within the framework of the Buenos Aires Hydraulic Master Plan, which focuses on implementing structural and non-structural measures throughout the entire city. The program, which was launched in 2005, has two main objectives: i) to increase the City's resilience to floods through the protection of its critical urban infrastructure, and ii) to introduce a risk management approach to the investments of the provincial and municipal administrations. Within the above framework, the program includes institutional measures and infrastructure investments to reduce both the vulnerability of the urban population and of critical infrastructure.

The program is expected to mitigate the effects of floods affecting approximately 1.5 million people. One million of them live in the Maldonado Basin and as such are considered to be the program's beneficiaries. Within this million, a subset of 110,000 people live in the most critically exposed areas of the Basin. The remaining 1.4 million are considered indirect beneficiaries. The program, which is on-going, will reduce the Maldonado basin's exposure to flooding through the improvement of its drainage system and the implementation of a risk management program through the structural and non-structural mitigation measures already mentioned.

Before

After

Challenge: Institutional fragmentation and lack of coordination across sectors and municipalities is an underlying challenge in the development of integrated urban water management strategies

Improving institutional arrangements to avoid fragmentation of urban water management is one of the main challenges in all cities studied, even those that have developed good practices in IUWM. In Medellin, institutional fragmentation in the urban water services sector hinders successful management of water services, with especially negative consequences for the stormwater system (see Box 13). Similarly in the MRSP, fragmented institutional management in the municipalities that form the Municipal Region, in all services, creates significant difficulties in dealing with the main water and land use related problems. Furthermore, institutions created to ensure protection of water resources and adequate water management in Sao Paulo have oftentimes been only partly effective, in great part because the laws leading to their creation failed to acknowledge the integrated aspect of challenges faced in the water and urban sectors. Federal laws are not evenly implemented across states and municipalities, complicating regional policy coordination.

Box 13. Institutional fragmentation in urban water management in Medellin

The current institutional arrangement for urban planning and urban water services, water resources and environmental control in the Medellin Metropolitan Area faces challenges due to fragmentation of responsibilities and absence of cross-sectoral collaboration. Currently, Solid Waste is managed in Medellin by VARIAS, which is a municipal company with solid economic sustainability; in the other cities of the Metropolitan Area, however, this is the responsibility of several institutions. Similarly, stormwater service is completely fragmented by area of service and by type of service. Urban planning is conducted only at the local level, with limited collaboration across cities. A single utility, EPM, provides water and sanitation services in the whole metropolitan area.

Service	Medellin	Metropolitan Area
Urban Planning	City	Cities
Water Supply and Sanitation: water supply, treatment and distribution; sewage collection, wastewater treatment and disposal	EPM (Empresas Publicas de Medellin)	EPM (Empresas Publicas de Medellin)
Solid Waste: collecting, cleaning and disposal	VARIAS	Private and public services in each county
Stormwater: implementation and maintenance	EPM for minor drainage system City administration for major drainage	EPM for minor drainage system Major drainage managed by the cities
Water Resources: river management and water permits	Area Metropolitana	Area Metropolitana
Environment: conservation and license	Secretary of Environment and Area Metropolitana	Area Metropolitana

Response: Providing local leadership, supportive legal frameworks, and accessible financing mechanisms

From the experiences of the IUWM case studies, three ingredients seem particularly important in the process of encouraging institutional change: establishing a clear integrated management strategy backed by local leadership, designing legal frameworks conducive to cross-sectoral work, and making financing mechanisms available for new initiatives.

Firstly, *local leadership is essential in galvanizing the process of implementing long-term solutions.* The periods in which the greatest successes have been achieved in terms of integrated management in the IUWM case studies are typically marked by clear leadership and vertical alignment at the municipal and national levels. This is precisely the value of adopting an integrated approach, which can build consensus and alignment across actors and sectors to comprehensively address the city's interconnected challenges. Furthermore, implementing institutional reform to address water-related challenges requires adopting an officially endorsed, overarching institutional structure for integrated urban water management, rather than addressing problems in a piecemeal manner that fails to capitalize on their interrelated aspects. This entails establishing concrete operational strategies and channeling resources toward their implementation. Thus, in the case of Aracaju, the State of Sergipe (SSE) engaged in a participatory planning process that involved public consultations with civil society and identified priority areas of intervention. This participatory planning process served as a key input to SSE's 2008-2011 economic development and government action plan, which selected integrated management of natural and water resources, solid waste and sanitation services as one of the SSE's key priorities. Likewise, the case of Tegucigalpa shows how periods with strong leadership at the various levels have been those during which the City has made most progress in addressing its significant water challenges.

Secondly, *legal frameworks must be conducive to cross-sectoral work, and courts must be willing to step in to enforce them.* In Sao Paulo for example, the MRSP has established several innovative laws to overcome existing silos in urban water management. One of these is the State Complementary Law 1,025 of 2007, which seeks to better coordinate water management efforts by the state government, the federal water utility SABESP, and municipalities. The law integrates planning and implementation activities, and promotes collaboration between the state, municipalities and civil society by creating a State Council for water supply and sanitation (CONESAN). Similarly, in Monterrey the San Juan Agreement was established in 1989 to address competition for water between urban areas and irrigation, resulting in common rules for operation of a system under scarcity conditions. Improvements so far include the increase of flow regularization and water efficiency.

In both Bogota and Buenos Aires, the courts stepped into define institutional responsibilities and accelerate programs to address water pollution control. In Bogota, in 2004 a local court ruling mandated that the main public entities in charge of water resource management: the national government, the District of Bogota and its water company (EAAB), the regional environmental authority (CAR), and the involved hydropower company (EMGESA) work together to improve the river's quality. On this basis, agreements were signed in 2007 and 2011 to define the responsibilities of each entity. These agreements and the original local court ruling are now under review by Colombia's Supreme Court (see Box 14). Likewise, in Buenos Aires a Supreme Court Ruling also was the starting point for the various institutions to initiate the cleanup and environmental rehabilitation of the Matanza Riachuelo River, a heavily polluted, tributary of the Rio de la Plata.

Thirdly, *financing mechanisms must be available to finance integrated projects*. In Tegucigalpa for example, the *Frente Ciudadano del Agua para la Capital* (Citizen's Front for Water in the Capital or FCAC) arose in 2010 to mobilize a range of actors around water challenges, but its efforts have been stymied by a lack of access to funding and the absence of a robust institutional support structure. In the MRSP by contrast, the success of many of the multi-sector, multi-actor initiatives currently taking place has been greatly spurred by the support of Federal plans such as the Growth Acceleration Program (*Programa de Aceleracao de Crescimento* - PAC). Joint requests for PAC resources have been made to the Federal Government by the State Secretariat for Water and Energy, the Sao Paulo Municipal Government, and the State Housing and Urban Development Company (CDHU), with particular emphasis on slum and urban upgrading, expansion of solid waste collection systems, and resettlement of families. Similarly in Medellin, sound urban water management is carried out by a set of technically strong institutions with financial independence and lack of political interference, such as EPM. ■

Box 14. Bogota's Urban Water Management Strategy

The metropolitan area of Bogota, which has a population of over 8 million people, discharges all of its wastewater into the Bogota River, but only 20 percent receives primary treatment. The holding reservoir for a hydropower facility downstream of Bogota, the Muna reservoir, is also highly contaminated. To address this issue, at the prompting of a local court, the Bogota District Government and its water utility, in conjunction with the Corporacion Autonoma Regional de Cundinamarca (CAR) and the national government, is undertaking an ambitious mega-program to improve environmental conditions in the Bogota River. The Bogota River Environmental Recuperation and Flood Control Project, financed in part by a World Bank loan, is part of this larger program aimed to transform the Bogota River into an environmental asset for the Bogota metropolitan region by improving water quality, reducing flood risk, and creating multi-functional areas along the river. To address these issues, the project has four components: (i) upgrade and expansion of Salitre WWTP; (ii) flood control and river restoration works; (iii) environmental and water studies; and (iii) project management and administration. Of particular relevance is the integrated approach in which various actors coordinate their actions (wastewater treatment, interceptor construction, river restoration works, resettlement of affected riparian population etc.) to create new urban spaces, decrease exposure to flooding and improve the environmental value of the Bogota River and so improve the quality of life in Bogota.

Before

After

7. Conclusions

Water is a defining element of Latin American cities; whether there is too much of it, flooding streets and houses, or too little to satisfy the basic needs of their population; whether its stench is spoiling green spaces, or it provides valuable habitats in revitalized urban ecosystems; whether the cities thirst forces them to reach further and further for new sources, alienating other users, or they work with local industries to develop innovative reuse and reclaim mechanisms. In any case, the development of green, sustainable cities is linked with their ability to turn water challenges into opportunities for development, embracing integrated urban water management in the process.

The work conducted under the World Bank's *Blue Water Green Cities* initiative reveals a multitude of good practices from which valuable lessons can be drawn. The underlying theme is that basin management, water service provision and urban planning simply cannot be tackled in isolation. When unplanned urbanization takes place in complete dissociation from the design of service delivery, water management, and flood protection strategies, it directly increases stress on water quality and availability and heightens the city's flood vulnerability. Successfully tackling a city's urban water challenges requires concerted cross-sectoral attention from municipal and water authorities, as well as stricter watershed management practices. The missing link is often times not a technical or economic one, but a question of promoting a more integrated and comprehensive form of planning and implementation across the relevant sectors, institutions and jurisdictions.

Indeed, the integration of urban and water policy is still a topic that leaves much to be desired, even in the IUWM cities showcased in this document. Urban development policies in the cities studied are not yet fully aligned with the delivery and design of water services, or with the needs of watershed protection; the intersection between urban planning and water services generally requires greater attention from municipal and water authorities. The negative effects of unplanned urbanization on the water system are frequently compounded by inadequate watershed management and regulation. Industries typically discharge industrial effluents into the sewer system or directly into rivers, just as informal settlements and slums often occur upstream of sub-basins or around the reservoirs. In parallel, densification and verticalization of urban settlement has resulted in increased impermeability of soils and heightened flood vulnerability in many of the region's cities.

The approach presented in this note – Integrated Urban Water Management – is not a substitute for solid technical and economic work in each sector, nor is it a panacea that will by itself solve any and all cities' water challenges. Rather, the note argues that by embracing IUWM, urban institutions will eventually, jointly, develop strategies and approaches that will be cleaner, more efficient, more resilient, and more equitable – in short, adopt a greener, more inclusive path of development towards the cities of tomorrow. ■

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