TRANSFORMING KOLKATA

A PARTNERSHIP FOR A MORE SUSTAINABLE, INCLUSIVE, AND RESILIENT CITY

Neeta Pokhrel

MAY 2019

ASIAN DEVELOPMENT BANK

ADB

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6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 632 4444; Fax +63 2 636 2444
www.adb.org

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ADB recognizes "Calcutta" as Kolkata.

Cover photo: A woman holds her ownership title of an apartment in one of the residential buildings (in background) built by the Kolkata Municipal Corporation through the Asian Development Bank project. (This photo and all others are by Amit Verma, unless otherwise specified.)

CONTENTS

TABLES, FIGURES, AND BOXES

TABLES

FIGURES

BOXES

ABBREVIATIONS

ADB	Asian Development Bank
DFID	Department for International Development of the United Kingdom
DMA	district metering area
FFEWS	flood forecasting and early flood warning system
GIS	geographic information system
KEIP	Kolkata Environmental Improvement Project
KEIIP	Kolkata Environmental Improvement Investment Program
km	kilometer
KMC	Kolkata Municipal Corporation
MLD	million liters per day
NGO	nongovernment organization
NRW	nonrevenue water
PMU	project management unit
SCADA	supervisory control and data acquisition
SMS	short messaging service
SMU	safeguards monitoring unit
SWM	solid waste management
S&D	sewerage and drainage

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BOOK PREPARATION CORE TEAM

Neeta Pokhrel, Principal Urban Development Specialist and team leader, Kolkata Environmental Improvement Investment Program South Asia Urban Development and Water Division (SAUW), Asian Development Bank (ADB)

Sourav Majumder, Senior Project Officer (Urban), and co-team leader, India Resident Mission, ADB

Luca Di Mario, Urban Development Specialist, SAUW, ADB

Pramod Kumar, Project Analyst, India Resident Mission, ADB

Bebedel Fabe, Project Officer, SAUW, ADB

Cielo Añon, Operations Assistant, SAUW, ADB

Elvie Jane Fernandez, Operations Assistant, SAUW, ADB

CONTRIBUTING WRITERS

Phillip Day
Melissa Howell Alipalo
Usha Tankha

EDITORS

Phillip Day
Kate Pigott

PEER REVIEWER

Tomoo Ueda, Principal Evaluation Specialist, Independent Evaluation Department, ADB

PHOTOGRAPHER

Amit Verma (unless otherwise cited)

DESIGNERS

Cleone Baradas
Gino Pascua
Judy Yñiguez

FROM THE MAYOR'S DESK

Covering over 5 million permanent residents and another 6 million estimated floating population, the Kolkata Municipal Corporation (KMC) has continued to serve the citizens of Kolkata. Even though it has done a commendable job in the past, there is a lot of scope for improvement and perfection. It's time that we start dreaming big for the city. A city of Kolkata's history, heritage, and lineage deserves to be rated world class in the quality of life it offers. We begin our humble journey with this ambitious but achievable vision in mind. And we are happy that partners like the Asian Development Bank (ADB) have been helping us reach this vision. Together we have embarked on a large-scale development of the city's infrastructure as well as strengthened its institutional capacity to serve its citizens better. We have to consolidate the work that has already been completed in sewerage and drainage, water supply, solid waste disposal, roads, management of parks and squares, and augmentation of greenery in the city. In parallel with improving infrastructure, we are working on institutional reforms and strengthening capacity.

We believe that a city of Kolkata's size, importance, and complexity deserves a more empowered civic body with a wider ambit of services, which can be made accountable for most of the civic services and amenities that citizens expect in their day-to-day life. Such strengthening of the elected local government would also be in line with the 74th Constitutional Amendment. We want to ensure that the benefits of ADB funding and all other projects and development initiatives reach all strata of society and that progress is inclusive and equitable. Hence, we have put great emphasis on social sector development, including slum improvement and implementation of minority development programs. We

> We believe that a city of Kolkata's size, importance, and complexity deserves a more empowered civic body with wider ambit of services, which can be made accountable for most of the civic services and amenities that citizens expect in their day-to-day life.
>
> *— Firhad Hakim, Mayor of Kolkata*

do the same to improve the city's health and hygiene through focused initiatives in vector control and overall improvement in sanitation and cleanliness.

Our constant endeavor is to ensure that this journey to prosperity and development would not put any additional burden on citizens. We strongly believe that by streamlining and simplifying the tax system, the KMC would ensure better compliance and coverage, so that its overall revenue targets are met without posing additional burdens on individual, complying citizens. We have introduced a modern regime of simplified tax structure that would root out corruption and ensure better compliance.

We promise to offer a transparent and responsive civic administration, leveraging the latest initiatives in information technology and e-governance. We also promise that all our councillors and civic officials would be in constant contact with citizens, would be accessible, and focused on providing better services to them. We thank ADB and other development partners who have been helping us on this journey to transform Kolkata City over the last 2 decades.

FIRHAD HAKIM
Mayor of Kolkata

FOREWORD

The year 2018 marked 20 years of partnership between the Asian Development Bank (ADB) and the Kolkata Municipal Corporation (KMC). The release of this publication reflects the journey and the accomplishments over the last 2 decades of this partnership to make Kolkata a more livable city.

I am pleased to see the progress Kolkata City has made over the past 2 decades. I was fortunate to be part of this 2-decade journey from the outset. My own engagement with the city started in 1998. I was the project officer for a technical assistance grant to support the improvement in the accounting systems of the KMC. Two decades, five loans, and four grants later, we have come a long way to achieving the common plans of the KMC and ADB for the city.

A number of factors are responsible for this success. *First*, there is the long-term engagement. Making a city more livable, thus more sustainable, inclusive, and resilient, requires sustained commitment and planning from the city, and critical levels of investments. *Second,* there is the establishment of a strong multidisciplinary project management unit. Executing the works has numerous challenges since urban infrastructure projects are multidimensional and need strong multidisciplinary teams to implement them. It takes time to build such teams and their capacities, even if the city and its partners are ready to invest large sums. *Third*, there is strong ownership among all stakeholders. While planning is underway, works must continue to ensure that basic needs are met. The efforts must be led and sustained by the city's leadership and supported by the residents themselves. Without the backing of political leadership and solid institutions and

implementation arrangements, efforts can fizzle out before they have a chance to demonstrate success. *Fourth*, there is the tenacity to continue, notwithstanding challenges and temporary setbacks. This matrix of necessary institutions with the right people and processes takes time to build and effort to sustain. Projects get criticized for slow start-up, but tenacity while implementing such projects is important. Kolkata has, indeed, tenaciously carried forward and overcome these challenges over the years. We do not have same degree of success everywhere as we have seen in Kolkata, where the leadership is committed to do everything to make the projects succeed.

Much has been achieved for the city—doubling the coverage of sewerage and drainage, a climate change resilient sewerage and drainage masterplan, 24/7 water supply services coming soon to three large areas of the city and general optimization of the water services, Kolkata's first flood forecasting and early warning system, and a comprehensive masterplan for solid waste management. Gaps remain and we still have a long way to go. We are committed to continue supporting the city on its journey to becoming more livable.

I sincerely appreciate the officials of the Economic Affairs Department of the Government of India, those in the Government of West Bengal and in particular, the mayor of Kolkata, the commissioner of the Kolkata Municipal Corporation, and the project management unit of the Kolkata Environmental Improvement Investment Program (KEIIP) for being at the helm to implement the project and contribute to this publication.

> We are committed to continue supporting the city on its journey to becoming more livable.
>
> *—Hun Kim, Director General South Asia Department*

Besides the core team led by Neeta Pokhrel, principal urban development specialist, this publication benefited from contributions of several persons, including the past project officers of ADB, current and past officials of KEIIP, project beneficiaries, and other development partners supporting the KMC. I thank each and every one of them.

HUN KIM
Director General
South Asia Department
Asian Development Bank

EXECUTIVE SUMMARY

Twenty years into the first ADB–supported financing to revitalize Kolkata, this publication looks at the journey taken by the partnership of ADB and the Kolkata Municipal Corporation (KMC) since 1998 to transform Kolkata into a more livable city.

ADB started its partnership with the KMC in 1998, when it approved two technical assistance grants to strengthen the corporation's accounting system and to prepare ADB's first urban sector loan to the KMC, the Kolkata Environmental Improvement Project (KEIP). KEIP was approved in 2000. The KMC has come a long way since then and is currently implementing ADB's fifth loan to improve the city's urban services, livability,

Transforming a city the size of Kolkata takes commitment spanning decades and multiple projects.

CHANGE FOR ALL. Much has been accomplished but more work is needed.

inclusiveness, and resilience. This book traverses that journey and tracks the outcomes achieved to date and the directions expected in future.

Transforming a city the size of Kolkata—with a permanent population of over 5 million and around 6 million floating residents—takes a commitment spanning decades and multiple projects. It takes capable project implementers, extensive funds, long-term planning, and steadfast leaders. The story isn't finished. KMC and ADB will continue to work on their shared vision for Kolkata City, but 20 years in the making is a good time to pause and take inventory of what has worked, what hasn't worked, what needs doing next, and where.

This book begins by telling the story of the shared vision for the city by the KMC and ADB in its **first chapter**. It references commitments spanning decades, a focused

Kolkata was highlighted time and again as a city at risk of climate change.

MANY FRONTS. Transforming a mega city takes massive effort on parallel fronts, and includes large-scale projects and smaller one-on-one capacity building.

and phased approach to implementing common goals, and a determination to enact integrated and long-term planning for the city. It tells the story of a diverse and ambitious urban development agenda, the partnerships and innovations that made it work, and the professionals who have fueled and sustained it.

The **second chapter** examines the interventions that have raised and will raise the sustainability of the city's core urban services, much of it invisible investments underground to ensure water and sanitation security for the city. The work includes expanding the sewerage and drainage systems and water supply improvements and optimization—new and improved treatment facilities, energy-efficient pumping networks and meters that reduce losses and provide accountability. In addition, planning and works are underway to make the city cleaner by managing

> The achievements of the past 20 years exemplify a phased and integrated urban planning, which is the core and true essence of making a city more livable.

its solid waste and building the KMC's capacity to better sustain the services it provides.

The **third chapter** looks at the impacts of the investments in promoting inclusiveness and gender equity in the city and how they have made a visible difference in the lives of people, especially those who once lived on the margins of the city.

The **fourth chapter** outlines how the city has been systematically preparing plans and policies to build its resilience, to understand climate change impacts, and to invest in soft and hard infrastructure so that it is prepared for whatever the future has in store, especially in dealing with shocks and stresses.

Kolkata's centralized system for underground sewerage and drainage was laid more than 150 years ago by the British empire. Kolkata at the time was only the second city to have an extensive centralized underground sewerage and drainage system in the world, after Hamburg in Germany. Before KEIP interventions, the city's sewage and stormwater drained through 130 kilometers of canals before emptying into the city's outskirts, where the city morphs into the countryside. Those canals had never been cleaned since they were built 150 years ago. The old combined sewerage system, built in 1859 and covering the city's core areas, badly needed desilting and rehabilitation to alleviate the flooding that Kolkata experienced each monsoon season. The trunk sewers in central Kolkata, some silted by 80% over the years with almost solidified deposits, needed urgent attention.

As climate change experts began to study vulnerabilities that would be exposed by effects such as rising water levels and more frequent and intense storms, Kolkata was highlighted time and again as a city at risk. In 2011, a detailed study by the World Bank assessed Kolkata's vulnerability to climate change and recommended investments in sewerage and drainage (S&D) systems, particularly in the peripheral areas previously uncovered. The KMC designed the Kolkata Environmental Improvement Investment Program (KEIIP) to increase its climate resilience and urban services by adopting the recommendations from the 2011 World Bank study, and following the KMC's master plans and policies that were prepared with the help of KEIP.

Through KEIP and KEIIP support, the S&D systems have been rehabilitated and extended outside the core areas to almost double their original capacity. The canals for treated effluent

ALL ABOUT PEOPLE.
Big infrastructure projects improve lives but real change comes from combining infrastructure with community development.

WORKING TOGETHER.
Success in upgrading underground services of a 300-year-old, dense megacity takes focused planning, capable people, and technology.

have been cleaned and the sewage treatment plants rehabilitated. Flooding has been addressed to a large extent and fewer streets remain impassable during downpours. Through phased sequencing of investments under KEIP and KEIIP, the KMC is increasing its climate resilience by systematically achieving expansions in the S&D network in peripheral areas of Kolkata, including flood-prone areas; increasing sewage treatment capacity; improving water supply by reducing nonrevenue water (NRW); and increasing operational efficiency of services.

Municipal finance has been strengthened, with the financial management systems now computerized and brought up to date. Every property in Kolkata now has a digital identification, and the city has introduced area-based property taxes, a modernized and digital system, so that citizens can pay online. Work is continuing to bring

clean water to more people and for longer periods of the day. Plans and ongoing works are aimed at reducing water loss. A large number of slum dwellers who lived around canals and wetlands now reside in livable housing and have meaningful employment. Solid waste collection and recycling are being improved. A comprehensive master plan is finalized to cover the full solid waste management cycle and provide long-term sustainable solutions for the city.

The KMC and its dedicated program management unit (PMU) for KEIP, which continued subsequently for KEIIP, have come a long way from the project's early days, when there was little progress and the partnership seemed in jeopardy. The initial results and the speed at which the project progressed from 2000 to 2004 were not promising at all. Both ADB and the KMC realized that things needed to change. In those early days, ADB realized it needed to boost its support so that the KMC

MODERNIZING KOLKATA. ADB projects used modern technologies to minimize disruption and improve implementation.

could learn fast, adapt, and consider alternatives when implementing projects in one of the oldest and densest cities in the world. It took a few years before the partners began to see the way forward.

The scenario changed and the project began to succeed when, from 2005 onward, the KMC geared up for the task by assigning capable leaders as project directors. the KMC gave full authority to these leaders to build the right multidisciplinary cadre and provided training and the incentives that would ensure long-term involvement. It modernized the systems and structures in its PMU while also improving its own monitoring. These were necessary and missing parts of the jigsaw when implementing such a large-scale infrastructure project.

The PMU under the KMC is now a juggernaut project-implementing entity, with more than 100 full-time staff. Having such an entity within a local municipal body is rare, not only in India, but also in most of Asia. The PMU has become renowned for its extraordinary and consistent performance in handling complex engineering projects in India. It was awarded the best performing ADB-funded project in India in 2017, after a joint annual evaluation by the Ministry of Finance, the Government of India, and ADB during their tripartite review of projects. Some of the people involved in the projects—consultants, staff of KEIP, contractors—who helped bring efforts up to speed in those early days are now experts in urban rehabilitation.

The PMU under the KMC is now a juggernaut project-implementing entity, with more than 100 full-time staff. Having such an entity within a local municipal body is rare, not only in India, but also in most of Asia.

Administrative and management systems have been modernized and strengthened, maintenance systems have been digitized, and supervisory control for water supply services has been upgraded.

Key to implementing the ADB-funded projects have been measures to ensure that social interventions are focused and phased and that long-term master plans are prepared and diligently followed.

The success of KEIP and KEIIP to date can also be attributed to the use of high-level technology that started with microtunneling and e-measurement of works and now is growing to many aspects of the KMC's urban services management support through the projects. Micro-tunneling to lay large sewerage and drainage pipes under the projects minimized the disruption to traffic and social costs usually entailed in such work. The KMC utilized remote sensing and geographic information systems (GIS) to put all its urban assets, properties and services on one digitized map, and is making it accessible to citizens an interactive e-platform to its citizens. Administrative and management systems have been modernized and strengthened, maintenance systems have been digitized, and supervisory control for water supply services has been upgraded using data acquisition for more efficient water systems management. A state-of-the-art flood forecasting and early flood warning system has been established. The KMC and ADB continue to partner with agencies such as the European Space Agency to utilize remote-sensing data and satellite imagery to analyze problems and improve urban services. All such tools aid the planning and designing that will make Kolkata more livable as the city continues to grow.

The achievements of the past 20 years exemplify a phased and integrated urban planning, which is the core

and true essence of making a city more livable. In partnership, ADB and the KMC have overcome immense challenges by improving their own capacity to plan, design, and manage investments in a challenging urban environment. Their efforts are exemplary in South Asia where similar projects have often not been as successful. Along with strategic planning and persistent implementation, policy reforms have progressively continued to protect recent and future investments. The city's leaders and citizens and development partners have remained focused on planning for the long term, phasing the interventions, while continuously building capacity for design, construction, and maintenance of the assets.

The tasks of making Kolkata greener with fully sustainable urban services, as well as more resilient and inclusive for all its citizens, are so enormous that gaps still remain. More work is needed on multiple fronts, including enforcing spatial land-use planning, restoring local water bodies, having nature-based solutions to control flooding, sustainably collecting and treating solid waste, and making Kolkata greener and more resilient to face the growing climate change threats. Two decades of engagement later, Kolkata City is on the path toward achieving the shared vision of becoming more livable, greener, more sustainable, inclusive, and resilient.

A MORE LIVABLE KOLKATA.
Kolkata city is implementing and updating its service improvement plans to become a greener, cleaner, and more resilient city.

TRANSFORMING AN **ICONIC CITY**

They came because of the water, the rivers and wetlands that would slake their thirst and nourish their crops. The rivers were their highways, so they settled beside one that would give them a strategic outpost. Villagers had already settled here when the Dutch came. Then came the Portuguese. The British East India Company gave way to the British Empire. All attempted to rearrange the city to their needs and water was always at the center of their plans. How to control the floods, how to keep it clean for drinking, how to ensure that sewage did not taint it?

Kolkata is a blessed city, with tributaries of the Ganges on both sides to provide fresh water, and the East Kolkata Wetlands providing a natural filter for its effluent. The Dutch constructed a diversion canal on the banks of the Hooghly River, near the present

THE PAST IS PRESENT. Kolkata's vibrant history has left an impressive mark on the city, but also poses challenges for its urban service expansion and modernization.

The centralized underground sewerage and drainage system, an engineering marvel when it was introduced as early as 1859, was the first of its kind in Asia and second only to Hamburg in Germany.

IT'S ABOUT THE WATER.
A ready supply of water has been a boon to the city but wastage from its old system is its biggest challenge.

Central Business District. The British East India Company developed the canal further, and then the British Empire went on to construct an intricate transport network through the Hooghly–Ganges water system.

One of the oldest municipal corporations in India, the Kolkata Municipal Corporation (KMC), has faced the heady challenges of providing urban services to its residents since its inception through the Calcutta Municipal Consolidation Act of 1876.

Now, Kolkata is a thriving metropolis, capital of the state of West Bengal, with an estimated 5.2 million people living within its official boundaries. The total population of the city and its surrounding suburbs, known as the Kolkata Metropolitan Area, was estimated at 14.7 million in 2015, making it the third most populous metropolitan area in India.[1] With 24,000 people living per square kilometer in Kolkata, it is also one of the densest megacities in the world.

The city is and will remain the dominant commercial and financial hub in the state of West Bengal, producing 13% of the state's gross domestic product. Further, the state of West Bengal is uniquely situated in eastern India, sharing its borders with five other Indian states as well as Bangladesh, Bhutan, and Nepal.[2] This advantageous location has made Kolkata a traditional market for eastern and northeastern India, as well as Bhutan and Nepal. The state of West Bengal is also a strategic entry point for markets in Southeast Asia, and Kolkata benefits from that.

Kolkata's Mayor Firhad Hakim expects Kolkata to earn upper-middle-income status within a decade. The Brookings Institution's Global Metro Monitor from 2015 (footnote 3) looked at the per capita gross domestic product and employment growth for 2013–2014 and rated Kolkata's performance 32nd in the world, behind only Delhi for South Asian cities.

History has left a deep footprint on the city and its water systems.

This iconic city aspires for modernity and prosperity but while its rustic urban charm survives in its era-gone-by architecture and wide boulevards, it simply wasn't designed for this many people. Streets now overflow with commerce, cars, and construction.

The centralized underground sewerage and drainage system was an engineering marvel when it was introduced in 1859. It was the same for Kolkata's

[1] The Brookings Institution. 2015. *Global Metro Monitor. Washington, DC.*

[2] Assam, Bihar, Jharkhand, Odisha, and Sikkim.

BOX 1

THROUGH THE HISTORICAL LENS:
Kolkata—A Municipal History

The following passage is taken from the website of the Kolkata Municipal Corporation.

With the passing of the Calcutta Municipal Consolidation Act, 1876, a Corporation was created consisting of 72 Commissioners with a Chairman and Vice-Chairman; 48 Commissioners were elected by the rate-payers and 24 appointed by the Government. In 1888 the Municipal boundaries were extended by the inclusion of suburbs lying east and south of Lower Circular Road. Seven wards were brought within the fold and additions were made to three other wards in the north of the town. The number of Municipal Commissioners was raised to 75, of whom 50 were elected, 15 appointed by the Government and the other 10 nominated by the Chambers of Commerce, the Trades Association and the Port Commissioners.

Great changes in the system were effected by the Mackenzie Act of 1899. The administration of Kolkata was vested in the hands of three Co-ordinate Authorities - the Corporation, the General Committee and the Chairman. Of these, the Corporation consisted of the Chairman (appointed by the Government) and 50 Commissioners of whom 25 were elected and appointed from bodies like Chambers of Commerce and Port Commissioners. The entire executive power was vested in the Chairman and real authority concentrated in a General Committee dominated by European community. In protest against this retrograde step, the elected native commissioners resigned in a body.

Democracy was ushered into the Municipal Government of Kolkata by making provision for election of a Mayor annually, by Sir Surendranath Banerjee, who as the first Minister of Local Self-Government in Bengal was the architect of Calcutta Municipal Act of 1923. A major reform was the enfranchisement of women. The adjacent municipalities of Cossipore, Manicktola, Chitpore and Garden Reach were amalgamated with Kolkata. Garden Reach was later separated. C. R. Das was the first elected Mayor and Subhas Chandra Bose his Chief Executive Officer. The city was ruled under the Act till March 1948 when the State Government superseded the Corporation.

A new chapter was opened on 1 May 1952 when the Calcutta Municipal Act, 1951 came into force. The Corporation was envisaged as a policy-making, directive and rule-making body, the executive side being left as much as possible in the hands of the Commissioner. 76 Councillors were returned from the General territorial constituencies. The Chairman of the Kolkata Improvement Trust was made an ex-officio Councillor. In 1962 adult franchise was introduced in the municipal elections. The number of wards later increased from 75 to 100. Tollygunge was merged with effect from 1st April, 1953. The 1951 Act provided for an elected Mayor, a deputy Mayor and 5 Aldermen elected by the Councilors. The three Co-ordinate Authorities were (i) the Corporation (ii) the Standing Committees and (iii) the Commissioner.

To retain the integrity of the original text, no edits have been made.
Source: Kolkata Municipal Corporation. Kolkata - A Municipal History. https://www.kmcgov.in/KMCPortal/jsp/MunicipalHistoryHome.jsp (accessed 1 August 2018).

water supply. As early as 1870 a centralized scheme was in place to supply potable water to Calcutta (its former name) from Palta. It was designed to supply 27.28 million liters of treated water daily to a population of 400,000 people, 68 liters per capita per day. With this, Kolkata was the first city in Asia to get piped water supply. The water supply and sewerage and drainage systems still work. But as the city has grown, these systems have not kept up.

Early attempts to tackle this rapidly growing urbanization and expand urban services to cope with it were mostly piecemeal. Some succeeded and some failed. The city leaders trying to provide services and keep up with the city's myriad issues soon realized that what was needed was an integrated and planned approach that looked at the city as an organic entity, an approach that addressed all the issues at the same time. Otherwise it was like pushing on a balloon—fix one problem here and another popped up over there.

A New Vulnerability in Town

Kolkata's history adds to its charm but it also makes life difficult for city planners and developers and those seeking to improve its functioning. For just one example of a typical issue: How do you fix an ancient leaky water delivery system that sees estimated losses of 40%–65% in its system on the way to consumers, when some of the pipes were laid 140 years ago and you don't have a map that shows where all the pipes are? That was the sort of challenge that faced the KMC and ADB planners when they together instituted an overall approach to improve Kolkata's urban services almost 20 years ago. The challenges are only getting harder as the city looks to the future, with a looming issue that threatens Kolkata's vulnerabilities even further: the fallout from climate change is now a glaring threat for the city.

Numerous studies rank Kolkata among the top 10 most vulnerable cities in the world due to

high exposure to flooding under climate change projections.[3] The Organisation for Economic Co-operation and Development conducted the first global assessment of port cities' exposure to climate risks in 2007 and identified Kolkata and Mumbai among the top 10 cities with high exposure to flooding (Figure 1).[4] That study suggested that by 2070 Kolkata would have 14 million people exposed to flood risks, due to the effects of climate change and urbanization. The World Wildlife Fund calculated Kolkata's vulnerability as a 7 on a scale of 10, using the indicators of vulnerability shown in Figure 1.[5] The same report ranked Kolkata fourth in vulnerability behind Dhaka, Jakarta, and Manila among the 10 most populated cities of Asia.

Table 1: Overall Vulnerability Score of Kolkata

Vulnerability Indicators	Score
Environmental exposure	6
Storm threat	3
Sea-level rise	8
Flooding/drought	7
Socioeconomic sensitivity	7
Population	7
Assets threatened	6
Inverse adaptive capacity	7
Kolkata vulnerability score	7*

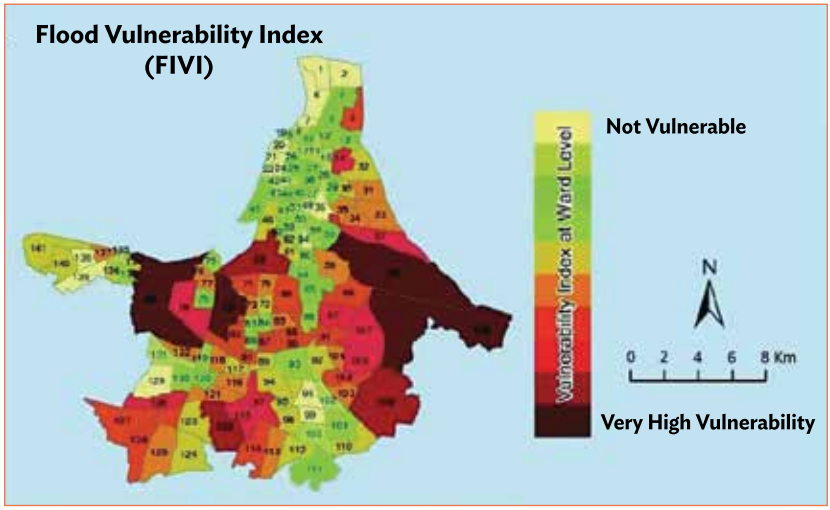
* Measured on a scale from 0 to 10 where 0 means no vulnerability, and 10 means high vulnerability.
Source: World Wildlife Fund. 2009. *Mega-Stress for Mega-Cities: A Climate Vulnerability Ranking of Major Cities in Asia.* Gland, Switzerland: WWF International.

[3] Field, C. B. et al., eds. 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change.* New York: Cambridge University Press; UN-Habitat. 2010. *Annual Report 2010.* Nairobi; World Bank. 2011. *India: Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate.* Report No. 53282-IN. Washington, DC.

[4] World Bank. 2011. *India: Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate.* Report No. 53282-IN. Washington, DC.

[5] World Wildlife Fund. 2009. *Mega-Stress for Mega-Cities: A Climate Vulnerability Ranking of Major Cities in Asia.* Gland, Switzerland: WWF International.

Figure 1: Flood Vulnerability for Kolkata City



km = kilometer, N = north.
Source: World Bank. 2011. *India: Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate*. Report No. 53282-IN. Washington, DC.

Other studies have predicted that inadequate sewerage coverage on its own may lead to substantial losses by 2050 due to flooding caused by climate change.[6] Kolkata's current stormwater drainage system consists of gravity-based sewerage and drainage systems that pump the stormwater and sewage from pumping stations to the city's canal network and treatment areas or plants. As the intensity of flooding increases, other urban infrastructure will be affected and slow the city's functions.

Studies on Kolkata's vulnerability agree that the city's risks are associated with three factors: natural vulnerability, such as topography; developed vulnerability, particularly the city's population growth rates and unplanned, unregulated urbanization; and compounded vulnerability—natural and developed urban

[6] World Bank. 2010. *Climate Risks and Adaptation in Asian Coastal Megacities*. Washington, DC; World Bank. 2011. *India—Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate*. Washington, DC.

disadvantages made worse by the impact of climate change, especially rainfall intensity and sea level rise.

Natural Vulnerability

Kolkata sprawls across a flat terrain with poor natural drainage to remove water after the 7 or 8 major downpours it gets each year. When it rains hard, the river usually floods. Kolkata's location in the lower coastal region, between 1.5 meters and 11 meters above sea level, also makes it more directly susceptible to climatic impacts. Already, cyclones and tidal blockage of channels (a "developed vulnerability" described more below) cause flooding and waterlogging in the city. With climate change, the city faces increased risks from rapid, above-average rates of sea level rise, more periods of intense rainfall, cyclonic activity, and storm surges.

Developed Vulnerability

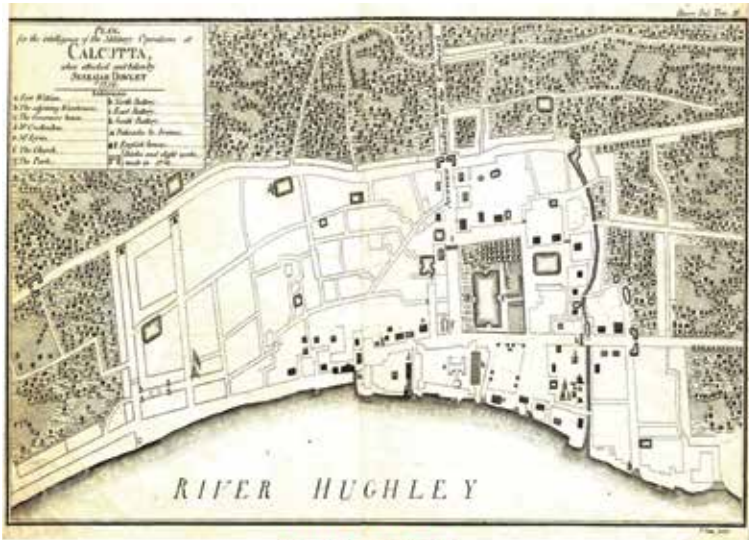
Kolkata has been a city in the making for 300 years (Box 2). It grew rapidly in the 18th and 19th centuries as the capital of British India to become the second largest city of the British Empire after London at the time. By the end of the 1800s, today's Kolkata began to take shape, with demographic trends that resemble modern Kolkata—a Western-style business center and congested, ill-planned, and growing sprawl. This urbanization trend is further illustrated in Figure 2.

Surging flows of refugees and migrants have shaped today's Kolkata, amplifying disparities between the center and the sprawl of urbanization outside it. Kolkata City proper is organized into 15 boroughs and 144 wards across 205 square kilometers. The larger Kolkata metropolitan area is 1,027 square kilometers, with three times the number of people as are in the city center.

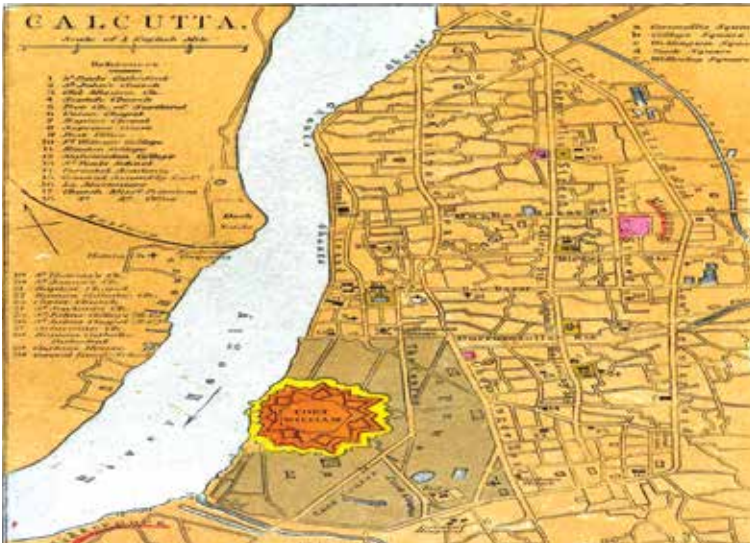
The underside of the city is proof that uncontrolled urbanization has negative consequences. A decaying skeleton of colonial-era

BOX 2

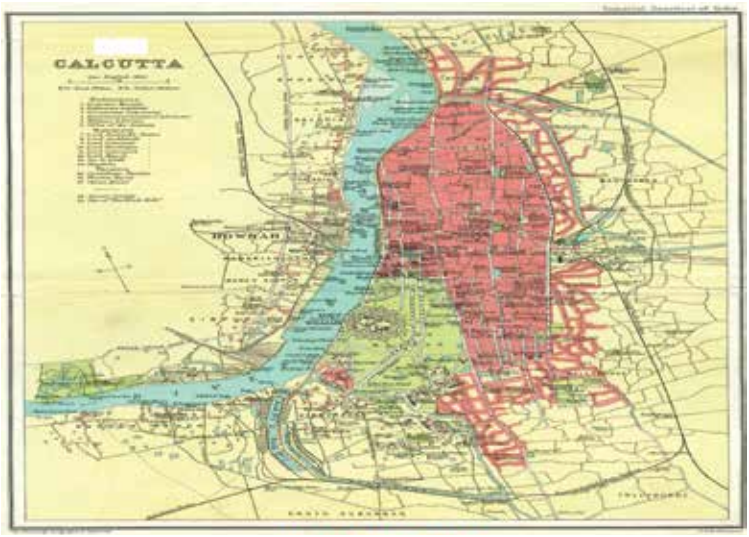
THROUGH THE HISTORICAL LENS:
City in the Making Over 300 Years



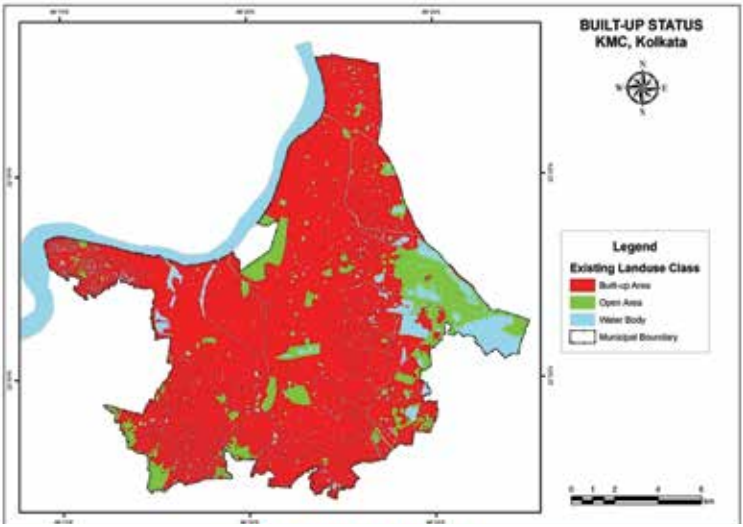
KOLKATA (CALCUTTA) MAP 1756



KOLKATA (CALCUTTA) MAP 1862



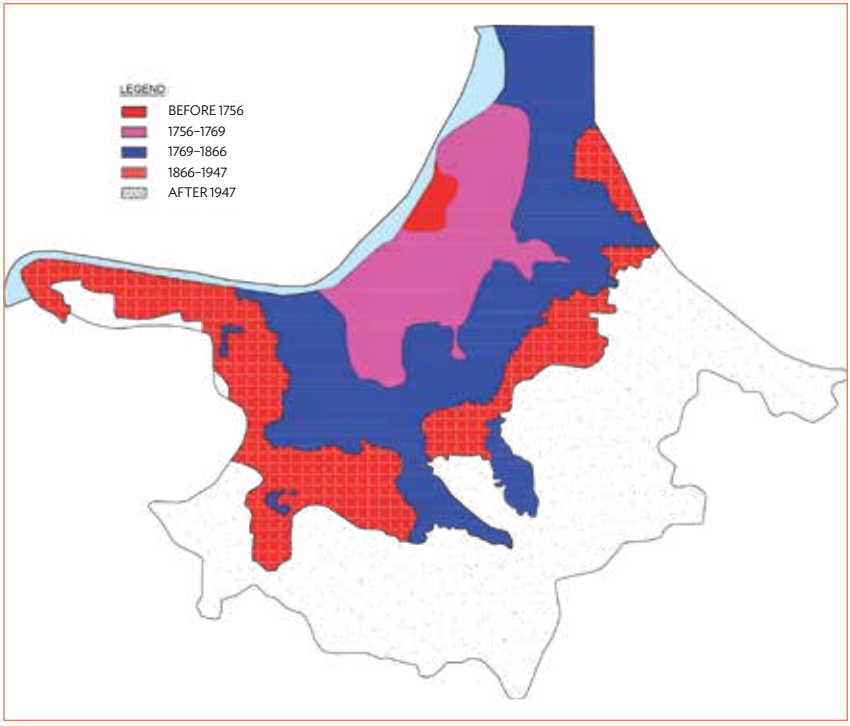
KOLKATA (CALCUTTA) MAP 1907



KOLKATA MAP 2008

Source: From the archives of Kolkata Municipal Corporation or provided to project team by the same.

Figure 2: Urbanization Trend in Kolkata City



* Colors represent the spread of urbanization in Kolkata as it moved outward from smallest central area (solid red, before 1756) along the Hooghly River.
Source: Kolkata Municipal Corporation.

infrastructure needs a massive investment makeover. Low-income communities comprise one-third of the Kolkata metropolitan area, according to 2010 UN-HABITAT data.[7] More and more countryside is swallowed by the city each year. In a span of only 20 years, between 1991 and 2011, Kolkata's periphery areas swelled by 3 million people.[8] That is 150,000 new people every year, or 12,500 every month. A constant flow of people looking for prospects in Kolkata have resettled along the city's marshes, lowlands, and other formerly uninhabited areas.

[7] UN-Habitat. 2011. *State of the World Cities 2010/2011—Cities for All: Bridging the Urban Divide.* Sterling, Vermont, United States.

[8] Cox, W. 2012. *The Evolving Urban Form: Kolkata: 50 Mile City.* Sherman Oaks, California and Grand Rapids, North Dakota, United States: NewGeography.com. http://www.newgeography.com/content/002620-the-evolving-urban-form-kolkata-50-milecity (accessed 1 August 2018).

These settlements along rivers and canals impair the ecological functions of those waters for the city, impeding drainage, filtration, and natural flood control.

Compounded Vulnerability

The effect of global and regional climate change trends amplifies the challenges of the natural topography and unrestrained urbanization and makes them even tougher to deal with. Rainfall intensity and sea level rise are two major vulnerabilities facing Kolkata. Even common downpours are known to back up traffic in Kolkata for 5 to 6 hours, or for days in the low-lying or waterside slums. Being stranded during a flood is an all too common occurrence for motorists and pedestrians, keeping workers from their jobs and children from their classrooms. Flooding damages anything on the ground floors of buildings and other structures at street level are also susceptible.

A World Bank study conducted in 2011 looked at the possible effects of a 100-year flood (a flood of a magnitude that could be expected every 100 years) in 2050 on only the Kolkata metropolitan area.[9]

CONTROLLING FLOWS. Flood control efforts are more pressing than ever with climate change effects set to increase the stakes.

[9] World Bank. 2011. *India—Vulnerability of Kolkata Metropolitan Area to Increased Precipitation in a Changing Climate*. Washington, DC.

It concluded that it would cost the city, its residents, and its migrant workforce about $6 billion, rising to $6.8 billion if likely climate change scenarios were factored in. Damage would be felt most on residential buildings and property but, importantly, health care would be the next most expensive item on the ledger as hospitals suffered damage and the system became stretched by increased illness and disease. Businesses would be hit and workers would suffer, both because of the difficulty of getting to their jobs and due to the likelihood that their workplaces would be closed even if they managed to get there.

Kolkata's Redevelopers: Political Champions, Bankers, and Engineers

Kolkata is as much of an opportunity as it is a challenge to urban planners and engineers. Established in 1876, the KMC is the second-oldest civic body governing the city of Kolkata, and has had decentralized powers rarely seen in other local bodies in India.

ADAPTING TOGETHER. ADB and the KMC had to adjust their own practices to successfully implement their plans for the city.

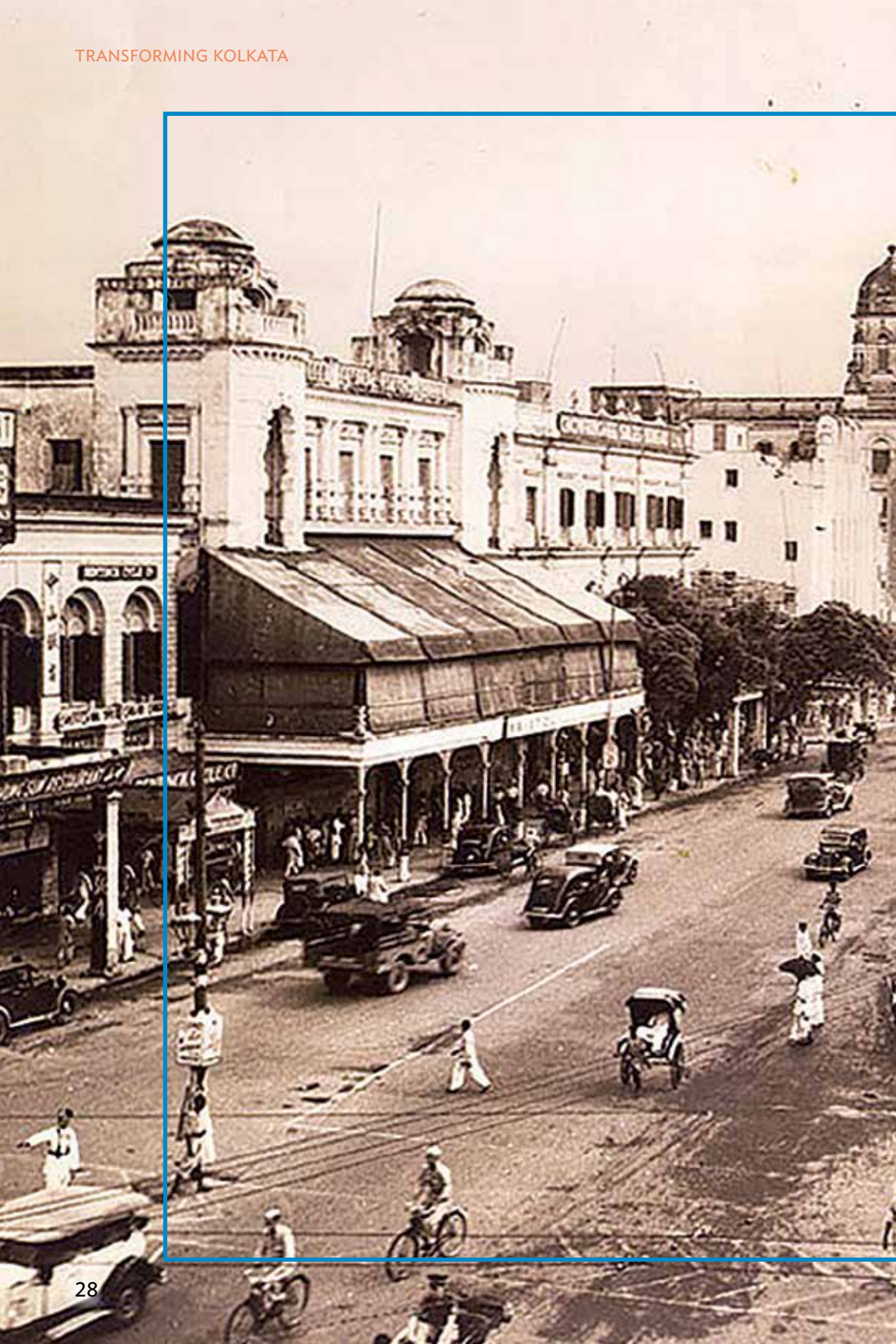
An overall lack of investment and policy gaps hindered institutions like the KMC from being able to deliver and sustain top-class urban services. These limitations may have been manageable, but each year Kolkata's expanding economy and deficient investment and maintenance made narrowing those investment and policy gaps more urgent.

In the late 1990s, the Government of West Bengal and the KMC began progressive urban reforms and sought external partnering and financing to drastically improve its urban infrastructure and services. ADB recognized the opportunity presented by the government's initiative and willingness to continue the reforms. If investments in a megacity such as Kolkata were going to work, the effort would need to address the city and its problems as a whole. Scale would matter and Kolkata would require long-term planning, financing, and sustained support to its systems and people. Partners were needed to provide and manage the resources, spread the risk, and offer focused technical expertise and oversight to the different types of construction work and capacity building required.

ADB Support for Kolkata

Since 1998, ADB has been supporting the KMC to make Kolkata a more livable city through phased investments and integrated urban planning and development—starting with small grant funds in 1998, which led to the Kolkata Environmental Improvement Project (KEIP) and subsequently the Kolkata Environmental Improvement Investment Program (KEIIP), a long-term investment program for the KMC.

Once the project preparatory and capacity-building technical assistance grants for the KMC in 1998 identified the immediate and long-term needs, the first phase of ADB support or investment came in the form of KEIP in 2000. KEIP took on urgently



BOX 3

THROUGH THE HISTORICAL LENS:
Today's Planners and Engineers Not First to Face Problems

The statement of the British Governor General in 1803:

"It is now become absolutely necessary to provide permanent means of promoting the health, the comfort, and the convenience of the numerous inhabitants of this great town. The construction of the Public Drains and Water-Courses of the Town is extremely defective. The Drains and Watercourses, in their present state, neither answer the purpose of cleansing the Town nor of discharging the annual inundations occasioned by the rise of the River, or by the excessive fall of rain during the south-west monsoon.

During the last week, a great part of the town has remained under water, and the drains have been so offensive, that unless early measures are adopted for the purpose of improving their construction, the health of the inhabitants of Calcutta, both European and Native, must be seriously affected. The defects of the climate of Calcutta during the latter part of the rainy season may indeed be ascribed in a great measure to the state of the Drains and Water-Courses, and to the stagnate water remaining in the town and its vicinity.... Experience has manifested that during the rainy season, when the River has attained its utmost height, the present drains become useless; at that season the rain continues to stagnate for many weeks in many parts of the Town, and the result necessarily endangers the lives of all Europeans residing in the Town, and greatly affects our Native Subjects."

To retain the integrity of the original statement, no edits have been made.

Source: Administrative Minute by British Governor-General Lord Wellesley, 16 June 1803.

Photo source: Claude Waddell (Public domain), via Wikimedia Commons.

needed infrastructure investments in sewerage and drainage that had not been touched or expanded since the British laid them in the mid-1800s. It also made the city's finances and financial management more robust so it could take care of its urban services better and make the city more livable for those in the least serviced wards, which make up 25% of the city. It strengthened the city's weakest spots—sewerage and drainage (S&D) and the rehabilitation of drainage canals that had long been used as a key element in Kolkata's infrastructure, both modern and ancient—and prepared a comprehensive master plan with extensive surveying and hydraulic modeling for the entire city's S&D needs. The S&D works also required investments to increase the city's pumping capacity, refurbish existing sewage treatment plants, re-excavate drainage canals, and resettle canal dwellers. ADB and the KMC also seized on the investment as an opportunity to—and made history by—raising the living standards of the canal dwellers that were resettled and empowering women. Giving more than 2,800 resettled households the titles in the name of their women, providing gender-secluded water quarters for bathing and laundering, creating self-help groups for women in more than 100 slums, and training them in always-in-demand skills, were socioeconomic investments that have had multiplying effects on the everyday well-being of slum dwellers and on overall empowerment of women in the city.

KEIP supported the KMC in modernizing and improving its financial management capacity and training its staff intensively for the job.

MULTIPLYING EFFECTS. ADB-funded projects have helped increase inclusiveness of the city and well-being of its informal settlements.

KEIIP started in 2000, and was completed somewhat later than expected, in 2013. The initiation of such a major investment, especially one that required relocating thousands of residents along the city's canals, called for dedicated resources to ensure that the general public and the people affected understood its necessity. The initial investment also aimed to renovate city parks and ponds, elements in making a city livable that are often overlooked. In parallel, KEIP supported the KMC in modernizing and improving its financial management capacity and training its staff intensively for the job. The KMC's books were never audited until potential partners such as ADB and the Department for International Development (DFID) of the United Kingdom supported it to do so, prior to bringing in investments. From then on, the KMC would undergo various reforms to modernize itself, its administration, management, systems, and workforce.

ADB investment has also leveraged cofinancing from the DFID in KEIP, and from ADB's Urban Climate Change Resilience Trust Fund[10] in KEIIP. The investment projects have employed hundreds of consultants and contractors from private construction, technology, and management. Now the standards and experience gained with the KMC are being replicated in projects elsewhere across the country and South Asia. Figure 3 summarizes the support given to the KMC by ADB and its financing partners over the last 2 decades.

With the first phase completed successfully in 2013, ADB and the KMC embarked in 2014 on a larger program of investments, the KEIIP, a $400 million multitranche financing facility that was expected to have three tranches (loans) between 2014 and 2023. KEIIP is focused on a policy reforms road map to provide better urban services. Under KEIIP, the KMC adopted a water loss roadmap in 2016 and embarked on property tax reforms in 2017. Both partners learned many lessons during the first phase of partnership, which started slow and introduced many challenges (Box 4).

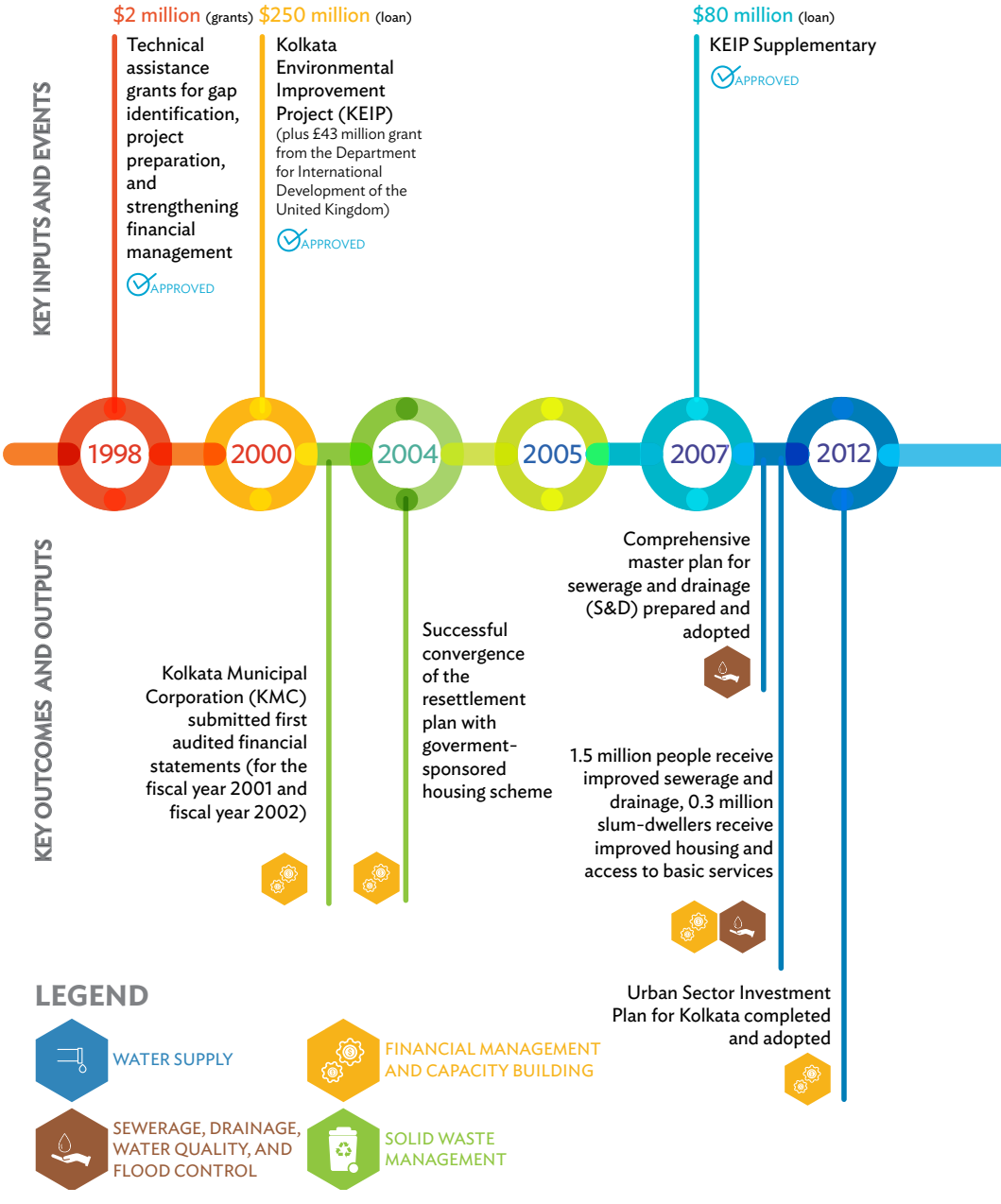
KEIIP addresses the vulnerability of Kolkata to climate change and incorporates measures to make the city more resilient to its effects. It includes the phased sequencing of investments to increase climate resilience by systematically expanding the S&D network in peripheral areas of Kolkata, including flood-prone areas. It is increasing sewage treatment capacity, improving water supply by reducing nonrevenue water (NRW), and increasing the operational efficiency of services. Through KEIIP, the KMC is also implementing information technology-based solutions for smart management of urban services, dividing water supply services into district-metered areas for optimized water supply and reduced water loss, digitizing maintenance systems, and establishing an

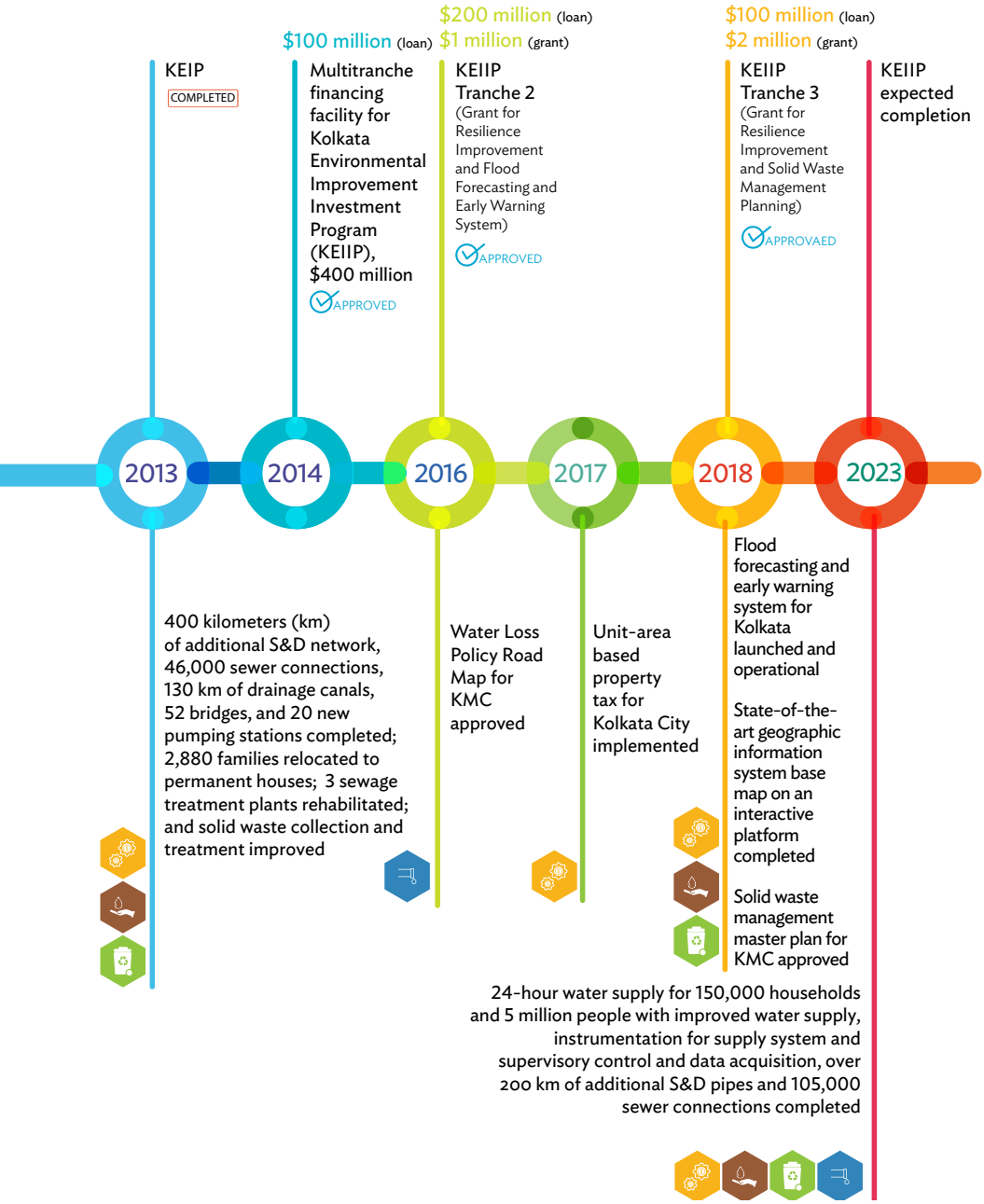
[10] Financing partners: the Rockefeller Foundation and the governments of Switzerland and the United Kingdom.

ADB's Water Operational Plan for 2011–2020 calls for ADB investments to show higher water-use efficiency, expansion of sewerage and drainage coverage, and the private sector's best practices in utility operations.

LIFEBLOOD OF THE CITY. Managing drains, water, and sewage tops the list of priorities for Kolkata.

Figure 3: ADB Support to Kolkata City




$100 million (loan)
$200 million (loan)
$1 million (grant)
$100 million (loan)
$2 million (grant)
KEIP
COMPLETED
Multitranche financing facility for Kolkata Environmental Improvement Investment Program (KEIIP), $400 million
APPROVED
KEIIP Tranche 2
(Grant for Resilience Improvement and Flood Forecasting and Early Warning System)
APPROVED
KEIIP Tranche 3
(Grant for Resilience Improvement and Solid Waste Management Planning)
APPROVAED
KEIIP expected completion
2013
2014
2016
2017
2018
2023
400 kilometers (km) of additional S&D network, 46,000 sewer connections, 130 km of drainage canals, 52 bridges, and 20 new pumping stations completed; 2,880 families relocated to permanent houses; 3 sewage treatment plants rehabilitated; and solid waste collection and treatment improved
Water Loss Policy Road Map for KMC approved
Unit-area based property tax for Kolkata City implemented
Flood forecasting and early warning system for Kolkata launched and operational
State-of-the-art geographic information system base map on an interactive platform completed
Solid waste management master plan for KMC approved
24-hour water supply for 150,000 households and 5 million people with improved water supply, instrumentation for supply system and supervisory control and data acquisition, over 200 km of additional S&D pipes and 105,000 sewer connections completed

> The KMC had to learn how to handle a big project in a city like Kolkata with its complexities and problems. ADB also learned that they had to change their strategy, their plans, and had to be more flexible. They understood our difficulties and (became) more accommodating with their framework to make the program a success.
>
> *— Khalil Ahmed, commissioner, Kolkata*

BOX 4

PROJECT LESSON NO. 1:
To Build a Project, First Build the Capacity for Building

In 2000, the Kolkata Municipal Corporation (KMC) received significant external financing support to begin major public works. What the KMC did not have was the capacity to spend money

The KMC took more than 10 years to complete the first investment phase, which did finish strong in 2013. But the first 3 years of the project were nearly lost to administrative paralysis. ADB and its partners expected the KMC to establish an autonomous working environment for the project, adequately staff the project management unit, keep the schedule for fund disbursements (the indicator that the project is progressing), and follow its social and environmental commitments. That the KMC could not perform these basic project management functions was an indication of its capacity gaps and the risks the investments faced.

Soumya Ganguly, the longtime director general for the project, said that the commitment charges ADB levies on stagnant investments were an effective motivator, but a hard lesson to learn. "ADB was on the verge of canceling the loan," Ganguly said. "We learned from paying commitment charges to ADB when the disbursements were late."

A turning point came in 2005, nearly 5 years into the project, when the KMC assigned a senior and experienced officer in the government's elite Indian Administrative Service, as project director. Many credit the eventual success of the investments to his and his successors' streamlining of project implementation and administrative structures, while building capacity of the staff. "Project directors like them completely turned the project around," Ganguly said.

ADB learned the lesson to lead investments with new clients, such as Kolkata was in 2000, with capacity-building activities.

"Certainly, both KMC and ADB learned a lot from this partnership," Khalil Ahmed, commissioner of Kolkata said. "The KMC had to learn how to handle a big project in a big city like Kolkata with its complexities and with its problems. ADB also learned that they had to change their strategy, their plans, and had to be more flexible. They understood our difficulties and (became) more accommodating with their framework to make the program a success."

Source: Personal interviews during story-gathering fieldwork for ADB in 2018.

BOX 5

PROJECT LESSON NO. 2:
Engineers—Good Ones—Make Best Project Managers for Complex Engineering Projects

In the age of management consulting, the continuity of Asian Development Bank (ADB) investments in the Kolkata Municipal Corporation (KMC) is a reminder to the development industry of the value of engineers sitting behind management desks and occupying most of the top branches of the project organization.

"Engineers understand the project cycle of such a complex project that needs deeper understanding of the city's limitations and needs and construction practices that can best respond to meet them. That's very important," said ADB Principal Urban Infrastructure Specialist Neeta Pokhrel. "We have been fortunate to have so many engineers leading and working on this project from both ADB and the KMC."

According to ADB Senior Project Officer Sourav Majumder, "Initially good contractors were skeptical of the capacity of the project team and hesitated to participate in the development process. Over time, the engineering team in the project management unit acquired strong technical and managerial capabilities and demonstrated those through completion of complex technical interventions by involving good contractors in the process. It's a perfect example of partnership between the contracting community and the client."

COMPLEX JOB.
Project leaders need to use and sync planning, financial management, project oversight, contracting, and engineering.

> Contractors used to repeatedly challenge our design, referring to what they had executed elsewhere on some non-ADB-financed project, where they had the liberty to construct on a more ad hoc basis.
>
> *—KEIIP Director General Soumya Ganguly*

The project engineers did have a learning curve to conquer. "The engineers had zero exposure to the outside world of projects. We had a very narrow knowledge base," KEIIP Director General Soumya Ganguly said. He is talking about the higher construction, health, and safety standards that come with multilateral development financiers (such as ADB) as well as their systems and mechanisms for keeping the layers of government, contractors, and subcontractors accountable to those standards. Project-sponsored training on project management helped them conquer that learning curve.

KEIP and KEIIP have put their best engineers in management positions, but with strict stipulation to instruct and not be instructed by the consultants or contractors. "Nobody (outsiders, such as consultants or contractors) should know this project or the job better than the engineers in charge of managing it," Ganguly said. It does not mean the engineers did not listen or take note of the best practices suggested by the consultants. They willingly did. But they also spent adequate time in the field understanding and tackling the real issues themselves.

The project management unit is also stacked with both senior and junior engineers, which provides a pipeline for younger professionals to earn their way up. The engineers are also assigned to the project management unit full time.

Having gained confidence and professionalism with the project, the engineers reportedly do not compromise on construction standards. Construction teams had to prevent buildings from cracking or even collapsing from the impact of tunnel excavation. "The hydraulics on this project are a hell of a job. You wouldn't believe the narrow crisscross roads and sinkholes in this city," said Atanu Chakroborty, deputy team leader of the KEIIP design and supervision team.

"Contractors used to repeatedly challenge our design, referring to what they had executed elsewhere on some non-ADB-financed project, where they had the liberty to construct on a more ad hoc basis," said Ganguly. "But we have high safety and design standards on ADB-financed projects. The standards are hard to maintain, and come at a cost, but at the end of the day, the same contractors say that their stakeholders are happier and more satisfied on ADB jobs. So we are raising the bar with this project. Contractors are demanding these standards be included in the bid documents for other projects and places."

Source: Personal interviews during story-gathering fieldwork for ADB in 2018.

SKILLING COMMUNITIES. ADB-funded projects have improved skills and provided employment of local communities over the last 20 years.

interactive e-platform for citizen interface, among other measures.

KEIIP consolidates and builds on the lessons learned from the first phase, KEIP, in both technical design and implementation and capacity development for policy reforms. An experienced, long-term, and adequately staffed unit under the KMC is managing the project.

The KMC has also learned that designs must incorporate measures to tackle Kolkata's inadequate road space, high population density, and mixed land use. Thus, technology such as micro-tunneling has been adopted to lay large sewerage and drainage pipes to minimize disruption to traffic and community at large.

The program introduces new technology and training to improve the resilience and adaptive capacity of the government and the public. The investments exemplify what both India's government and ADB's Water and Urban Sector Operations identify as Kolkata's most immediate needs.

ADB's Water Operational Plan for 2011–2020 calls for ADB investments to show higher water-use efficiency, expansion of sewerage and drainage coverage, and private-sector best practices in utility operations. The investments in the KMC tick all these boxes.

Water efficiency and sensitivity is the key to Kolkata's resilience. An efficient water supply, sewerage, and drainage system does not tolerate leakage, wastage, or inundation. As an economic and social good, water must be measured, monitored, valued, and sustained. Wastewater must be captured, valued, treated, and released without causing harm to the environment. In fact, wastewater is a resource that can be put to productive use either socially, commercially, or environmentally. Stormwater must have a course to run through the city's impervious surfaces, away from people's footpaths, homes, and businesses.

REFLECTION

Sourav Majumder, ADB co–team leader for the Kolkata Environmental Improvement Investment Program

Before joining ADB as staff in 2006, I was one of the design engineers providing project management services to the Kolkata Environmental Improvement Project (KEIP). This gave me an opportunity to closely see the transformation of the project management unit (PMU). The Kolkata Municipal Corporation (KMC) hired the best among the technical experts in sanitation, procurement, and project supervision for KEIP's PMU. Over time, the PMU learned and gained experience in implementing complex infrastructure projects, which involved laying and replacing underground sewerage and drainage conduits in this densely populated city with a maze of unforeseen and unknown hindrances.

Since I joined ADB, I have been working with several executing agencies in many states in India. I see the difference between the PMU in the KMC and other similar agencies, one of which is the importance they give to comprehensive and long-term master planning. I have seen personally how long it took—around 5 years—and what an effort the KMC and their consultants made to prepare the master plan for sewerage and drainage for the city, which was completed in 2007. Similarly, they prepared an urban sector investment plan for Kolkata in 2012. These documents have led to and become the basis for all urban sector investments in Kolkata.

Another good practice and edge I see from the PMU is their swift management of interdepartmental coordination (between different utility departments), which results in very little delay in getting clearances for utility shifting. The KMC has addressed this by operationalizing a dedicated cell in the PMU to take care of the timely inter-coordination and utility shifting requirements, which involved the highest decision makers of the KMC whenever required. I hope other urban development agencies in India will adopt a similar approach. I feel very proud to be part of this development team, which works round the clock with a clear vision to improve the lives of Kolkata citizens.

REFLECTION

Kenichi Yokoyama, country director,
ADB India Resident Mission

ADB's long-term partnership with the KMC has grown and strengthened into a collaborative effort that is now focused on helping Kolkata transform into a "smart" city by 2026.

I visited the project sites in Kolkata in March 2018 and was impressed with the way the the KMC's dedicated project management unit has been implementing KEIP and KEIIP over the last 2 decades.

Throughout these 2 decades, we in ADB have been working very closely with the KMC on the projects that are targeted at improving urban services in Kolkata, as well as strengthening the KMC's capacity to undertake wide-ranging reforms, including on property tax and water charges, to help the municipality expand its revenue base.

Kolkata presents an example of integrated urban planning ably executed by a dedicated municipal administration. I believe the KMC now presents a model for other municipalities in India to follow. During our annual review of the performance of ADB-funded projects in November 2017, jointly done with the Department of Economic Affairs, KEIIP was accorded the best performing project award. We have seen the KMC project management unit change from low-performing to a very effective one, which has been disbursing more than $30 million of ADB funds annually over several consecutive years, a rare feat for most urban project implementing agencies in South Asia. I trust it will continue to remain one of the most efficient entities for implementing urban projects in India.

ADB will continue supporting the KMC closely on project implementation and urban reforms. Our joint targets are 24/7 fully metered water supply with less than 10% loss (nonrevenue water) in the city. The sewerage and drainage network—which has already doubled by using innovative technologies such as micro-tunneling—will be expanded to uncovered areas. The city will have a solid waste management system with recycling facilities and an early warning flood system to help it become clean and resilient.

A MORE **SUSTAINABLE CITY**

Sewers, drains, and water pipes are the invisible bones of the city, the backbone of its environment and the key to health and well-being of its citizens above ground. Unfortunately, they are often the most neglected infrastructure in the city. They prove the old saying: out of sight, out of mind. Wear and tear eventually betray the system's age and condition with floods, inconsistent water pressure, irregular supply, and residual pollution from stagnant and brackish ecological flows. Over time, the city accumulates clever but often counterproductive coping strategies that sabotage the system even more: additional pumping stations and household pumps; diversionary drains and supplementary septic tanks; and ubiquitous ad hoc connections and ingenious workarounds. The public takes the system into its own hands and

CITY LIFE.
A city's livability is measured by its citizens and the services they receive, not the infrastructure.

What could improve the livability of a city more than a reliable and safe supply of drinking water and disposal of dirty water and waste?

applies bandage over bandage for the chronically wounded and ill system below.

What could improve the livability of a city more than a reliable and sustainable service supplying drinking water and disposing of dirty water and waste? Only a city that takes care of these essentials sustainably can be competitive, green, and clean. Water is not an amenity, and neither are the supplementary systems that prevent that water or the environment and people around it, from being contaminated. Like the doctor's Hippocratic oath, the city's water infrastructure should first "do no harm." It should never be allowed to turn into a toxic hazard that could make its residents ill, either immediately or over time.

Despite the obvious need for and evidence of a worsening situation with water, sewers, drains, and

THE HEALTH OF A CITY. Proper water and sanitation aren't luxuries, they are essentials to the well-being of the citizens.

waste treatment, politicians are often reluctant to invest in these mostly sunken systems. Repairing aging systems or building them where they do not exist is capital intensive; construction takes a long time and is complicated and disruptive to the city. The costs of the investment and the never-ending operation and maintenance that follows must be recovered somehow. That often means an unpopular increase in user fees and tariffs, which adds to the perception of low political returns on the investments. Water infrastructure problems are so entrenched and costly that attempting to fix them can seem too risky of a political venture for those in elected office. Though their constituents will experience the benefits of an improved system every day and for decades to come, these urban services are basic expectations of government and any credit may soon be forgotten. When these basic needs are

met, public discontent quickly moves on to the next rung on their hierarchy of needs.

This urban political scenario is playing out in too many cities in both the developing and developed world. But the story of Kolkata's urban improvement has been one in which the political will exists that is too often lacking elsewhere. In the mid-1990s, the Government of West Bengal and the Kolkata Municipal Corporation (KMC) already knew that the city's ailing water and wastewater infrastructure, built in the 1800s, needed urgent expansion and rehabilitation that was essential to the city's resilience and competitiveness. Though detailed studies on Kolkata's vulnerability to climate change impacts will not come for several more years, Kolkata's flat terrain and proximity to water sources made the reality above ground (risks of flooding and disease) telling enough for its leaders. The proximity to abundant water sources and its important geopolitical and economic history, has always given Kolkata an edge over other cities. The quality and coverage of Kolkata's water systems (water supply, sewerage, and drainage) has thus always been above the national average. But the coverage, capacity, and condition of the systems did not keep pace with the 20th century, an epoch of historical, socioeconomic, and political changes in the region that resulted in waves of political and economic refugees and migrants into Kolkata. That influx continues.

The service areas covered by the KMC are divided into "core city areas" and "newly added or peripheral areas," which are the wards in the outskirts of the city that were added in the last 3 decades. The centralized underground sewerage and drainage system built in 1859 covered the core KMC area but not the peripheral areas. Even in core areas, the coverage was uneven, and the level of services declined with each kilometer out from the center into the urban sprawl. The lowest coverage levels were along the city's drainage canals and in the periphery settlements, where there was little to no coverage.

These are the wards that ADB investments prioritized. The sewerage and drainage (S&D) system was heavily silted by up to 80% in some of the major trunk lines. And the volume of sewage and wastewater exceeded the capacity of the city's engineering works and unique ecological assets that have been used to naturally drain and filter sewage flows.

The majority of the sewage from the core inner city area—about 1.1 billion liters per day—did not receive any formal treatment before being discharged via the 36-kilometer (km) dry weather flow canal into the Kulti River and the East Kolkata Wetlands, covering around 12,500 hectares (Box 6).

Sewerage and Drainage: Essential Environmental Assets

When Kolkata decided to join hands with ADB in 2000 to improve the city's livability through the Kolkata Environmental Improvement Project (KEIP), the first phase of investment, it had clear priorities and targets. Step 1 aimed to expand and rehabilitate the sewerage and drainage system, mainly in the peripheral areas of the city that needed them the most. That would include the canals, sewage treatment plants, and solid waste management services that are critical components of the system. It also needed to help increase the revenues of the city to sustain the services.

Prior to KEIP interventions, the city's sewage and stormwater drained through 130 kilometers of drainage canals that had never been cleaned since being built. The effluent emptied into the city's

KEIP brought new life to an ailing system that badly needed updating and expanding.

BOX 6

PROJECT LESSON NO. 3:
Protecting East Kolkata Wetlands, Kidneys of the City

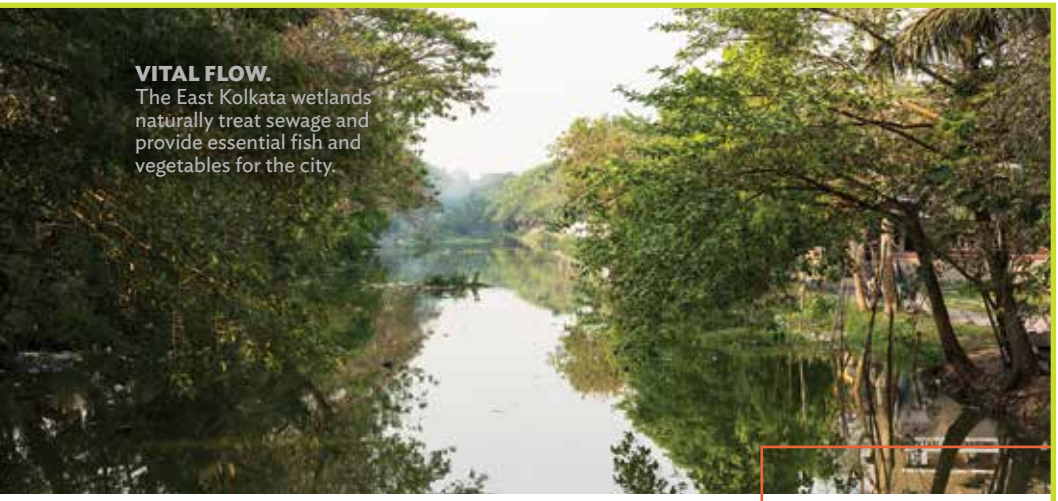
The East Kolkata Wetlands and the city of Kolkata have been intertwined almost from the start. A 12,500-hectare area of ponds, marshlands, and rice paddy, the wetlands today are a key part of the city's sanitation system. As well as treating about 750 million liters of sewage per day, they contribute about 10,500 tons of fish and 55,000 tons of vegetables to produce markets in Kolkata each year. About 50,000 people are directly employed in the fisheries and farms that operate within the wetlands.[a] Without the natural sanitation provided by the wetlands the city's vital infrastructure would collapse.

Some of the first foreign settlers in the area could not forsee the significance of the wetlands, however. In 1803, the governor-general of India, Lord Wellesley, noted that a mistake had been made by his colonial predecessors in their construction of the city's infrastructure. In an administrative document that would have repercussions stretching to the present day, he suggested major changes. "An opinion is generally entertained, that an original error has been committed in draining the town toward the River Hooghly; and it is believed that the level of the country inclines toward the salt water lake, and consequently that the principal channel of the public drain and water-courses ought to be conducted in that direction."

And so it was. Over the following decades, Kolkata's sewerage and drainage systems were made to flow (much of it still through pipes and canals installed as a direct result of Wellesley's orders) inexorably toward the wetlands. There, sewage is exposed to the purifying rays of the sun before being used to grow algae and plankton in the water for fish to eat or spread on fields as fertilizer for vegetables or rice. It is said to be the largest sewage-fed aquaculture complex in the world and in 2002 was designated as a Wetland of International Importance, under the Ramsar Convention.

Two hundred years ago, the wetlands were mostly brackish ponds and salt marshes. But as water and sewage drained into them from Kolkata, and as a nearby brackish river dried up, the water in the wetlands became less salty. By the early years of the last century, the water in the wetlands had lost much of its salinity. That was a problem for the local fishers, who had come to rely on fish suited to the brackish water. Their actions in adapting their methods to use the sewage flowing out of the city led to the current makeup of the wetlands, with about half the total area now dedicated to fish farms.

The original system of draining the city was aging fast by the turn of this century. Canals, sewers, and drains had silted up and the city's frantic growth had encroached on the parts of the system that were exposed above the ground. The wetlands were threatened as more and more migrants scrambled for space. In 2005, the East Kolkata Wetlands Authority was established to monitor and protect what had become a vital resource for the city.



VITAL FLOW.
The East Kolkata wetlands naturally treat sewage and provide essential fish and vegetables for the city.

Efforts to address the problems of the city's sewerage and drainage have been a big part of the program of improvements to the city's infrastructure financed by the Asian Development Bank (ADB) and its international partners and the Kolkata Municipal Corporation (KMC). All phases of ADB investment support have focused on sustaining and protecting the East Kolkata Wetlands through measures such as rehabilitating the existing sewage treatment plants and constructing new sewage treatment plants so untreated sewage from the sewerage and drainage systems do not burden the East Kolkata Wetlands. Through ADB-funded projects, extensive master planning was also conducted of the sewerage and drainage systems, as well as of solid waste management. That will further ensure that the East Kolkata Wetlands' carrying capacity is not affected by unplanned discharge and waste in the future. Closure of the landfill site, currently in the East Kolkata Wetlands, and its rehabilitation is a critical part of the master planning process on solid waste management supported under the projects. Pipes and canals have been cleared of silt; over 46,000 new sewerage connections have been added to the system; and over 400 kilometers of new sewerage and drainage networks have been connected, which again assist in sustaining the wetlands and lessening the load placed on them. Under the first phase of investment, over 2,800 households of slum dwellers who lived beside the 130 kilometers of canals that drain from the city were relocated into good quality apartments, allowing the canals to flow freely and at the same time giving the residents a better chance in life.

It is said to be the largest sewage-fed aquaculture complex in the world and in 2002 was designated as a Wetland of International Importance, under the Ramsar Convention.

[a] Environment Department, Government of West Bengal. 2016. East Kolkata Wetlands Management Authority Report, 2013–2014 to 2015–2016. Kolkata: Government of West Bengal.

Source: Information gathered from Kolkata Municipal Corporation and East Kolkata Wetland Management Authority in 2017 and 2018.

THE CITY'S BACKBONE.
The system of drains and sewers under the city date back to colonial times and improvements were well overdue.

outskirts, where the city frays into the countryside. The old combined sewerage and drainage system in the core areas desperately needed desilting and rehabilitation, and needed expansion to uncovered areas, to alleviate the flooding that Kolkata used to experience each monsoon season. The trunk sewers in central Kolkata, some silted by 80%, needed priority attention. Kolkata's streets became waterlogged during the monsoon, partly because the sewers were heavily silted. Drainage pumping stations also needed rehabilitating and had to be upgraded to run more efficiently.

Before the rehabilitation, some mockingly called Kolkata the Venice of India. Entrepreneurs would charge people a few rupees to ferry them around the flooded streets in small boats during monsoons, a sad version of Venetian gondoliers. Just as Kolkata had its equivalent to the Venetian canals, albeit a negative connection, there is a counterpart in Kolkata to Rome and that city's ancient catacombs. Tourists do not line up to visit Kolkata's underground wonder, as they do in Rome for the catacombs

where thousands were entombed, but it is a wonder nonetheless. Hand-built of bricks, the 180 kilometers of sewer and drainage tunnels under Kolkata's city streets were an engineering marvel of their day.

KEIP brought new life to an ailing system that badly needed updating and expanding. It cleaned the ancient underground brick sewers and canals, rehabilitated the sewage treatment plants, and laid a new sewerage and drainage (S&D) network to cover about 25% of the city's peripheral areas—areas identified as the most desperate in the city. The rest of the peripheral city areas struggled on with the same situation that was the reality before KEIP.

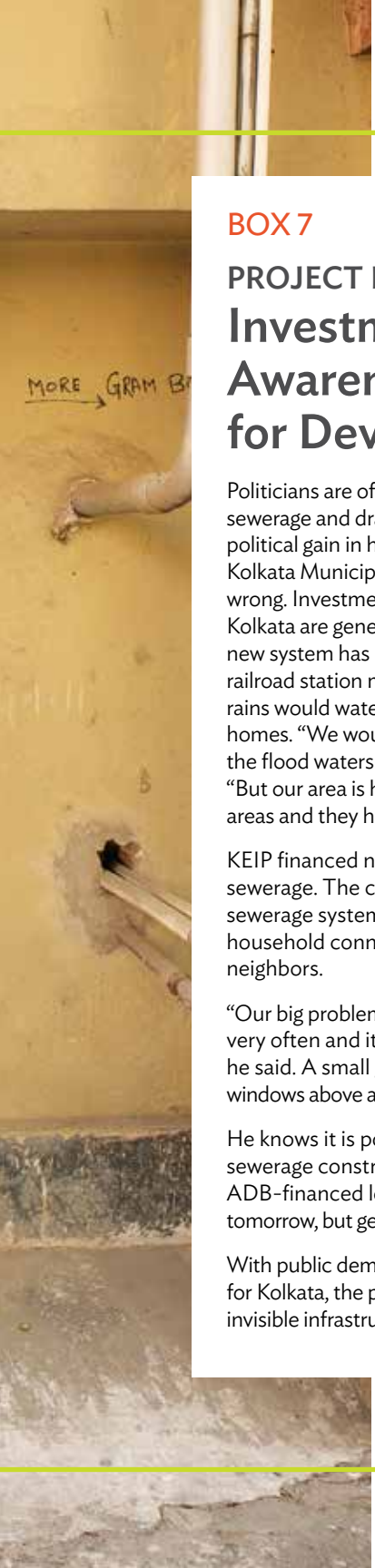
"From 2005 to 2012, we removed around 50,000 square meters of silt, most of which had solidified over the years, from 26 kilometers of these very old brick sewers that no one had dared to clean until then," said KEIP Project Director Yadav Mondal.

The old brick sewers or tunnels were cleaned and upgraded with an inner lining of glass-reinforced polymer to allow water to flow more easily. This was not carried out under KEIP funds directly. The KMC, as a part of the learning curve from KEIP, did this with their own funds and using KEIP staff. This was a technological marvel in itself since such type of lining and restoration in old brick conduits had not been done anywhere in India. The KMC engaged a team of international experts and specialized contractors to do the work.

The KMC has already almost doubled its sewerage and drainage network and systems since ADB started supporting it in 2000. ADB investments have enabled the KMC to begin intercepting the city's sewage and wastewater with over 50,000 new sewerage connections and over 370 km of new S&D networks in the project area to date. Investments are now generating awareness and new demands (Box 7).

Through KEIP, 20 new energy-efficient pumping stations are operating and 22 preexisting pumping

LOOKING TO UPGRADE. Hrishikesh Basu has seen his neighborhood improve but says more is needed.



BOX 7

PROJECT LESSON NO. 4:
Investments Raise Awareness, Demand for Development

Politicians are often reluctant to spend or borrow to develop sewerage and drainage systems. They believe there is little political gain in hidden, underground infrastructure. But the Kolkata Municipal Corporation (KMC) is proving this thinking wrong. Investments in sewerage and drainage in some parts of Kolkata are generating demand among the public where the new system has not yet reached. Hrishikesh Basu, 82, a retired railroad station manager for Howrah Station, remembers when rains would waterlog his community, a quiet courtyard of low-rise homes. "We would have a little trouble coming and going until the flood waters went down, usually a couple of hours," he said. "But our area is higher than other areas. Talk to people in lower areas and they had big, big problems."

KEIP financed new storm drains in his community, but not sewerage. The community still relies on septic tanks. The sewerage system developed in other parts of the city with their household connections have created demand among Basu's neighbors.

"Our big problem is the septic tanks. They have to be cleaned very often and it is a big nuisance here. It smells horrible," he said. A small gathering of neighbors and onlookers from windows above agree with him. "We need a sewer system here."

He knows it is possible because he is aware of the KMC's sewerage construction works elsewhere in the city with the ADB-financed loan. "I'm not telling you to do it today or tomorrow, but get it done because it is really necessary," he said.

With public demand, gaining the political will is easier. Fortunately for Kolkata, the political will was always there for investing in invisible infrastructure, like sewerage and drainage.

Source: Personal interview during story-gathering fieldwork for the Asian Development Bank.

The KMC now plans to achieve total coverage of sewerage and drainage in the investment areas, and the results have thus far directly benefited 1.5 million people.

stations have been rehabilitated with increased efficiencies and capacities. The KMC has augmented three existing sewage treatment facilities and rehabilitated over 210 km of existing S&D conduits and 14 water bodies. The untreated sewage and wastewater that once drained through the East Kolkata Wetlands is now treated. The KMC can monitor the quality of the treated sewage to be used for pisciculture and sludge for agriculture, ensuring the health of fishermen and farmers and their produce.

Flooding has already been reduced in about 4,800 hectares covered by the projects. The KMC expects flooding to be reduced in the entire 6,000 hectares covered under the investment projects in the near future. Starting from September 2018, a state-of-the-art flood forecasting and early warning system for Kolkata City has been developed, installed, and operationalized.

The system being introduced under the Kolkata Environmental Improvement Investment Program (KEIIP) will alert the authorities and all its residents during impending floods through short messaging service (SMS) and other means.

KEIIP aims to improve sanitation, through continued expansion of sewerage and drainage and the construction of three new sewage treatment plants. It is also rehabilitating the water supply system to reduce losses and modernize services. The city has completed a master plan for solid waste management, installed a flood warning system, improved public spaces, and is mapping and digitizing its properties and utilities. Many other

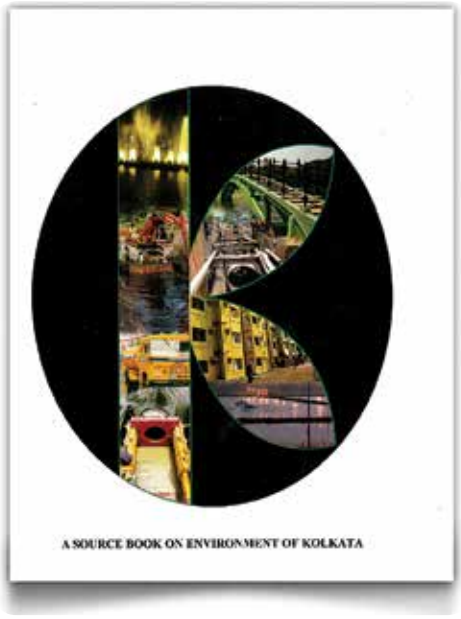
soft and hard interventions to improve the city's livability are planned and being implemented. Most importantly, the focus of all phases of investments has been to create and enable an environment that encourages policy reforms and improved finances of the city, alongside the infrastructure improvements, so that the services and assets can be maintained.

Preparing a comprehensive sewerage and drainage master plan for a city like Kolkata, where the systems were laid as far back as 1859, is a huge task. The original plan in the 1800s was approved after almost 5 years of study (Box 8). With support from KEIP, from 2002, it took almost 5 years to put the modern plan in place as well. The KMC initiated its master plan for sewerage and drainage with the help of ADB under KEIP in 2007. Extensive surveys were carried out to map exactly what had been laid underground. The larger hydrological and hydrogeological conditions of the entire basin had to be mapped and understood, along with climatic conditions and the potential increased precipitation under climate change scenarios. Extensive hydraulic modeling was conducted, and calibrating it was no small feat. The challenge for the master plan was to accommodate and service the different levels of sewerage and drainage systems in different parts of Kolkata City.

The arrival of ADB financing in 2000 for the first phase of works under KEIP capitalized on the government's political will for better urban environment and urban services. To minimize the disruption of long-term construction in the city, the investments introduced microtunneling, which reduced open excavation and its inconvenience to the city (Box 9). A major public awareness campaign from the mayor's office raised public understanding of and appreciation for the project. The success of the initial efforts spread awareness and increased demand throughout the city for investments in new areas, as residents saw how their neighbors' lives had improved under the projects.

The KMC now plans to achieve total coverage of sewerage and drainage in the investment areas, and the results have thus far directly benefited 1.5 million people. By the end of the investments in 2023, most of Kolkata's more than 5 million permanent residents as well as floating population will benefit. In focus group discussions, beneficiaries of KEIP confirmed that flooding has decreased significantly since the commissioning of the new drainage network in 2014. Cases of malaria in the project areas covered by KEIP declined 92% from 96,909 in 2010 (including one death) to 7,041 in 2014, with no deaths.[11] Similar outcomes are expected in areas covered by KEIIP.

Figure 4 summarizes increased S&D coverage under KEIP and KEIIP.



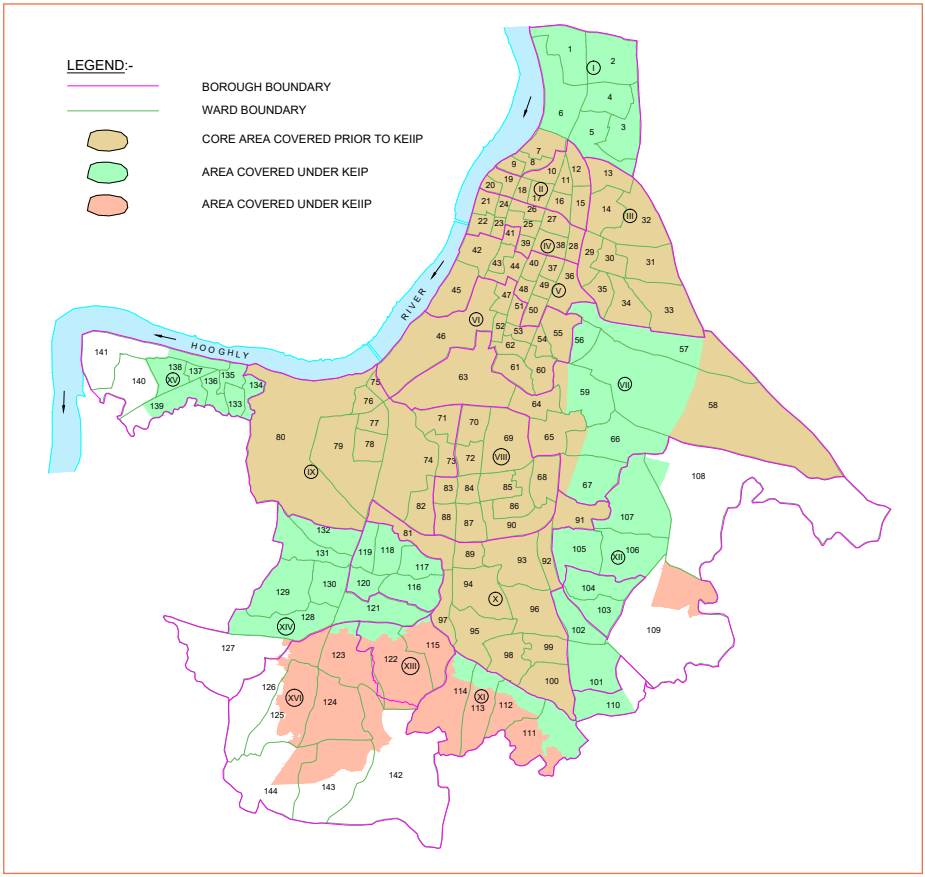
SPREADING KNOWLEDGE. Chinmoy Chakraborty wrote the book, *The Source Book on Environment of Kolkata*, published by the project management unit of KEIP.

The KMC expects to be able to collect and treat all of the city's sewage by 2023, since it is constructing additional three sewage treatment plants under KEIIP. It is further expanding 170 km of a sewerage and drainage network and connecting around 85,700 additional households in Kolkata City to the S&D network under KEIIP in the near future. Chinmoy Chakraborty, the KMC's environmental officer for KEIP and KEIIP, expects the environment of Kolkata to greatly benefit from these efforts.

Chakraborty also wrote a book published by the project management unit of KEIP in 2013, titled **The Source Book on Environment of Kolkata.** It has added immensely to collating data and information and documenting the same in Kolkata's environmental indicators and situation. Colorful and

[11] Kolkata Municipal Corporation. 2015. Activities and Achievements of KMC Health Department, 2010–2015. Kolkata.

Figure 4: Increase in Sewerage and Drainage Coverage for Kolkata City



Source: Prepared by Kolkata Municipal Corporation in August 2018. Numbers in the figure denote wards and boroughs of the city.

packed with pictures and illustrations, it tracks the history and environment of Kolkata, the nature and activities of its people, its flora, fauna, and geological makeup. It also details the KMC projects and plans.

Water Supply: Making Up for Lost Water

For centuries, Kolkata had more water than it needed. Now water supply is uneven and inadequate. Many residents have to make do with only a few hours of water every day. It is fair to ask why.

BOX 8

THROUGH THE HISTORICAL LENS:
Story of Kolkata's State-of-the-Art "Town Scheme" on the Combined Sewerage and Drainage Scheme in 1859

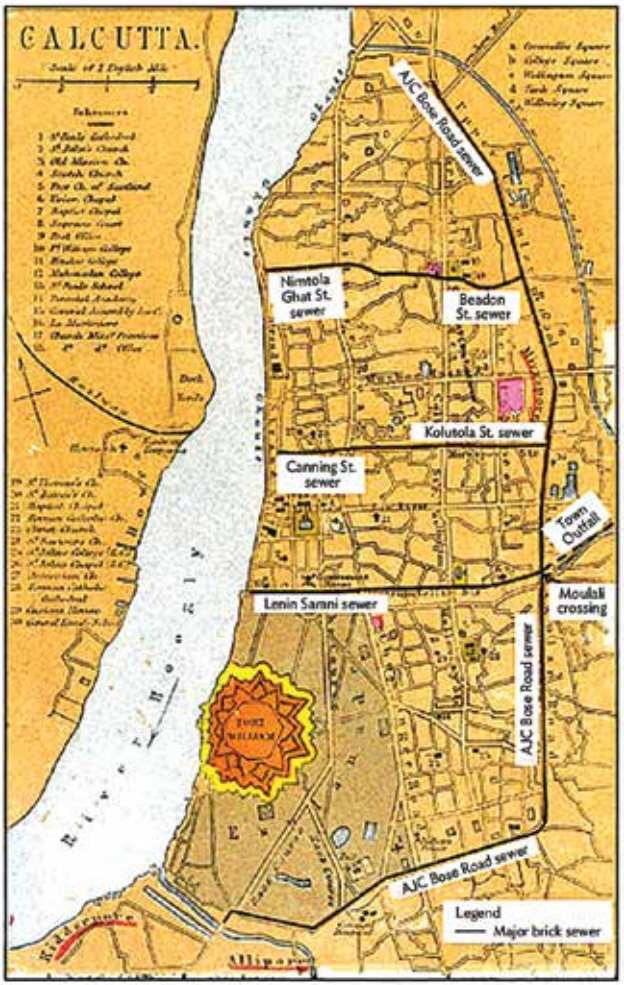
The need for a sewer system had been identified for at least 40 years when a plan for building better infrastructure for the "town" was proposed by William Clark in 1855. His proposal was put to the local government and then sent on to the powers-that-be in England. The so-called "town scheme" was approved in 1859. Construction was begun on a system that would slope along with the natural elevation away from the Hooghly River and toward the marshes and salt lakes east of the city. The system would be connected to the river so that tidal forces could act as a natural flushing of the tunnels. Five main sewers were planned to be laid along major roads, with smaller branches connecting to the larger tunnels. Almost half of the sewers were of a type known as "man entry" sewers, big enough that a man could enter standing up.

By 1890 most of the initial system was complete and capable of supporting a population of 500,000. But almost as soon as it was finished, work began on extending it to the fast-growing suburban areas of the city. Two main tunnels were added, along with canals to carry wastewater out into the countryside.

That system remained the main conduit for sewerage and storm drainage for Kolkata for the next 100 years. Over time, neglect, overuse from a population many times bigger than it could accommodate, and simple age meant the system deteriorated. By the time the tunnels were investigated before the rehabilitation, some of them had become more than 80% full of silt. That was a major cause of the flooding that led to the mocking comparison with Venice. Manholes that had been built to provide access to the tunnels had been covered by city streets as Kolkata grew and grew.

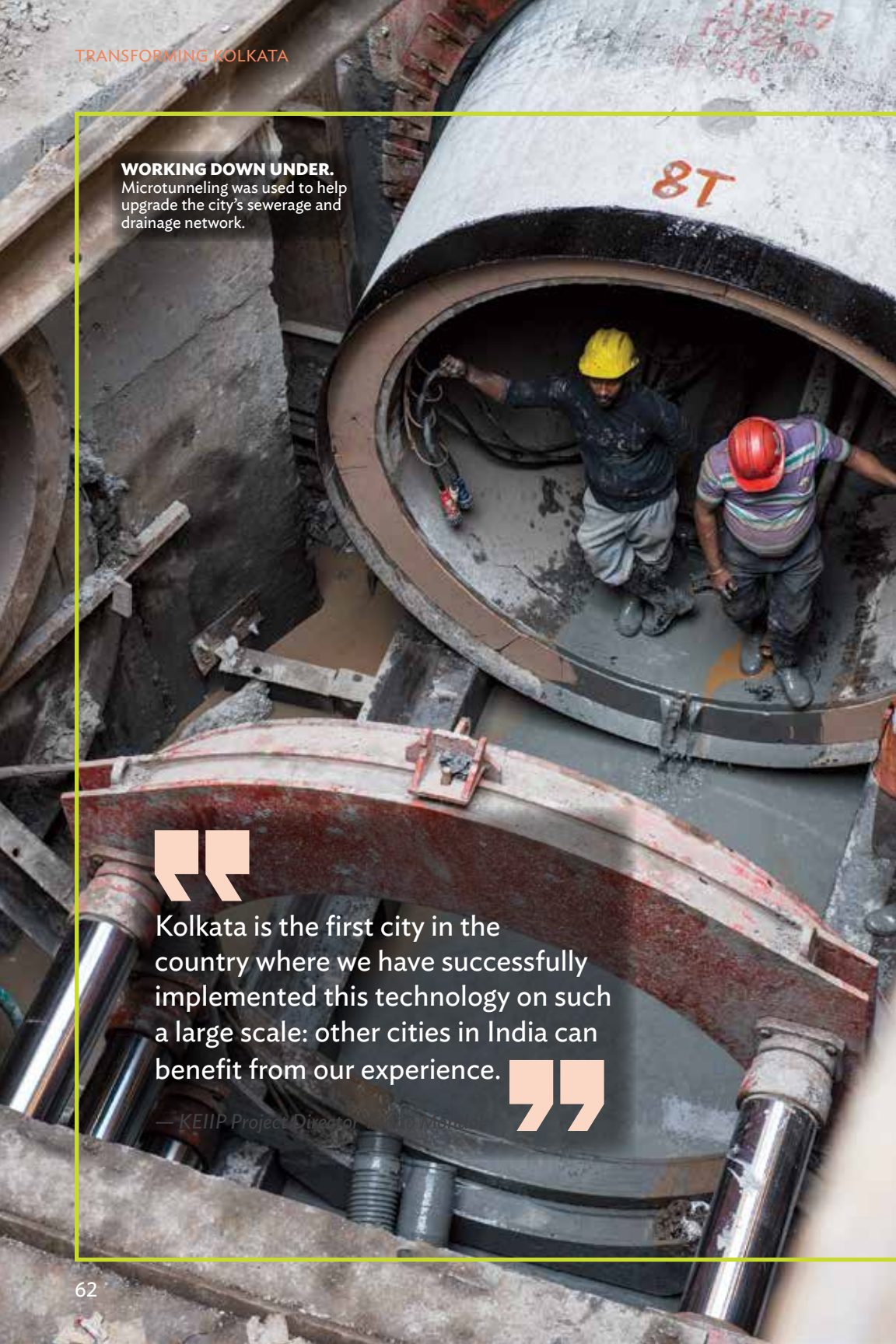
In an article published in Civil Engineering, researchers Basu, Dey, and Ghosh deftly explain the original plan. They write, "Under the original scheme, five main sewers were initially planned to be laid along prominent roads with their branch sewers, associated works and outfalls. Two main intercepting sewers were to be constructed: one along Upper Circular Road (now APC Roy Road) from Sova Bazaar Street to Dharrumtollah (Moulali) Junction, where it was to be joined with another one along Lower Circular Road (now AJC Bose Road) coming from Zeerut Bridge near Tolly's Nallah

to Moulali Junction. Three other main sewers were planned from the River Hooghly to open into the APC Roy Road sewer along Nimtala Ghat Street, Kolutola Street, and Dharrumtollah Street (now Lenin Sarani). A main outfall sewer (the Town Outfall) was to convey this combined flow to Palmer's Bridge pumping station. The total catchment area of the scheme was 19.1 square kilometers and anticipated sewage flow at the pumping station was 1.27 cubic meters per second from a contributing population of about 500,000."



Source: Kolkata Municipal Corporation.

Source: Basu, N. B., A. Dey, and D. Ghosh. 2013. Kolkata's Brick Sewer Renewal: History, Challenges, and Benefits. Civil Engineering. 166 (CE2). https://www.researchgate.net/publication/278671755_Kolkata's_brick_sewer_renewal_History_challenges_and_benefits#pf8 (accessed 28 June 2018).



WORKING DOWN UNDER. Microtunneling was used to help upgrade the city's sewerage and drainage network.

> Kolkata is the first city in the country where we have successfully implemented this technology on such a large scale: other cities in India can benefit from our experience.
>
> *— KEIIP Project Director*

BOX 9

PROJECT LESSON NO. 5

Microtunneling: The Faster, Cleaner, and Less Disruptive Method for Dense Cities

How does a city lay 540 meters of very large diameter pipes under a busy road without disrupting traffic? The Kolkata Municipal Corporation (KMC) knows how.

The ADB-financed Kolkata Environmental Improvement Program (KEIP) and its successor the Kolkata Environmental Improvement Investment Program (KEIIP) have made the KMC king of microtunneling in India.

"Because Kolkata is such an old and congested city, we have such very old utilities. Shifting those utilities without risk of damage to public services, such as telecommunications or existing water lines, is a big challenge," said KEIIP Project Director Yadab Mondal. "We also can't take the risk of disturbing the foundation of flyovers and at the same time we can't disturb the traffic flow, which is so high. Microtunneling is the only solution."

Typical open excavations cause lane and road closures, backing up traffic for kilometers. Microtunneling bores a single wide pit into the road. Then, from about 10 meters deep, a rotary drill cuts the tunnel horizontally for hundreds of meters below the surface of the road, keeping the road intact. High-pressure pumps remove the tunneled earth and store it in tankers that haul and dispose of it at a pre-approved site. The main lines for water, sewerage, or drainage are then either pulled or pushed through the tunnel. Traffic can bend and flow around the work site more easily and continuously. When the pipe is in place, the hole is sealed and the crew moves on to the next stretch of pipeline to install. Microtunneling is faster, cleaner, and less disruptive than the conventional cut and cover method.

"Kolkata is a ground-filled city. It's all developed and every utility is underground," said Rupak Sarkar, vice president of the company working as a key contractor for the KMC on many microtunneling components of the projects. "Microtunneling has been an important technology for upgrading sanitation systems for the city."

The KMC tested the limits of microtunneling in a challenging stretch between Santoshpur Pumping Station and Garden Reach Sewerage Treatment Plant. For the first time in India, the KMC used microtunneling to complete a 540-meter tunnel, 13 meters deep, beneath ponds, a railway line, and major roads in a single drive.

"Kolkata is the first city in the country where we have successfully implemented this technology," Mondal said. "Other cities in India can benefit from our experience."

Source: Personal interviews during story-gathering fieldwork for ADB in 2018.

The problem is not a lack of water sources. Kolkata is endowed with the Hooghly River to the west, vast groundwater reserves, and wetlands in the east, which naturally treat the city's wastewater before discharging into fisheries and agricultural land. The city pumps more than 1,900 million liters per day (MLD) from the Hooghly River, a 260-km tributary of the Ganges River and the major water source for Kolkata. Though there are abundant surface sources of water supply for Kolkata, connecting each household to those sources requires a much larger investment than it has been able to provide. Coupled with large water loss, this has meant that Kolkata still relies on standposts and tube wells for around 20%–25% of the community. It has about 17,000 standposts, 12,000 hand tube wells, and around 2,500 large tube wells. The homeless, transient, and slum population who have very little physical space for private taps, have come to depend on the hand pumps for access to water. But groundwater levels dropped consistently from 1996 to 2006 and have been contaminated by leaking sewerage pipes, salinity, and industrial pollutants.

The problem is not entirely one of system coverage, either. A centralized system of water supply from a treatment plant in Palta was built for Kolkata, the first in Asia. Built in 1863, it was adequate to supply potable water to its entire population, at the time 400,000 people. The system in Kolkata is now serviced by five water treatment plants which produce sufficient quantity to meet Kolkata's demand for drinking water for the foreseeable future (Table 2).

The water treatment plants are in good condition and need only minor work and standard maintenance. Augmentations to the Garden Reach Water Works (an upgrade of 340 MLD) and Indira Gandhi Water Treatment Plant (an upgrade of 90 MLD) are planned. And the city has 28 pumping stations and overhead tanks. Six additional stations are under construction for the system's expansion in the unserviced urban periphery.

CONSERVING WATER. Limiting the amount of wasted water will improve the system.

Table 2: Kolkata's Existing Water Treatment Plants

Water Treatment Plant	Capacity
Indira Gandhi Water Treatment Plant (Palta)	1,180 MLD
Watgunge Water Treatment Plant	22.7 MLD
Jorabagan Water Treatment Plant	36.4 MLD
Jai Hind Jal Prakalpa (Dhapa)	136 MLD
Garden Reach Water Works	545 MLD
Total	**1,920 MLD**

MLD = million liters per day.
Source: Prepared by Kolkata Municipal Corporation in August 2018.

System coverage is high, at around 90%, though disparities remain between central and peripheral areas (correcting this imbalance is at the heart of ADB's latest support to the KMC). Transmission mains convey water from the water treatment plants to the heart of the city: approximately 440,000 residential properties, 9,000 commercial properties, and 250 bulk supply operations within the KMC area.

ADB and the KMC thus knew that an all-out war needed to be waged on reducing water loss to achieve their shared vision of 24/7 water supply for all of Kolkata's citizens.

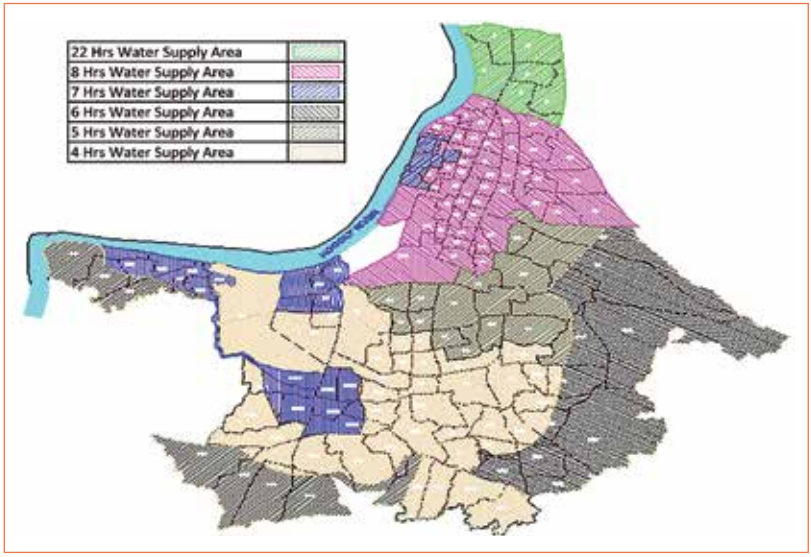
A clue to the problem is found in the availability of water supply in the system. Water is only sporadically available an average of 8 hours per day, though the number of hours varies wildly (Figure 5).

Engineers and policy makers generally attack the problem of water loss at three levels: pipes, pressure, and payments—new or improved pipe networks, pressurized systems, and payments to recover both the lost water and the cost of supplying it. That cost includes the initial investments as well as the operations, maintenance, and expansion of systems. Essential to all three is something the ADB–KMC investments are introducing to city users for the first time: meters to monitor and measure the production and consumption of water. Meters give water a value so it can be costed and conserved. Of the 1,600 MLD pumped from the Hooghly, only an average of 950 MLD makes it through the system's 5,700 km of water pipes. Without meters, exactly where the water is lost and for what reason is a mystery. Without meters,

Water losses from different areas of Kolkata's water supply system.

there are no data on the production and consumption rates at industrial, commercial, and household levels. Modern centralized monitoring software, such as supervisory control and data acquisition (SCADA), uses meters to monitor the production of treated water, the transport system, and consumption rates. It detects leakage and pilferage by identifying outlier pressure and consumption levels.

Figure 5: Estimated Average Water Supply by the Kolkata Municipal Corporation



Hrs = hours.
Source: Prepared by the Kolkata Municipal Corporation, August 2018.

By reducing water loss first, the KMC can postpone major capital investments in new water production. The KMC's project management unit (PMU) for ADB investments staffs a water loss management unit.

The real problem is extensive losses from the water supply system. "Kolkata is blessed with a lot of water. But over the years, there have been huge losses—30% to 40% of what we produce is lost," said the municipal commissioner of the KMC, Khalil Ahmed. "There's no uniform distribution network. People get water from 3 to 18 hours a day. The KMC's intention is to reduce the losses and distribute the water evenly and continuously through the city."

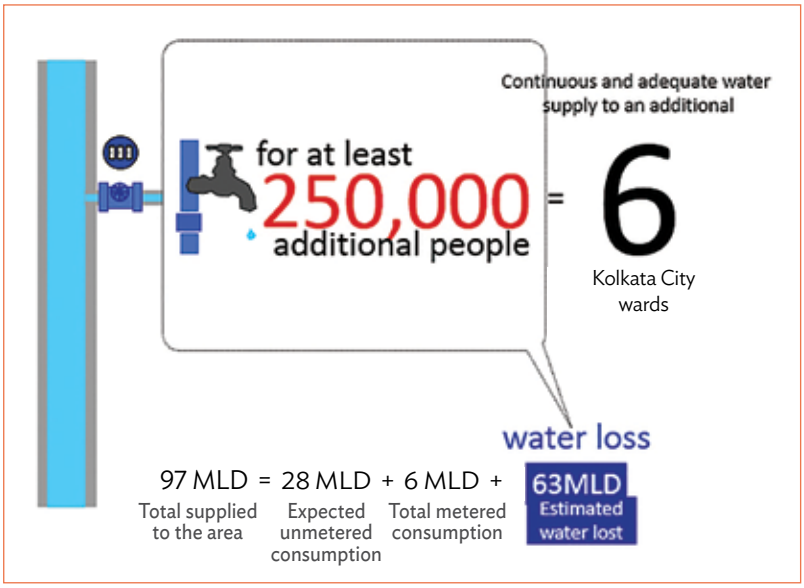
As part of project preparations, Suez prepared a base map through detailed survey and mapping of the project area using a geographic mapping software tool. A door-to-door consumer survey was carried out to understand the spatial distribution of population and water demand in the project area. An

extensive road network survey was also carried out during the base map preparation process.

Engineers who have studied the water system for the ADB–KMC investments report that 40%–60% of all water entering Kolkata's main trunk line and networks is lost to leaks and consumer wastage. The further south one goes from the city center, the less available water gets. The more water an area gets, the more water it likely loses.

An ADB study conducted by ADB consultants from 2012 to 2014 used Cossipore as a pilot to estimate the water loss for the city. It estimated that out of the 97 million liters per day supplied to Cossipore, around 63 million liters per day, or 65% of the water supplied, does not reach end users (Figure 6). The losses from this area alone would be enough to supply water to an additional 250,000 people, which is equivalent to supplying another six wards of Kolkata City with adequate and continuous drinking water.

Figure 6: Estimated Water Losses from Cossipore Area



MLD = million liters per day.
Source: Surveys and analysis conducted by ADB consultants in 2014 while preparing the performance-based water loss management contract for Cossipore.

Such high water loss, estimated to be around 300 million liters per day across the city based on the exercise carried out for the pilot area in Cossipore, undermine the general productivity of the city and income of citizens.

ADB and the KMC therefore knew that an all-out war was needed to reduce water loss to achieve their shared vision of 24/7 water supply for all of Kolkata's citizens.

In February 2016, through support from ADB, the KMC prepared and adopted a water loss reduction road map, implementing many improvements, both physically and institutionally, to reduce losses and overhaul and optimize water

PLENTY OF WATER. Kolkata has lots of water but using it more efficiently is the challenge.

> Key to the district metering area (DMA) approach is its scalability. Each DMA is a separate, isolated cell in the city's overall water infrastructure.

supply services. The goal is to achieve its 24/7 water supply vision for the entire city by 2023. In addition to metering and setting the water supply services into district metering areas (DMAs) to reduce water loss it is also modernizing its water supply systems and building staff capacity on solutions based on information technology, such as geographic information systems (GIS), upgrading of SCADA, digitizing maintenance systems, and extensively training its plumbers and technical staff.

Nonrevenue water is one of the best indicators of a water system's efficiency because it contributes to the operational costs involved in treating water as well as in pumping it for distribution to consumers. If a large portion of treated water is lost along the way, a water utility increases its costs without any revenue or income to show for it. Moreover, leakage reduces the volume of water reaching customers, and is a major factor leading to intermittent supply that is common in a subcontinent where water is only provided between 2–16 hours per day.

An essential part of winning an all-out war to reduce water loss is also learning how to detect the leaks and fix them and having the right tools to do so. ADB has been supporting the staff training of KMC's water supply department in water loss reduction, at all levels including the plumbers who must know how to fix pipes the right way. This external and internal training has been an important part of the partnership over the last 2 decades and has particularly intensified in the second phase of investments.

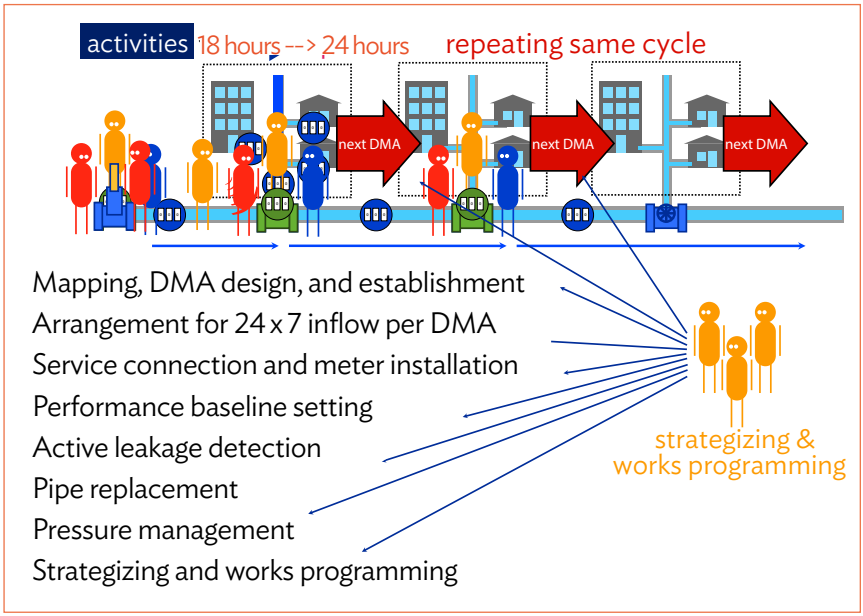
District Metered Areas to Reduce Water Loss

The approach advocated by ADB with the KMC was to use DMAs in pilot projects to radically reduce water loss and create a pressurized, 24/7, metered, billable water supply. The DMA approach brings together the key functions of a sustainable water service: high-performance networks; stable and proper water pressure; and metering for monitoring consumption and accurate billing. Where water does not have a true cost, it does not have a true value in the minds of those who consume it.

Key to the DMA approach is its scalability. Each DMA is a separate, isolated cell in the city's overall water infrastructure; there could be hundreds of DMAs in a typical mega city using a DMA approach. Each DMA is a hydrologically isolated, pressurized service area (Figure 7). A bulk meter measures the volume of water supplied to and discharged from the DMA. Every consumer within the DMA is also metered to measure and monitor consumption levels and control waste and pilferage. Pressure is more easily maintained because the DMAs are closed systems, making leaks and wastage easier to detect and thefts easier to resolve. An issue in one DMA won't affect another DMA because they are contained, isolated systems.

As the first step toward achieving its vision of 24/7 water supply for all, the KMC will establish DMAs and 24/7 supply for more than 150,000 households in three high-priority areas (Cossipore, Jai Hind, and Joka) and provide 12-hour daily supplies for around 800,000 households in other areas of the city through rehabilitation work financed by the ADB investment. The KMC estimates that the DMA approach will reduce water loss to only 15% or less, and ultimately the DMA approach should be rolled out across the entire system. To do that, the KMC adopted a water loss reduction

Figure 7: Kolkata Municipal Corporation's Design of Water Loss Management Works



DMA = district metering area.

Source: Prepared by Asian Development Bank consultants to show how the district metering area approach is used for managing water loss.

road map in 2016. The KMC has calculated that it has enough water for homes and industry beyond 2040 but distributing it in sufficient quantities to the fastest growing, mostly outlying areas, remains a challenge. The KMC plans to expand the DMA approach beyond the limited project area and is doing hydrological modeling of the main trunk line for the entire KMC area, not just the limited project area currently financed by ADB.

"The challenge is how to implement a big project like this in an unplanned city," said KMC Water Supply Department Director General Bibhas Maiti. "For example, the district metered approach to reducing water loss is showcased in India, but only in small towns. Those are not relevant to us in Kolkata."

The DMA approach has, however, been a celebrated success in Manila and Dhaka. KMC

SYSTEMIC CHANGE.
The entire water system must work to eliminate waste and get the maximum amount of water to people who need it.

officials and the international and national experts supporting them have studied what was done there to understand the approach, in order to inform the design of the water loss management approach for Kolkata.

In Nepal, more than 55 small towns are supplying 24/7 water services, operated by small users association that have more than 33% women in key positions, keeping their NRW below 15% on average and recovering on average over 95% of their total costs.[12]

If Dhaka, a denser city than Kolkata and with similar sociocultural and socioeconomic conditions—as well as numerous small towns in Nepal—can do this, surely Kolkata can, too. Other ADB-financed urban development projects are also rolling out the DMA approach, such as in the

[12] Pokhrel, N. and S. Adhikary. 2017. *Tapping the Unreached: Nepal Small Towns Water Supply and Sanitation Sector Projects—A Sustainable Model of Service Delivery*. Manila: ADB. https://www.adb.org/documents/nepal-water-supply-sanitation-services.

cities of the water-scarce states of Karnataka and Rajasthan.[13]

ADB expects the DMA approach to restore and optimize the KMC's water distribution system, which it is pumping and treating now with much lost along the way. The installation of water meters by 2022 will improve monitoring of water use and help reduce losses. The KMC is also mapping all system assets with GIS tags for monitoring and easier maintenance.

Metering to Conserve Water

A key to the sustainability of new systems in Kolkata is cost recovery. Kolkata is one of the few cities in India that has not introduced meters and does not charge domestic water users directly. A water tax is collected from bulk metering of housing societies and industry but no direct tariffs are levied on domestic connections. There is a sewerage charge for industrial and commercial connections but again, not for domestic sewerage connections. The KMC does recover its operational and maintenance costs for water services through bifurcating 30% of the property taxes collected.

The KMC has begun metering domestic water connections, starting with three pilot areas being covered under KEIIP for around 150,000 domestic connections.

The city's maintenance depots and customer service centers are being upgraded and connected to the SCADA software that gathers and analyzes real-time data of the entire water system. This will be linked to the GIS so that the water supply department can address customer complaints immediately.

METERING PROGRESS. Measuring usage helps reduce waste.

[13] Sharma, M. and M. Alipalo. 2017. *The Dhaka Water Services Turnaround*. Manila: ADB. https://www.adb.org/publications/dhaka-water-services-turnaround.

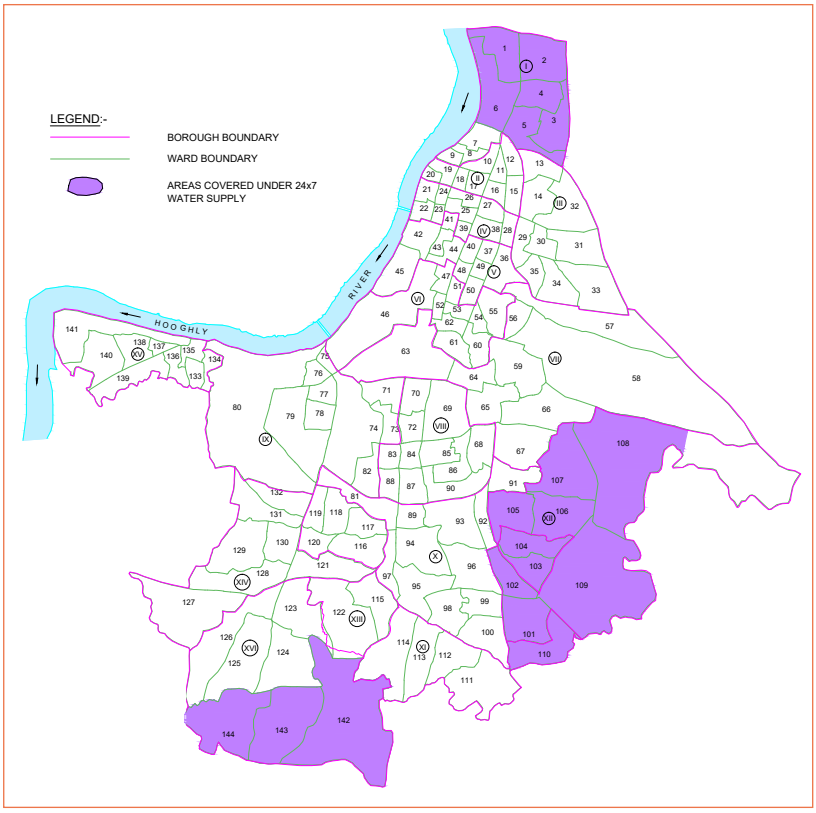
The water loss reduction road map adopted by the KMC in 2016 will introduce meters and consumption-based water charges to users and achieve 24/7 water supply across the city in a phased approach. The plan incorporates the key elements needed to deliver efficient, cost-effective water and sanitation services, maintain the infrastructure, and achieve financial sustainability. It will also enable the KMC and the Water Supply Department to plan for the system's future.

Under its phased approach to domestic metering, the KMC has installed 400 new water meters for bulk users. This will reduce water loss in the trunk lines and increase water availability and flow to end users. The KMC has introduced volumetric water tariffs and sewer surcharges for bulk domestic, institutional, commercial, and industrial users. Rates are based on the cost of service delivery and factor in the results of a survey on consumers' willingness and ability to pay. By expanding areas with 24-hour water supply, reducing operational inefficiency, and continuing to raise the coverage of sewerage and drainage network coverage, the KMC will get the popular support it needs to introduce user charges for domestic connections.

Paying affordable water consumption rates will help conserve water supply. When customer connections are not metered and the water is not charged based on volumetric consumption, users have no incentive to turn off the tap or ensure that

The KMC has begun metering domestic water connections, starting with three pilot areas being covered under KEIIP for 100,000 domestic connections.

Figure 8: Areas in Kolkata City Being Upgraded for 24/7 Water Supply



Source: Prepared by the Kolkata Municipal Corporation in August 2018. Numbers denote wards and boroughs of the city.

their household hardware is good enough to stop wastage. "When the KMC reduces water loss within the project area, let's say from 40% down to just 20% through the DMA approach and eventually with self-correcting user fees, it will be able to provide hours more of water supply every day to areas the investments have not yet reached," said Matthew Geisseman, the international water utility and NRW loss management expert engaged by ADB to support the KMC on its water loss management efforts. "Progress takes time, and this is one way of buying time and more water as the DMA system spreads throughout the city" (Box 10).

PILOT PROJECTS. Kolkata Municipal Corporation is testing ways to limit the excessive loss of water in the system.

BOX 10

PROJECT LESSON NO. 6:
Measuring and Saving Every Last Drop

A 6-year contract on a performance-based design, build, and operate modality has been awarded under the Kolkata Environmental Improvement Investment Program to M/s Suez India Pvt. Ltd, to improve water services to 24/7 in wards 1-6 in the Cossipore area of the city. This contract will improve water services for about 290,000 residents by introducing the district metered area (DMA) approach in these areas, reducing losses, metering, and rehabilitating the system. The service zone for the project covers about 9 square kilometers, with 19 DMAs planned.

Cossipore is one of the oldest parts of Kolkata, which means that while its households have water available for more hours (between 8–18 hours per day depending on which part of the Cossipore area) than those farther out from the center of the city, the infrastructure underneath them is some of the oldest. Much of it dates back to the mid-1800s. To get started on the project, the company first had to figure out what they were dealing with, both underground and in the habits and perceptions of the area's inhabitants.

So far it has surveyed 185 kilometers (km) of existing pipes and mapped them using geographic information systems. It has dug 142 trial pits down to the pipes to see what shape the existing network was in. It layered 210 km of roads onto the maps it was generating, mapped the contours of the area, and conducted global positioning system surveys.

> It (contractor) brought in local groups who could help mobilize their communities to limit water loss and to help explain why change was needed.

It also had to find out how the people of the area treated the water they had access to, and so it surveyed almost 38,000 households. It installed 1,700 water meters to help understand the pattern of consumption and behavior of households toward water use. It discovered four main reasons for high water use:

- Water is free and available most of the day.
- People were unaware of any need to conserve water.
- Ground-level reservoirs were being allowed to overflow.
- Standposts had no taps to turn off supply when not being used.

To educate the public on water use and the changes they would see as the project was implemented, a "water friend" initiative was launched in November 2017. It brought in local groups who could help mobilize their communities to limit water loss and to explain why change was needed.

By August 2018, six DMAs have been hydraulically isolated. Suez expects three DMAs to be fully commissioned and supplying 24/7 water by December 2018, and it expects all DMAs in the Cossipore area to be hydraulically demarcated by then as well.

The key performance indicators/objectives of this contract are to achieve the following in the Cossipore area:

- Metered 24/7 water to all households at uniform pressure at consumer taps;
- Reduced physical losses in the distribution pipelines by fixing leaks;
- Establishment of DMAs for efficient management and monitoring of the distribution system including consumer complaint handling; and
- Training of all staff and setting of systems to sustain the services.

Project implementation is expected to take 3 years, with a further 3 years of operation and monitoring once it is finished.

Source: M/s Suez India Pvt Ltd. 2018. Informative Material on Cossipore Water Loss.

Solid Waste Management: An Integrated and Sustainable System for a Livable City

Kolkata generates mountains of trash, about 4,500 metric tons of solid waste per day. That is roughly 40% of all the waste generated in the state of West Bengal. Studies estimate that Kolkata will produce an average of 5,500 metric tons per day of solid waste by 2048. What to do with all that trash is a problem that will involve a number of government departments, pollution control agencies, regulatory bodies, and the public to resolve. Up until now, only small improvements in solid waste management have been seen in the city. The city and private operators haul garbage to uncontrolled dumpsites around the city where most of the solid waste is disposed without treatment. This has a serious impact on environmental and public health, affecting the city's livability. Everyone acknowledges that radical change is required.

DEALING WITH TRASH. Improvements in trash collection and disposal mean a better environment and quality of life in the city.

The city's efforts to collect trash start with about 8,000 handcarts and 3,000 pedal tricycles. Only 20 battery-operated tricycles are in the trash collection fleet. There are about 13,000 full- and part-time workers, as well as people hired daily to collect trash and sweep streets. Waste is then transferred to 77 compactor stations and 350 open vats. Those open vats have long been seen as a blight on the city and are being phased out; a decade ago there were 662 of them. From the transfer stations (compaction and open vats) the waste is transported to the city dumpsites, where it is finally disposed. A total of 210 trucks of various capacity are operated by the KMC or private contracted agencies to transport the waste to final disposal sites.

Across the city and at the 50-hectare Dhapa dumping ground, where most of the city's waste is finally disposed, the poorest of the poor exploit the trash for what they can get from it, exposing themselves to physical and biological hazards. Trash pickers sort through it for anything they can sell, while cows, dogs, and pigs also root through the waste for food.

A United Nations Development Programme survey reported that solid waste management is the second biggest concern of most urban centers, after unemployment. Generation of solid waste has a direct correlation with population density, whereas income levels determine the types of solid waste in a given location.

"Waste is just matter in the wrong place," said Diptarup Kahali, deputy team leader and technical director, one of the country's experienced engineers and thinkers on solid waste management. He is currently assisting the KMC in preparing a long-term solid waste management master plan, along with other international and national experts. "If you do not create a market for this waste, nothing will improve."

Subhasis Chattopadhyay, director general of the KMC's Solid Waste Management Department,

EVERYONE INVOLVED.
Everyone in the chain of workers who dispose of the city's waste will be included in the upgraded system.

BOX 11

Master Planning for Solid Waste Management in Kolkata

A comprehensive master plan for Kolkata City Solid Waste Management was finalized in October 2018. The Master Plan takes into account the key principles of the international waste management hierarchy that is used as an international guide to sustainable waste management. The waste hierarchy prioritizes waste management options according to their environmental impacts. Waste prevention is given top priority. However, for a range of practical, social, and economic reasons, preventing waste generation is not always feasible. Where waste is generated, the priority is reuse, then recycling,recovery—including energy recovery—and last of all is disposal.

Under this plan, the KMC aims to

- review the present status of solid waste management in terms of source segregation, reduction, collection, transportation, recycling, treatment, and disposal as well as available manpower and budgetary expenditure;
- make Kolkata a model for sustainable waste management by adopting and implementing an integrated approach to collection, reduction, recycling, treatment, and disposal, which minimizes an impact on the environment and maximizes the use of waste as a resource;
- comply with the requirements of the Solid Waste Management Rules, 2016 of the Government of India;
- strengthen public–private participation in the municipal solid waste management system of the city; and
- integrate and empower informal sectors, including informal private sector and waste pickers.

Source: Kolkata Municipal Corporation. 2018. Summary of Solid Waste Management Master Plan for Kolkata. Kolkata.

explains that the problem is also one of definition. "Historically, solid waste management was thought of as a health issue rather than an engineering problem," he said. "Municipalities had health workers in charge of disposal and various multipurpose trucks were used in an ad hoc system to collect waste."

Today, the KMC is responsible for managing municipal solid waste. The city has an annual budget of $76.46 million for solid waste management (SWM) for the financial year 2017–2018. The solid waste generated in Kolkata is a mixture of organic and inorganic material (Figure 9).

In recent years, the KMC has undertaken several initiatives to increase house-to-house collection of solid waste and source segregation (where trash is sorted at home before it is picked up), and has introduced compactor stations. Source segregation was mandated by India's Solid Waste Management Rules, introduced in 2016. The practice of segregation of municipal solid waste at

A United Nations Development Programme survey reported that solid waste management is the second-biggest concern of most urban centers, after unemployment.

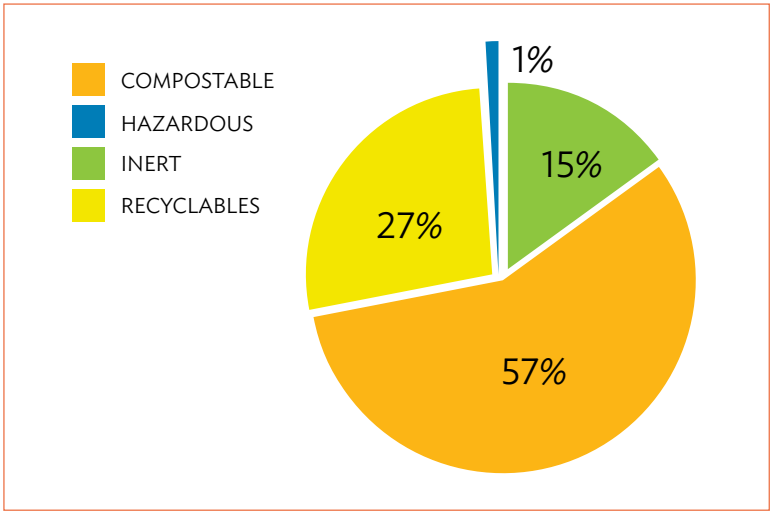
the source has been successfully piloted in seven wards under the KMC, but that leaves most of the city (137 wards) where it still needs to be introduced.

With ADB's support through teams of international and national experts, the KMC is developing a 30-year master plan that includes short-term actions to take over the next 5 years, medium-term goals over 10 years, and long-term plans over 15 years. ADB is also supporting the development of detailed project reports and bid documents to seek financing for the SWM, including for the private sector. In addition, ADB has agreed to finance (through a grant) transaction advisory when the tendering process for the SWM contracts start.

The master plan envisages 100% collection coverage and source segregation within the next 5 to 10 years. Key to achieving this is developing an efficient and seamless collection and transport system, coupled with continuous and extensive public awareness and behavioral change campaigns. "Citizens' participation and appropriate business

TREATING WASTE.
Recycling and treating the city's waste is a priority.

Figure 9: Solid Waste Composition of Kolkata City



Source: Prepared by Kolkata Environmental Improvement Investment Program consultants based on a representative survey conducted in September 2017 in Kolkata.

models and/or incentives are perhaps the most important elements for sustainable SWM," said Luca Di Mario, urban development specialist at ADB. Di Mario worked with other ADB project officers in guiding the team of consultants, along with KMC officials, to prepare the KMC's solid waste management master plan.

Khalil Ahmed, Kolkata's commissioner, agrees that segregation of waste by all Kolkata households is absolutely needed and will happen given time, "and it's going to be a big challenge but we will do it."

Another key feature of the master plan is the integration of the informal sector, which provides significant free benefits to the city's SWM by diverting a considerable amount of recyclable waste from the system. Today, most recyclables are captured by the informal market. Of the estimated 3 tons of recyclables generated daily in Kolkata, 2.5 tons are collected by informal vendors and pickers. The informal waste workers should be incorporated into the market system with incentive-based payments, and they should also receive health

coverage and other forms of social protections. They should not be cut out just because the system is becoming more formal.

The master plan aims to maximize SWM treatment and resource recovery. Several treatment solutions coupled with appropriate business models were analyzed to shift waste from dumpsites and minimize the land required for final disposal. For example,

- a composting facility for treatment of the separately collected organic material to produce a good quality compost;
- dry recyclables recovering facilities, for use in established recycling markets;
- a construction and demolition materials waste recovery facility to produce aggregate materials for reuse; and
- a waste-to-energy facility to transform waste in an efficient manner into a useable form of energy, thereby displacing fossil fuels and contributing to energy security.

"Don't believe people who say there is no market for waste or the market isn't ready for solid waste management," said Neeta Pokhrel, the ADB project officer for KEIIP. "You have to create the market. ADB and the KMC are working together in this comprehensive master planning to do just that, as well as bring in the private sector to leverage our investments."

REFLECTION

Keiichi Tamaki, former ADB project officer for the Kolkata Environmental Improvement Project, now retired

I got involved in Kolkata's urban development around 2005–2007 when new management for the project was brought in from the KMC to resuscitate ADB's first urban project, which had been half-dead in its initial years. KMC officers whom we helped carry out this difficult task were proud people who dared to stand up and express what they believed and make real changes to the project and the staff. Through this experience, the KMC and ADB learned the hard way what works and what doesn't when implementing a complex urban development project in a difficult setting. It's probably fair to say that, along with Karnataka, Kolkata established ADB's model for long-term and city-level urban development assistance in India.

It's also noteworthy that Kolkata focused its ADB assistance initially for sewerage and drainage rather than water supply. That was possible (and reasonable) thanks to the decade-old ingenious pisciculture (fish farming) practice at the East Kolkata Wetlands, which can take care of a significant part of the "treatment" function of Kolkata's human waste management. Due to the "yuck" factor, East Kolkata Wetlands is largely "unsung" so far. But it really deserves to come into the limelight.

I am also happy to see that ADB projects included property tax reforms under which market-value-based property taxation is intended. Long-term sustainable revenue generation and establishment of proper incentives for healthy real estate development in India hinge on such taxation reforms.

> Kolkata established ADB's model for long-term and city-level urban development assistance in India.
>
> *—Keiichi Tamaki , former ADB project officer for the Kolkata Environmental Improvement Project, now retired*

REFLECTION

Hiroyuki Ikemoto, former ADB project officer of the Kolkata Environmental Investment Improvement Project, currently principal institutional coordination specialist at ADB

In 2012–2013 when the KEIIP was being conceptualized, everyone in ADB was talking about the beauty of water loss management and the need to do so in Kolkata, but no staff was able to guide me on how to do this step by step. Around the same time, the project team learned that Maynilad Water Services Inc. in Manila had reduced its water loss from 66% in 2007 to 38% in 2013 in its service areas—so a good teacher was actually in Manila. The team visited Maynilad's water loss management team a number of times and learned how the paradigm shift in operations took place—from a water supply augmentation approach to a loss reduction approach.

Maynilad was previously a public agency, and our team learned the technical knowledge and skills for water loss management reduction, and how they attracted good contractors and made sure that these contractors delivered the results. The essence of all lessons and findings was incorporated in the design of the institutional improvement action plan and the performance-based water loss management contracts under KEIIP. Nonetheless, it was not possible to bring the modern water loss reduction initiative without significant help of the world-class consultants who patiently taught me the A to Z of performance-based water loss management contracts.

There were some cases of performance-based water loss management contracts in ADB, but these contracts were designed using ADB's standard bidding documents with significant modifications through the particular conditions of the contract. To attract good contractors who could ensure delivery of results, the project team and consultants felt that it was necessary to create a new contract in ADB by modifying the general conditions of contract and keep the size of particular conditions of contract to a minimum. Based on the performance-based water loss management contracts used elsewhere, the consultants designed the new contract. Concurrently, the project team organized several staff meetings with ADB departments to help them understand how a performance-based water loss management contract works.

A MORE **INCLUSIVE CITY**

In the beginning they came for the water. In the 20th century, and into this one, they have come for the safety provided by the big city, or for the economic opportunities it offered. Waves of refugees fleeing wars, communal violence, cyclones, and famines or a lack of work have settled in and around Kolkata. The flow has slowed over the last 2 decades but people from within West Bengal and neighboring states still arrive every day, looking for a better life in the city.

Kolkata has about 5,000 registered and unregistered slums. It is estimated that one-third of Kolkata City's population (around 1.5 million people) lives in low-income and slum-like conditions.

In Kolkata's slums, people have little hope beyond a subsistence living. Hence, improving the conditions of slums and the livelihoods of slum

HELPING WOMEN. Exemplary social inclusion measures helped women advance as resettlements were carried out.

BOX 12

PROJECT LESSON NO. 7:
Take Note of Success and Failure and Use Lessons in the Future

Project implementation offers an opportunity to learn lessons that can be used to measure a plan's success. If a particular approach works well, it needs to be documented so that anyone taking on a similar task is informed. Below are the lessons learned in the relocations undertaken during the first phase of transforming Kolkata's water system under the Kolkata Environment Improvement Project (KEIP):

(i) The protection of sites from which people are relocated is necessary. Otherwise, squatting or encroachment can recur, defeating the very purpose of resettlement.

(ii) Engagement with the community in situations of conflict, refusal of compensation, or divergent opinions is a prerequisite for successful resettlement. Initial buy-in from local community leaders and politicians is needed to prevent such situations.

(iii) Flexibility on the part of project proponents—e.g., in the case of KEIP, the decision to undertake sectional improvement of canals—can help avoid or minimize resettlement.

(iv) Two-part resettlement creates greater distress for affected persons. Relocation in one step after completing the necessary housing and infrastructure facilities works better. Coordination with line agencies to ensure that adequate transport facilities such as bus services are close to resettlement sites is critical to protecting the livelihoods of relocated persons, especially women.

(v) Providing additional dwellings or benefits for large families translates into greater chances of resettlement success, because this may help avoid fragmentation of families and social networks.

(vi) The social development unit of a PMU needs to be adequately staffed until well after the period of physical relocation so that it can handle responsibilities that do not end with relocation (e.g., lease deed registration). The project should also in a timely manner mobilize the safeguards experts and continue their services till loan closure.

(vii) There must be a systematic and continuous approach to enhance capacity in ADB policy, procedures, and requirements for staff of the executing agency.

LESSONS LEARNED. Relocating communities is difficult and sensitive work.

(viii) Local nongovernment organizations (NGOs) with a strong grassroots presence are more successful at community work than NGOs based in other places. NGO personnel need to be given adequate time beyond the resettlement implementation period for activities aimed at sustainability.

(ix) There is need to always include secondary displacement due to land acquisition and resettlement for resettlement sites in all resettlement plans.

(x) Resettlement monitoring needs to be more stringent during implementation to ensure just compensation for temporary income loss.

(xi) Resettlement plan updating, monitoring, and due diligence needs to be better structured. It should focus on compliance with ADB policy and the project's entitlement matrix, as well as continuous feedback from and dialogue with the project office to ensure midcourse corrections, if necessary.

Source: ADB. 2015. ***Completion Report: Kolkata Environmental Improvement Project in India.*** Manila.

Along with its direct impact on people's lives, KEIP has also helped develop the city's social sector. Through KEIP, the KMC has registered 2,025 neighborhood groups, 82 neighborhood committees, and 1,953 thrift and credit societies.

residents is an important part of transforming the city. The KMC and ADB took advantage of opportunities within the design of the larger investment to build civic organizations and offer livelihood training and self-help groups, especially for women.

Resettling communities from along the city's canals and improving the environment of the city's slums were major challenges but also opportunities for the KMC to make a real difference in the lives of

the city's poorest residents. KMC implementation of the social and gender action plans have exceeded expectations and challenged cultural norms. For example, the compensation policy for families who would have to transfer from the city's canals entitled women to ownership of the new homes provided by the program. A permanent address and one in a woman's name can be a powerful thing, a culture-bending thing.

Women learned how to open bank accounts, save money, and apply for a loan to start their own business. The program mobilized women into self-help groups that could deal with typical problems in their communities, such as children quitting school or girls being married too young. Through KEIP, the KMC has registered 2,025 neighborhood groups, 82 neighborhood committees, and 1,953 thrift and credit societies.

Slum improvement projects tacitly acknowledge that while slums are not ideal, they are one kind of a solution to the lack of affordable low–income

BEST FOR ALL. Resettlement is a delicate matter but it was necessary if Kolkata was to address its drainage problems.

housing. The housing shortage in India is acute and estimated at 18.78 million housing units. This is expected to increase in response to continued rapid urbanization and population growth, among other factors. The government recognizes that residents of slums also have a stake in the city and have a right to basic infrastructure and services, that are connected to and serviced by the city's centralized systems.

The second phase of KEIIP focuses on increasing the inclusiveness of the city. The fees for households to connect to the water supply, sewerage, and drainage systems are highly subsidized to almost a nominal rate, for administration only, to ensure 100% coverage within the project area, with free connections to the vulnerable and those below the poverty line. Public spaces are being mapped and made safer and accessible for the elderly, women and children, and differently abled people.

The city is also embracing technology to better manage urban spaces and hold its administrators publicly accountable for their performance in delivering urban services. Kolkata is adopting geospatial technology to digitally tag its public assets and monitor the performance of infrastructure and utilities from shared web-based platforms. The KMC understands that making information and services accessible in real time to citizens, its thousands of municipal employees, and decision makers promotes transparent, efficient, and inclusive delivery of urban services. These interventions are rebalancing the

The KMC helped the residents of each building organize into registered housing cooperatives, which manage communal spaces such as corridors, water tanks, and the surrounding land.

NEW HOMES. Families were resettled in four low-rise apartment buildings.

city's social and economic scales and making it more inclusive. Box 13 shows one example of how the KMC is doing it.

Resettling the City: Space for Canals, Places for Displaced People

Kolkata has grown roughly north to south along the east bank of the Hooghly River. Waves of refugees and economic migrants, unable to find jobs back home or housing within the city, have settled in the marshes and lowlands. There, they typically had no connections to piped water, sewerage systems, or waste removal services. Decades of these communities just getting by on less-than-basic infrastructure choked the canals on which they lived along with sewage and garbage.

In 1985, large areas of these settlements were put under the KMC's jurisdiction. The KMC knew it would eventually have to recover the land along the canal banks if the drainage system was going to survive. KEIP provided this opportunity as it would desilt 130

HOME IMPROVEMENT. Dilipo Barua with his son Ayushman at his house in the Behala slum area in Kolkata. His family is one of the beneficiaries under KEIIP's Sewerage and Drainage House Connections program, funded by ADB.

kilometers (km) of canals, avoiding the relocation of 559 shops and residences. It would link 21 km of canals and construct 52 bridges over canals and would require the resettlement of 2,880 households.[14]

Households along the canal banks were organized into canal resettlement groups, based on a household survey. The resettlement plan prepared for KEIP, which was reviewed and accepted by ADB, only required that resettlement compensation be given, equal to the replacement costs of the dwellings of the people being resettled. The KMC and project leaders decided they could do better and joined hands with a central government scheme called the Valmiki Ambedkar Awas Yojana to construct six low-rise buildings with 24–32 flats per

[14] The resettlement sites were located at Kalagachia, Kasba-Rajdanga, Nonadanga, Purba Putiary, and Shampa Mirza Nagar.

building and give each of the resettled families a flat in these buildings. Each flat is about 195 square feet, with a balcony suitable for a kitchen setup. The flats are connected to the water supply and sewerage system. Units were assigned to affected households by lottery. Households headed by women, the elderly, and the disabled, which made up 11% of the affected households, were given ground floor flats to make it easier for them to run shops and small businesses from their homes.

By successfully demonstrating convergence with a government housing program, the project not only provided housing with secure tenure to these non-titled affected households, it set an example for other local bodies across the country. Ninety-year leases were given to 2,880 families, with the nontransferable housing titles in the name of the family's female household head, empowering them legally. It was the most socially progressive benefit for women to come from the project. Kali Ghosh, adviser to the PMU's social development unit, said, "Above all, the women have become involved in decision making of the household, as they have legal entitlements."

The support of ward councillors proved essential to introducing the resettlement plan's progressive entitlements. "Women form the backbone of our households and society," said Ward 1 Councillor Sita Jaiswara. "Reaching out to them is the first step toward ushering in change."

Women in the affected communities advised the project implementation team on the types of entitlement that would benefit them, such as how various community groups should be set up and the types of training that would help restore their livelihoods after the move. Women also got their say on the floor plans of the new resettlement flats, paying particular attention on the design of the toilet spaces so that they would adhere to local norms.

The KMC helped the residents of each building organize into registered housing cooperatives, which

manage communal spaces such as corridors, water tanks, and the surrounding land. The KMC provided a one-time grant to the cooperatives as seed money for their operations and maintenance fund and it encouraged the cooperatives to levy modest building dues to keep the operations and maintenance budget funded.

The PMU set up a dedicated social development unit to supervise the consultants and NGOs contracted to resettle the affected households. The NGOs engaged by the project trained nearly 1,000 women from the resettlement communities and other low-income communities in forming self-help groups, financial management, bookkeeping, and banking. They learned technical and management skills to start and operate microenterprises, such as sanitary plumbing, advanced tailoring, mobile handset repair, air-conditioner and refrigerator repair, beauty care, and electric wiring.[15]

In preparing a final report on the completed first phase of investments, the KMC hosted focus group discussions to hear from the men and women about their lives after relocating from the canal banks. They reported having better access to health and education services in their new communities. The skills training they received as part of the resettlement compensation also helped them find better employment. Many said that owning a home and living with secure tenure had given them a better social standing. With their own housing titles and permanent addresses, the resettled families are now able to access bank loans and educate their children. Health and hygiene have improved significantly. "Now, we feel more secure and don't have to stand in long queues for water," said Bharati Santra, who resettled from the canal banks to a flat in S.M. Nagar. "We can raise our children in a better environment."

[15] Of the women trained, 326 were from self-help groups in the resettlement colonies, and 517 were members of existing groups and new groups the KMC initiated in the 85 slums it helped develop during the first phase of investments.

Assigning Value: Slum Communities Get Due Development

More than 300,000 people living in 85 low-income communities have seen their environment improve under the initiatives taken under KEIP. The development of a slum improvement master plan under KEIP brought together the relevant departments of the Government of West Bengal, the KMC, and the NGOs to rebuild slum communities. Slum residents were involved in the entire cycle, from microplanning to plan implementation and the maintenance of assets and services. The social development unit, with the help of NGOs, mobilized the communities, formed self-help groups, and planned and implemented the slum infrastructure improvements.

The guiding strategy for slum improvement was to enhance the quality of life in the slums through

SERVICES FOR ALL. A city is livable only when its most vulnerable population gets essential urban services.

EMPOWERING WOMEN.
Placing home titles in women's hands was a progressive step.

the provision of infrastructure, enhancing incomes and guiding behavioral change. The KMC has constructed in the slum communities:

- 565 standposts,
- 700 community toilets,
- 280 bathing spaces,
- 28 km of drains, and
- 178,000 square meters of public space.

Connecting houses to the main sewerage system was an important task that showed immediate improvements to the local environment. Before the sewerage and drainage systems were expanded and rehabilitated under KEIP, houses in these areas

Ninety-year leases were given to 2,880 families, with the nontransferable housing titles given in the name of the family's female household head, empowering them legally. It was the most socially progressive benefit to come from the project for women.

discharged effluents into surface drains, spoiling the community environment. To date, all individual houses, around 46,150 covered under the areas targeted in KEIP, have been connected to the sewerage system

The guiding strategy for slum improvement was to enhance the quality of life in the slums by providing infrastructure, enhancing incomes, and guiding behavioral change.

BOX 13

PROJECT LESSON NO. 8:
Given the Chance and the Skills, Women Help Themselves and Others

Women in the Tallah borough of Kolkata are showing that the best kind of self-help is helping others.

They are implementing a national school meals program with the food preparation and business skills they acquired when the Kolkata Municipal Corporation (KMC) offered to help them form self-help groups to learn technical and entrepreneurial skills.

The KMC developed 35 self-help groups of about 15 members each in low-income areas through the Kolkata Environmental Improvement Project. ADB and the Department for International Development of the United Kingdom supported infrastructure development and environmental improvements in 85 slums. The self-help groups were trained in courses such as food processing, sewing and stitching, and computer operations.

The women in the group that is helping to prepare hot school meals are from 28 neighborhood committees all belonging to the Deep Neighborhood Committee in Tallah. They show up at 6 a.m. Monday to Saturday at their community kitchen to cook hot, nutritious midday meals for 2,600 students in 27 schools. They contract three rickshaws to deliver the lunches. Each woman in the program can earn up to ₹1,500 (about $21.00) per month.

Source: Personal interview during story-gathering fieldwork for ADB in 2018.

HELPING THEMSELVES.
ADB assisted in setting up 35 self-help groups for informal settlements.

BOX 14

PROJECT LESSON NO. 9:
Creating Entrepreneurs with Slum Improvement Changes Lives for Good

Shabana Sekh, 28, was working on commission with a local bank to sign up new accounts when the Kolkata Municipal Corporation (KMC) offered women in her low-income community training on how to set up a microenterprise.

"The targets with the bank were difficult to meet, and it was exhausting work," she said.

The KMC-sponsored training was part of ongoing improvements in 85 slums where the KMC was upgrading water, sewerage, and drainage infrastructure. Sekh's courtyard of modest one- or two-room family homes was paved, lighted, and outfitted with gender-segregated toilet, wash, and laundry areas.

The small business training provided by the project was a chance for personal change in Sekh's circumstances. She knew how to sew, and the KMC microenterprise training could teach her how to launch her own tailoring service.

"My brother has a shop where he sells cloth wholesale," she said. "I asked him for a little corner."

From the little corner in her brother's shop, Sekh takes tailoring orders from customers who come to buy fabric.

"If I had not gotten this training," Sekh said, "I would have just gone to work for him. But now I work for myself." She now has three women working for her, tailoring from their homes.

Source: Personal interview during story-gathering fieldwork for ADB in 2018.

BUSINESS TRAINING.
Shabana Sekh, 28, sits at her sewing machine in the bedroom. Sekh launched a tailoring business that employs three women after attending training sponsored by the Kolkata Environmental Improvement Project for women in 85 slum communities.

The small business training provided by the project was a chance for personal change in Sekh's circumstances.

GARBAGE GONE.
Mahua Naskar brings her laundry to a nearby pond that has been renovated by the Kolkata Municipal Corporation as part of the ADB-supported investments in Kolkata environmental improvements. The expansion of 24/7 water supply to her community would supply her with enough water so that the pond would likely be used less for household chores and personal bathing than purely scenic and recreational uses.

BOX 15

PROJECT LESSON NO. 10:
Ponds Can Be Transformed into Centerpieces

In Bagh Colony of the Parnashree area, Mahua Naskar brings her laundry and dirty dishes to be washed every day in the pond just a block away from where she lives. The Kolkata Municipal Corporation (KMC) has cleaned up the pond and rehabilitated the surrounding drainage system. A periphery boardwalk and platforms were built, and street lighting was installed to make it a safe recreational area.

Earlier, surrounding houses around the park used the pond as a dumping ground for garbage; poor drainage led to choked, mucky waters. "Before, people used to throw their garbage in the pond. The water wasn't so clean," she recalls. "But now, the pond and the park area is much more beautiful."

Rama Dasgupta has lived next to the park for 48 years. She moved here in 1971 as a 24-year-old refugee. Her neighborhood was a refugee rehabilitation colony, she said.

Over the decades, Dasgupta said she watched changes to the pond, a centerpiece and sometimes eyesore to the community. "I would walk, but not at night and not in the rainy season. Now I can walk anytime. It's good for me, for the community," she said. "Before the project, we couldn't even think of these things. Today, the park is used by early-morning walkers. We even have a laughing club in the park and also yoga. Land values in this area have soared."

The lack of 24/7 water still poses health and sanitation threats for people who use the pond, like Manhua. She brings her dirty dishes and laundry to the pond to wash because she wouldn't dare use the scarce drinking water she gets when the water flows, for only a few hours in the morning and a couple more in the evening.

Nearby, in the pond where Manhua is washing her laundry, men are bathing and children are swimming. This pond should be even more pleasant for the community once piped water becomes more reliable.

The KMC has begun a new phase of investments that are bringing 24/7 water to project communities, with the aspiration of 24/7 water for the entire city.

Source: Personal interview during story-gathering fieldwork for ADB in 2018.

LIFE GETS BETTER.
Rama Dasgupta has lived next to the park for 48 years. Since the Kolkata Municipal Corporation rehabilitated the park area, activities around the pond and park as well as property values have soared, she said.

and drainage network and the surface drains have been closed. To have their houses connected to drainage systems, most households paid a nominal ₹500 (about $7.00),[16] which only paid for one-off administrative charges. The project fully subsidized the real costs of the system. People below the poverty line and the vulnerable communities were exempted from the connection fee.

The KMC adopted a crisis-management approach to meet urgent sanitation needs in low-income settlements. Immediate repairs were made as the neighborhood access lanes were restored, electric lighting was installed, drains were widened

[16] Currency conversion at the time of editing (September 2018).

and re-laid, and networks for sewerage, drainage, and water supply were constructed. The KMC also built communal toilets and baths.

The second phase of investments, under KEIIP, has carried on with slum improvement on a smaller scale, by financing community-based metered taps, public space improvements, paved pathways, more street lighting, and skills development for women.

Reviving Recreation: Ponds and Parks Give New City Life

The KMC's rehabilitation of 14 ponds and parks around the city under KEIP was a relatively minor investment that benefited the surrounding communities. The dysfunction of drainage and solid waste management had turned these green spaces into toxic dumping grounds and cesspools. Yet poorer households had no other recourse but to continue relying on the ponds for laundry, washing dishes, and bathing. ADB financing provided resources for the KMC to revive the parks with new drainage, boardwalks, and lighting. The expansion of 24/7 water supply throughout the city will further safeguard these public spaces from continuing to be used for laundry and bathing. But until household water is more available, the cleaned-up ponds provide a valuable and reliable source of water for domestic chores.

For the mapping of public spaces, the grant funds would be used for an app-based platform to map the city's main roads, analyze the data, and recommend ways to improve inclusion and the use of public spaces.

Using Technology for Social Inclusion

A city's open spaces are important to its livability. If women or children are afraid to walk in a public space, that space is not providing the benefit it could to the city's inhabitants. Making public spaces friendly to women, the poor, the elderly, the disabled, and children—and reducing any direct and indirect discrimination for them—defines and strengthens the livability and inclusiveness of cities. The question is, how to identify and fix any problems with public spaces?

ADB has leveraged an additional $3 million in grants for the KMC from its Urban Climate Change Resilience Trust Fund, which will be used to conduct various resilience-building activities, including a

COMMUNITY SPACE.
Local ponds service both practical and aesthetic uses.

flood forecasting and early warning system, solid waste management planning, and mapping the city's public spaces to make them more inclusive. This work will also include piloting interventions such as additional lighting and disability ramps, among other things, to make those spaces more inclusive, particularly for women, children, the elderly, and differently abled citizens. For the mapping of public spaces, the grant funds would be used for an app-based platform to map the city's main roads, analyze the data, and recommend ways to improve inclusion and the use of public spaces. A Delhi-based social enterprise called Safetipin is engaged for this exercise, which links urban design to planning.

One of the applications is an audit of the city's open spaces for increased inclusion and accessibility. A location is audited based on

The KMC realized that residents needed to be better informed so that they supported these works, which after all were intended to improve their daily lives.

nine parameters: lighting, openness, walk path, the presence of security, availability of public transport, crowd, gender diversity, visibility, and feeling.

The city's vulnerability will be mapped through the app-based platform, which works through phones that are mounted inside the windshield of cars, particularly taxis. As the car moves, the app automatically takes photographs and records its location every 30–40 meters. These photographs are then coded by an in-house team to generate the maps. Additional data that indicate an issue that needs attention (absence of streetlights, faulty streetlights,

CHILDREN TOO. Schoolchildren were also involved in plans to upgrade their city.

COMMUNITY WORK.
Bringing everyone on board means reaching out.

broken or no pavement, inadequate or lack of public transport) are also recorded. Other elements that would be useful to city authorities can also be coded.

The data are represented in the form of GIS layers, maps, and reports that show specific problem areas. That will help the KMC decide where to deploy resources for lighting, security, closed circuit television cameras, and public transport, as well as make other decisions to improve urban planning and monitoring. Local bodies can integrate the GIS data layer into their databases and use it to make informed decisions for their area. These will be integrated into the city's GIS base map and updated over time by the KMC's information technology department with the help of the service provider departments, such as sewerage and drainage, water supply, and solid waste management, among others.

The KMC is digitally mapping properties and public assets across the city with a geographic information system that feeds an interactive web-based platform with real-time information for city officials and citizens. This gives all citizens who will have digital IDs better access to be able to know about and pay for many public services.

Another key output under KEIIP is the flood forecasting and early warning system, which is intended to provide better disaster preparedness, especially for vulnerable communities. In an impending flood situation, not only will all citizens receive an SMS from the city, the relevant department of the KMC will also visit poor and vulnerable communities to ensure action is taken and to reach people who may not have mobile phone access.

Dedicating Local Experts to Communicate with Stakeholders

In the early days of KEIP, residents of some communities protested when they saw their streets being dug up and heard rumors that a big project was underway. The KMC realized that residents needed to be better informed so that they supported these works, which after all were intended to improve their daily lives. The KMC knew that engineers who are good at constructing and engineering design need others to help them communicate at the field level and implement social interventions. They engaged local experts and field level social mobilizers, through nongovernment organizations in KEIP, and through firms that specialize in providing such services in KEIIP, and in both cases ensured plenty of field level strength in-house through the social mobilizers.

With lessons from the first phase, under KEIIP, the KMC has strengthened the social development unit with more people and renamed it the safeguards monitoring unit (SMU) so that the SMU can also

LOCAL KNOWLEDGE. The assistance of people like Ward Council Chair Tarun Saha was key in getting the message to local communities.

monitor broader safeguard issues (such as gender mainstreaming and environmental aspects). To support the SMU, the KMC has engaged a team of full-time public communications and social development consultants. The consultants make sure that the project and its staff continue to involve the stakeholders extensively at all levels and all points of project implementation—project beneficiaries, nongovernment organizations, community-based organizations, borough-level committees, schoolchildren, and policy makers. The consultants map the areas and meet the communities before work started on any stretches; they prepare and implement strategies for regular public outreach, consultations, and information dissemination; and they assist the contractors and the KMC to do the same.

REFLECTION

Ricardo C. Barba , principal safeguards specialist, ADB South Asia Department

My first visit to Kolkata was as part of a team that processed a supplementary loan for KEIP in 2006. We had a substantial job—reviewing resettlement work that involved significant displacement of residents and reviewing environmental management on a project that involved a sensitive site. At that time, it was probably the project with the most significant safeguards issues I had been involved with. While a colleague took charge of environmental issues, I focused on reviewing the resettlement work and identifying what was needed to update the resettlement plan. During that review, we naturally focused on the required corrective actions to ensure compliance. As in many projects we work on, we tend to focus on things that need to be fixed, instead of good practices that should be encouraged and replicated.

The original resettlement plan proposed cash compensation to those being resettled, but the efforts were soon tied into a partnership with the government's Valmiki Ambedkar Awas Yojana scheme to provide decent housing to former slum dwellers. The result greatly reduced the risks of impoverishment for the resettled and transformed lives. Following our 2006 review, transit villages were no longer used, which reduced the impacts during transition for subsequent resettlement. Many other examples of small and large changes resulted in successful resettlement implementation. These changes were informed by extensive consultation and participation throughout the project, which is an aspect of resettlement implementation that is often described in resettlement plans, yet not practiced in small doses.

Reflecting on the project today, I realize the many achievements in the work we did. Clearly, an adaptive management approach, which we see more often in environmental management, was used to full effect in project resettlement implementation. An iterative process turned not-so-great experiences into opportunities to learn and course-correct.

Since that work in Kolkata, I have moved to different divisions and regional departments in ADB. Many more projects with more significant safeguards impacts later, KEIP continues to be one I cite often as an example of how we should move forward in involuntary resettlement.

REFLECTION

Tatiana Galleo Lizon, former ADB project officer, currently head of the Urban and Housing Division of the Inter-American Development Bank

I took over the preparations and processing and administration of KEIIP in ADB from 2012 until 2014, after Hiroyuki Itemoto moved to another ADB department. Being engaged with the KMC for so long in helping improve its urban environment, we knew the solutions to Kolkata's challenges rested with its institutions and their ability to increase capacity and introduce reforms.

While plentiful, water services remained inadequate in 2010, and sewerage and drainage networks were insufficient to meet the needs of an expanding and denser city. This required infrastructure, but perhaps more importantly, essential changes to increase the city's operational efficiency and revenues, all in the form of a program to support both medium-term needs and progressive, tranche-by-tranche reform. Reform required embracing a whole new model of operation, acquiring skills from specialized private-sector companies, creating demonstrational pilots, engaging metrics for success, incentives and dialogue, and most challenging, engendering a willingness to change. All this through the implementation of an ambitious road map, which we jointly prepared, to achieve the necessary performance targets and standards. The instrument of choice for the loans under KEIIP, the multitranche financing facility, provided the right framework for the long-term engagement we have with the city.

If value is not readily attributed to this service in a water-abundant city, increasing tariffs to cover investment and the operational cost of sewerage and drainage networks—rarely seen and mostly perceived as a nuisance—posed a real challenge. An increased willingness to pay was therefore essential, and transparency—brought about by metering, a policy with clear and fair subsidies, and consultation—became the enabling instrument. The KMC has performed remarkably since the approval of the project in 2012. A capable agency, the KMC now needs to continue leading the path toward transformation in service efficiency and adaptation, and in this way secure necessary modernization.

A MORE **RESILIENT CITY**

Making a city more livable and inclusive can also make it more resilient and better prepared for the future, especially when it must deal with shocks and stresses. Through KEIP and KEIIP investments, Kolkata is becoming a climate-resilient city in several ways. First, it is expanding its sewerage and drainage network on a large scale, to cover the entire city, significantly reducing risks of flood in current climate conditions and future scenarios. Second, it is improving the efficiency of water supply operations. It is reducing losses and optimizing existing systems by reorganizing the service network into district metered areas (DMAs), for metering, digitizing the monitoring system, and improving customer response systems. These modern features for service delivery strengthen water security and make Kolkata more resilient. Third, by reforming the revenue base to improve the KMC's financial position and outlook it can properly fund operations and maintenance of its existing assets and continue investing in system improvements. Last, Kolkata now has a comprehensive city-level flood forecasting and early

Figure 10: Seven Entry Points for Urban Climate Change Resilience for Cities

Source: Bahadur, A., T. Tanner, and F. Pichon. 2016. Change Resilience: Seven Entry Points for Action. ***ADB Sustainable Development Working Paper Series.*** No. 47. Manila: ADB.

VIBRANT BUT VULNERABLE. Kolkata is particularly exposed to the effects of climate change.

warning system through ADB support, to reach its citizens to forewarn and respond quickly to disasters, which is the first of its kind for any city in India.

In addition, over the last 2 decades, through partnership with ADB and others, the KMC has been systematically studying climate change impacts, preparing plans and policies to deal with them, and working on all aspects of the city's urban climate change resilience. This process is demonstrated in the seven entry points of urban climate change resilience for cities, a template developed to explore the combination of measures needed to boost resilience (Figure 10). These measures are important to ensure that the city's assets and services are sustained with adequate capacity, systems and funds for their operations and maintenance, so that the city is prepared for any future shocks and stresses. Different cities may need to focus on different combinations of the seven focus areas but in general the template stands as a guide. This is what building the resilience of a city is all about.

The World Bank and the Department for International Development (DFID) of the United

Kingdom have also supported the KMC in assessing the city's vulnerability to climate change and the best options for building its resilience. The city's location makes it vulnerable and prone to the shocks and stresses of climate change and natural disasters. Kolkata is largely settled in flat terrain with inadequate natural drainage relief, which causes riverine flooding and overall poor drainage. Its location in the lower coastal region also makes it more directly susceptible to sea level rise and storm surges. The city is already at heightened risk of rapid sea level rise, periods of intense rainfall, cyclonic activity, and storm surges.

The ADB Urban Climate Change Resilience Trust Fund granted the KMC $3 million to design and implement a flood forecasting and early flood warning system and improve its approach to land-use planning, infrastructure planning, and disaster risk management to minimize risks of urban flooding in the long term. Along with other ADB loan and grant funds, the trust fund is also supporting the KMC's efforts to address solid waste management in the city, which has proven complicated for many cities in India, to streamline the waste collection and processing process. The KMC is also using the fund's grant to analyze the gaps in public safety and security in pilot areas of the KMC. The pilot areas are creating secure spaces for women and vulnerable people.

Upgrading Financial and Administrative Systems

When ADB offered financial assistance to revive Kolkata's aging water supply and sewerage and drainage services in 2000, it did so on the condition that the KMC accounts were audited and put in order. No accounts had been recorded or audited since 1970. Since then, the KMC has computerized its accounts and set up specialized teams to manage online accounting.

"The payment system has changed radically," said Debatosh Dasgupta, controller of municipal finance and accounts of the KMC. The accounting system interfaces with the city's payroll and citizen payment system, an online portal for paying public utility bills and taxes. As of May 2015, the KMC had presented accounts until fiscal year 2014 for audit to the examiner of local accounts of the comptroller and auditor general of India. The examiner of local accounts issued "a true and fair certificate" for its accounts up to fiscal year 2013. This was a major achievement for the KMC, which prior to ADB's support in 1998 had never had its accounts audited. ADB believes it is continuing to improve the system.

According to an October 2017 corporate credit report by Crisil India Ltd. and submitted to India's Ministry of Urban Development, "KMC is ahead of other municipal corporations in accounting standards and is expected to improve these further." Crisil has reaffirmed the KMC's "A plus" corporate credit rating and has revised the rating outlook to "stable" from "negative." The revised rating indicates an adequate degree of strength with regard to honoring debt obligations.

ADB leveraged its infrastructure investments in the KMC in 2000 to secure $42 million in grant cofinancing under KEIP from DFID. DFID funded the capacity-building program component of KEIP, under a parallel financing agreement with the KMC, which was administered by ADB. The capacity-building program supported the KMC at the time to build its much needed capacity, through reforms in accounting and financial management, organizational development, computerization, public relations and communications, and resource management, as well as the implementation of a geographic information system. DFID has been a long-term partner of the KMC and has been

SYSTEMS UPGRADED. It was important to improve the tools used by city managers.

supporting the city to improve its municipal finance and climate change resilience.

Santanu Mitra, the senior climate and environment advisor in DFID's Asia regional team, said, "DFID has enjoyed a strong association with KMC over many years, through the Kolkata Environmental Improvement Program and Kolkata Urban Services Program. We are very pleased to have supported this important partnership and also the initiative through the Urban Climate Change Resilience Trust Fund, which aims to help fast-growing cities in eight Asian countries reduce risks to poor residents from floods, storms, sea-level rise, and other extreme climatic events."

The (improved) accounting system interfaces with the city's payroll and citizen payment system, an online portal for paying public utility bills and taxes.

Keeping Close Watch on Construction Progress and Financials

KMC consultants developed software to digitally measure and record the progress of civil works. The certification of works and bills are completed online. Onsite measurements can be recorded digitally in the project accounting system of KEIIP. This has expedited the certification process of undisputed works for the contractors, the KMC, and its engineers' representatives (engaged to supervise the work and to measure and certify work quality). Access to the measurement system is limited to a few authorized people. Each user has a login identification and password, and the flow of the document is unidimensional.

"Though used in some international settings, this system is groundbreaking and one of the best practices in India for public sector construction

BETTER SERVICE.
Construction projects run better using information technology upgrades.

works," said Sourav Majumder, ADB's senior project officer.

"The advantages [of the project accounting system] are that multiple packages can be handled, information and payments can be processed quickly, errors that come with manual processing are avoided, and transactions and data processing are secure," said Narayan Chandra Mondol, finance head of KEIIP.

This financial monitoring mechanism allows seamless integration and data exchange with the KMC's systems.

The investments have supported the restructuring and streamlining of business processes and are bringing them onto an e-platform. The KMC is now able to approve construction works faster and deliver better urban services. The KMC also absorbed the operations of some civic services by para-state agencies so that citizens would have a one-stop shop for all civic services. Through

public–private partnerships and land monetization projects, some maintenance responsibilities have been successfully passed on to the private sector. The introduction of a grievance redress system and a citizen's charter make the KMC more accountable for the quality of services it is mandated to provide.

Recovering Costs through Metering Connections

Tariffs are a sensitive issue. They entail a shift from depending on the general budget and property tax allotments to a billing and collection system that charges domestic water users per cubic meter of water used and, most likely, higher bulk rates for industrial, commercial, and institutional users.

To date, the KMC does not directly charge tariffs for the water and sanitation services it delivers, but it is already ahead of many other cities in India

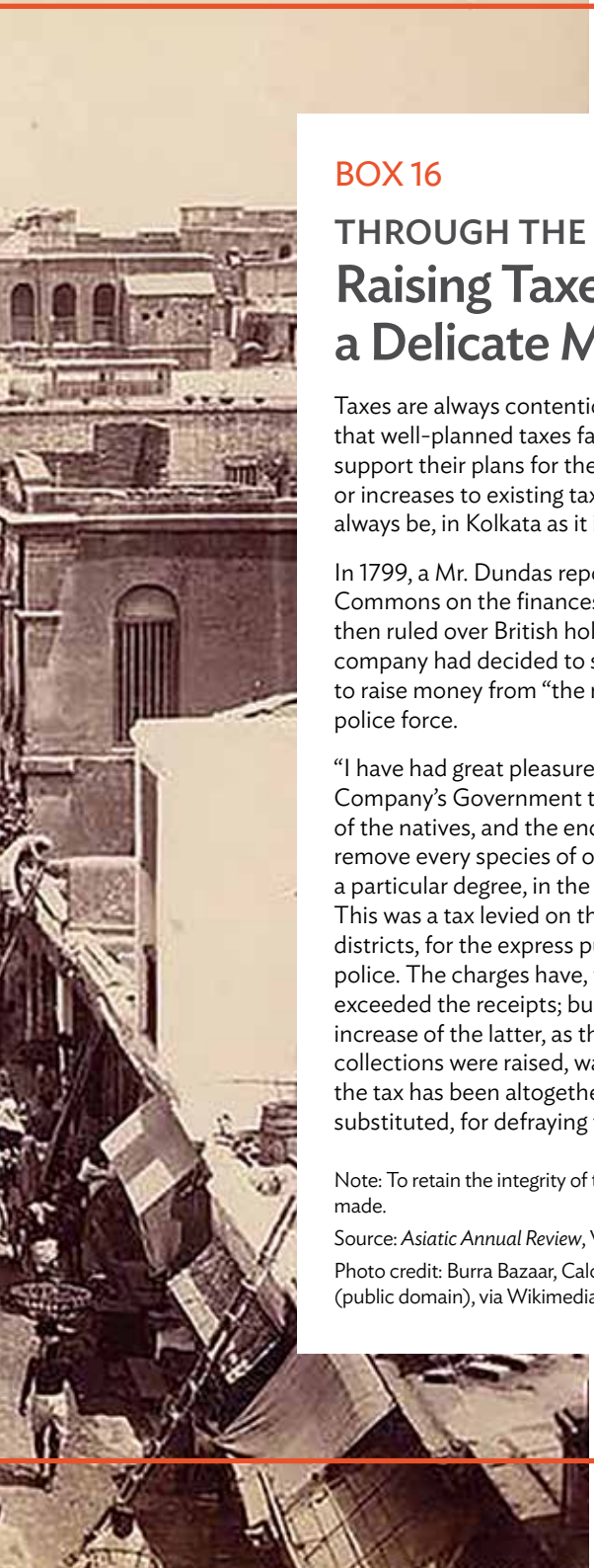
TAXES MADE EASY.
Taxes have been simplified, and people can pay taxes and service bills online.

The KMC is already ahead of many other cities in India by fully recovering the operation and maintenance costs through separating and consigning 30% of its property tax revenues for water supply and sewerage and drainage services.

by fully recovering the operation and maintenance costs through separating and consigning 30% of its property tax revenues for water supply and sewerage and drainage services.[17] The KMC plans to levy direct charges for water supply and sanitation services and is piloting metered, 24/7 water supply projects. Direct charging is aimed to ensure that exact costs for the maintenance of the new infrastructure are known, billed, and collected so that the assets do not prematurely degrade, as they have in the past. The difficult job of getting people to pay for services that were formerly paid out of general tax revenues is made easier by the credit that the KMC is earning from bringing 24-hour water supply to more people, expanding sewer network coverage, and reducing operational inefficiency. The KMC has separate units to work on water loss management and financial improvement to achieve full cost recovery.

"ADB is continuing to work with KMC on the challenge of cost recovery through various streams, like direct tariffs and revenue increase mechanisms, and not just through tax deductions and transfers, which is necessary for funding the vast capital investment required to expand the services across the city and to the level required," said Pokhrel, ADB's team leader for KEIIP.

[17] This is allowed through the Kolkata Municipal Corporation Act of 1980.



BOX 16

THROUGH THE HISTORICAL LENS:
Raising Taxes is Always a Delicate Matter

Taxes are always contentious. Governments complain that well-planned taxes fail to raise the expected funds to support their plans for the city. Residents balk at new taxes or increases to existing tax rates. So it has been and so it will always be, in Kolkata as it is elsewhere.

In 1799, a Mr. Dundas reported to the British House of Commons on the finances of the East India Company, which then ruled over British holdings in India. He reported that the company had decided to shift the mode of taxation it used to raise money from "the natives" for the establishment of a police force.

"I have had great pleasure in remarking, the attention of the Company's Government to the happiness and the comfort of the natives, and the endeavours always manifested to remove every species of oppression. They have appeared, in a particular degree, in the abolition of the police assessment. This was a tax levied on the houses of the inhabitants, in the districts, for the express purpose of maintaining an efficient police. The charges have, from the first institution, greatly exceeded the receipts; but notwithstanding the gradual increase of the latter, as the mode in which, of necessity, the collections were raised, was represented to be oppressive, the tax has been altogether abolished, and a stamp duty substituted, for defraying the expense of the establishment."

Note: To retain the integrity of the original statement, no edits have been made.

Source: *Asiatic Annual Review*, Volume 1, 1998–1999.

Photo credit: Burra Bazaar, Calcutta, circa 1880s by unknown author (public domain), via Wikimedia Commons.

Communicating with people, raising awareness on how user-pay systems work and their long-term benefits, was carried out through KEIIP, which is helping the KMC generate public support. In a measure that has also generated trust, in 2006 the KMC established anticorruption and governance measures. These measures include public disclosure of the details of physical and financial progress of projects, with the results of all tenders posted on the project website; public audits of project works by field-level committees in every borough; and computer-aided redress of public grievances with a requirement to respond within 24 hours of receipt.

Reforming Property Taxes

Property tax accounted for more than half of Kolkata's total revenue in the 2016–2017 fiscal year; reforms are underway to modernize and further improve revenue collection in the city.

The KMC has been steadily replacing the annual rental value method for property tax assessment with the unit-area method, which is expected to improve citizens' willingness to pay taxes. The unit-area method is accepted widely in India and internationally as a more scientific method of tax assessment. It is fair, transparent, and uses robust parameters, such as land value, infrastructure availability, location, structure of the building, occupancy, and usage of the building and its age to determine taxes. Because residents assess their own property, it is empowering and improves their willingness to pay taxes.

The new approach allows for more accurate revenue projections, more revenue collection, and better overall financial management. "By capping the increase or decrease to 20% of the property taxes paid under the old system, the KMC has mitigated the risks of sudden shock to the system, public outcry, and reduced revenue. The KMC provides

INVOLVING CITIZENS. The new web-based platform provides real-time information to city officials and citizens.

exemptions for the poor and rewards property owners for timely tax payments," said Khalil Ahmed, commissioner of Kolkata City.

The annual property value calculated through the new system is more robust and market-oriented. Kolkata has joined six other large Indian cities that already offer unit-area-based property taxes (Ahmedabad, Bengaluru, Chandigarh, Delhi, Indore, and Patna). Kolkata modeled its system after Bengaluru's, which was a success because of the city's comprehensive inventory of properties and extensive outreach program for citizens. Its process helped increase property tax collection by providing visible incentives for compliance. In a few cities in India, when such a system was introduced, a proper inventory was not set up before the rollout of the new system and property tax revenues initially decreased.

"Kolkata has followed in the footsteps of Bengaluru by rolling out the reforms along with a structured education program, allocating enough time to inform citizens, and adopting a phased approach that allows paying through the old system for the first 2 months," said Bhaskar Bhattacharya, KMC's chief revenue officer.

The KMC is collecting 60%–65% of assessed property taxes every year, with collections growing each year. The increase is mainly due to improvements in the collection machinery.

Turning Up the Technology

The KMC is using technology across the city in innovative ways and raising the bar for urban service delivery for municipalities, resilience building, and disaster management as well as the construction industry in the process. Tools such as microtunneling, GIS mapping, remote sensing, SCADA, and the digitization of customer centers and maintenance depots are bringing technology to KMC departments and the public. Early warning systems and other initiatives are involving stakeholders across the city to safeguard infrastructure and secure systems and people, making Kolkata more resilient and improving lives with better urban service provision and better disaster preparedness.

The KMC is using geospatial technologies and digitally mapping all its properties and public assets across the city.

MAPPING THE CITY. Detailed GIS mapping will help in designing improvements and managing assets.

The KMC is using geospatial technologies (GIS, remote sensing, photogrammetry, global positioning systems), and digitally mapping all its properties and public assets across the city. The GIS platform feeds an interactive web-based platform with real-time information for city officials and citizens. To ensure the city's resilience, the current and future state of its infrastructure must be measured and monitored, both by government agencies and by the public.

GIS and location intelligence are key components in the utilities sector. Most public organizations at a regional and municipal level need to share information between different departments, to integrate activities such as urban planning or utility asset inspection and maintenance. Web-based geospatial solutions are a common cost-effective approach to disseminate data across such organizations. Many municipal planning and management business workflows require editing

All property owners in Kolkata City have digital IDs and can access and pay for many public services online.

capabilities in online and offline mode, which are more challenging for typical web-based geospatial solutions.

Geographic data provide spatial dimensions for managing utilities like water and sewage to prevent breakdown. GIS mapping offers a comprehensive software platform that can deliver real business intelligence and ensure effective planning, management, and operations of these assets. It provides reliable location information of underground utility lines, which helps avoid excavation damage and aids in repair and replacement of utility lines.

All property owners in Kolkata City have digital IDs and can access and pay for many public services online from March 2019 onward.

The KMC has engaged CyberSWIFT Infotech to implement the system by acquiring remote-sensing maps and data, digitizing them, surveying all of the KMC's properties and utilities, and mapping the infrastructure of Kolkata. A base map with more than 50 layers of information is in the making and will be available by March 2019 to the KMC and the public. Digitization of the base map was completed in April 2018, including all properties and more than 250,000 kilometers of utility network mapping. This information will provide decision makers with real-time information they need to make good decisions on infrastructure development and management. The public will be able to use it for

better service delivery and interaction with their service provider.

"We are already seeing the benefits. Our revenue has increased and there is an inventory of all properties, digitization of all properties, and GIS database of all utilities ongoing. Now we are mapping all utilities including our sewer lines and water appliances. The data can be shared with other agencies who are planning to install their own utility lines," said Khalil Ahmed, commissioner of Kolkata City. A variety of technology tools have been added to the KMC's toolbox for maintaining and developing its utilities.

Becoming Flood Resilient

For Kolkata, a highly vulnerable city for flooding both under current and climate change projected scenarios, monsoon has always brought concerns while bringing relief for the farmers. Most flooding in Kolkata is pluvial flooding or surface flooding, caused when heavy rainfall creates a flood independent of any overflowing water body. Flat deltaic terrain, insufficient natural drainage, and tidal blockage of channels amplify flooding and water logging in the city. "It is stagnant, lazy water and it mixes with sewerage," said the director general of the KMC's Sewerage and Drainage Department, Amit Roy.

Because of extensive investments by ADB and the KMC in the city's drainage, flooding only typically lasts about 1–2 hours now, but is still higher and longer in informal settlements and low-income areas. Floods there can linger for up to 2 days. "The flooding is more of a disturbance than anything fatal," Roy said. However, he added, gross domestic product "is certainly affected."

KEIIP, through the technical assistance grant funded by ADB's Urban Climate Change Resilience Trust Fund, has helped the city design and install a

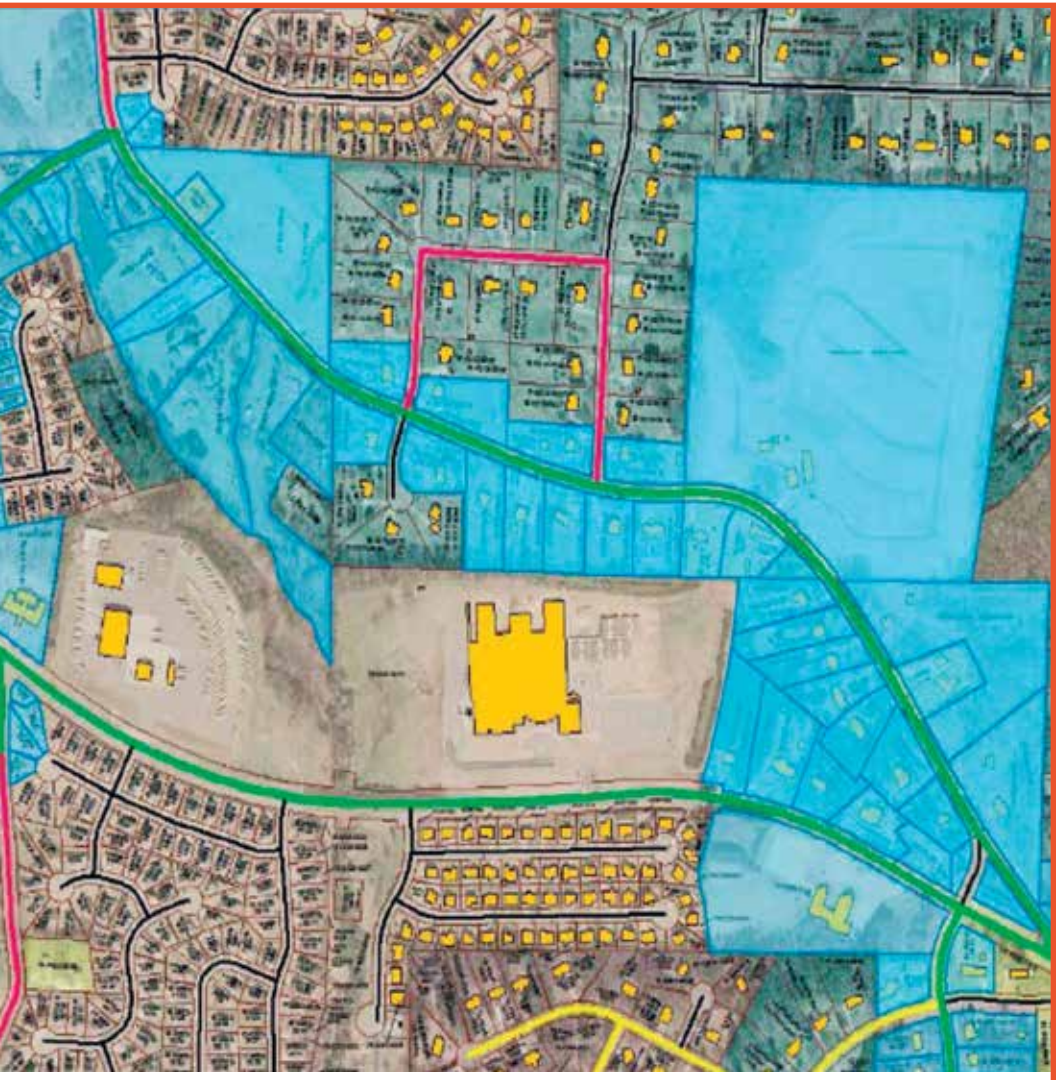
BOX 17

PROJECT LESSON NO. 11: Geospatial Solutions Benefit City Officials and Citizens Alike

- The value of the geographic information system for Kolkata City is increased by publishing it online, which provides all stakeholders of the city, officials and employees, citizens, and business partners fast and easy access to geospatial data and analysis tools.
- Accessing and analyzing geospatial data anywhere, anytime, enables users to consider up-to-date information quickly, to improve overall productivity through well-informed decision-making.
- Data server technology allows direct connections to geospatial databases, enabling organizations to incorporate the information they already have (including multiuser geodatabases) into their online systems, allowing the dissemination of any updated data to other systems sharing the same repository.
- This solution also provides the possibility of working in offline mode, for example, to perform field inspections, and upload the data edits after reconnecting to the network.

SEGMENT OF GEOGRAPHIC INFORMATION SYSTEM MAP FOR KOLKATA CITY

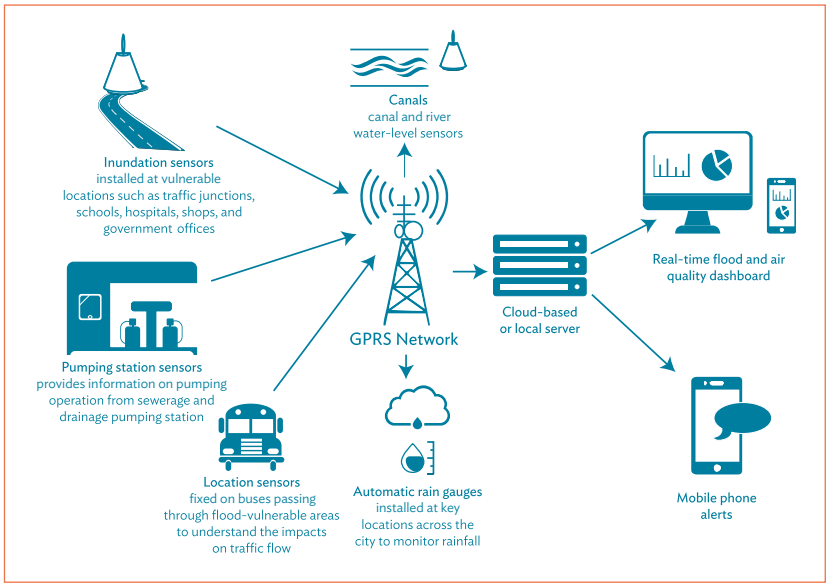
flood forecasting and early warning system (FFEWS) for the first time. The FFEWS for Kolkata is the first comprehensive city-level early warning system in India. It has been designed to provide forecasts as well as real-time updates from sensor nodes installed in key points throughout the city. Information generated and disseminated by the FFEWS will enable informed decision making before and during



Source: Extracted from the Work-in-Progress Geographic Information System by the Kolkata Municipal Corporation in August 2018.

disasters. The system includes: weather forecasts; flood models for various intensities of rainfall; real-time information on key pump status, sump and canal water levels, actual rainfall, inundation levels, among others; and a messaging system to provide warnings and real-time information to city officials and citizens (Figure 11, and www.kflood.in for further details).

Figure 11: How the Flood Forecasting and Early Warning System Works for Kolkata City



Source: Prepared by Taru Leading Edge Pty Ltd in August 2018.

FFEWS is a real-time model to assess rainwater flooding in all 144 wards in Kolkata. ADB is also supporting the KMC to reduce urban flood risks by improving land-use planning, developing the capacity of city officials to act, formulating effective disaster management strategies while introducing the FFEWS for Kolkata City. A consortium (comprising consultants Taru Leading Edge Pty Ltd, PricewaterhouseCoopers, and Antea Group) is helping the KMC design and implement FFEWS.

The first phase of Kolkata City's FFEWS has been operational since September 2018. The final FFEWS will have more than 400 real-time sensors across the city to monitor weather and potential flooding. The installation targets 347 vulnerable points, and in the sewerage and stormwater drainage system.

During the preparation and design of FFEWS, key stakeholders were consulted to understand the exact system needed. To identify the best places to

install the sensors, predictive modeling was used, to be verified during the monsoon season. In addition, other sources of data collection, and consultations with citizens and borough engineers were used to choose locations for real-time data collection on rainfall and flood risk.

Consultants and ADB are also using historical remote-sensing data, through their partnership with the European Space Agency, to study the movement of floodwaters during major floods in the past. These data and the modeling that follows are

EX-MAYOR CHATTERJEE AND NANDINI RAI OF WARD 5.
The launch of a flood warning system was a justly celebrated achievement.

being combined to help identify hotspots and install sensors for flood warnings.

Sensors upload data to servers and a shared platform is accessible to city officials. “The idea is to bring everyone together on a common platform so when the rain comes, they can use SMS to alert the public and make decisions together,” said Roy of the KMC’s Sewerage and Drainage Department.

“The system also brings together fire stations, police and government,” said Gopal Krishna Bhat, team leader for the consulting services team designing and installing FFEWS for the KMC. “They aren’t just doing this because it’s their job. They are also affected by urban flooding. Their wives and children get stuck in the floods.”

The data are communicated to the KMC’s control room and the real-time status of inundation is displayed on a flood monitoring dashboard. The dashboard integrates precipitation forecasts and provides scenarios from past and expected extreme events. The dashboard is accessible to

WATCHING FOR FLOODS. Sensors used in the flood forecasting and early warning system (FFEWS) for Kolkata City.

Photo credit: Taru Leading Edge Pty Ltd, taken on 15 September 2018 in Kolkata.

With the new FFEWS for the city, the KMC will capture real-time status and information from its key pumping stations, canals, roads, and vulnerable settlements to better prepare for floods.

computers and mobile phones through the internet. It will provide location-specific SMS alerts or make announcements on radio and television to enable preemptive action. "The real-time and forecast data can help in diverting traffic to safe areas and help in positioning response staff and equipment at vulnerable locations to enable faster drainage of water and evacuation of people and valuables in extreme cases. The ultimate aim of the system is to aid in developing flood-informed urban development and management," says Bhat.

With the new FFEWS for the city, the KMC will capture real-time status and information from its key pumping stations, canals, roads, and vulnerable settlements to better prepare for floods. Citizens will receive early warnings from regular monitoring of water levels in the drainage conduits as well as forecast data for future events.

"The Kolkata Flood Forecasting and Early Warning System will improve the resilience of vulnerable communities and of Kolkata's economy to current flooding risks and longer-term climate change," said Santanu Mitra, the senior climate and environment advisor for DFID's Asia regional team.

City officials, police, and fire department staff and citizen groups are learning how to use the new system and incorporate it into their monitoring systems. An information-sharing platform will

interface with groups from each government department and the public interface will share information and decisions almost in real time.

A training needs assessment of various government officials involved in planning control and flood and disaster management was completed in February 2018. This exercise identified areas where training is needed for the various stakeholders. That training could include: climate change adaptation and disaster risk management; major trends and practices in risk management, preparedness, and emergency response; long-term resilience building; planned investments for climate resilience; urban planning and land-use planning for flood management; dissemination of information on flood forecasting and early warning systems; communication systems and strategy; and community participation in planning and emergency response.

The training workshops that started in May 2018 are expected to strengthen the capacity of the officials of various organizations including the KMC on climate change adaptation and disaster risk reduction concepts as well as best practices in India and abroad, and ensure familiarization with the FFEWS system. "Decision makers, administrators, and control room staff will be involved in the capacity-building exercise. The training programs will include various aspects of FFEWS including data collection and analysis, coordination between data providers and other stakeholders, developing effective warning and/or advisories to different users, communication protocols and dissemination mechanism, and finally analysis of feedback," said Manomita Das of KEIIP's Risk and Resilience Unit.

KEIIP is also developing a multistakeholder working group for climate resilience and disaster risk management. It will compliment earlier works carried out by DFID and other partners to support the KMC in building the city's climate change resilience. "We (ADB, DFID, the World Bank, and other external

partners) are joining our efforts to comprehensively strengthen the city's knowledge, tools, and expertise to scale up the interventions and sustain them," said Pokhrel of ADB.

Harnessing Space Technology

ADB and the European Space Agency have partnered under the Earth Observation for Sustainable Development program, a new European Space Agency initiative, to increase the uptake of satellite-based information in regional and global development programs. Kolkata is one of the few cities selected under the program, which aims to provide governments and public utilities like the KMC with precise mapping of the city for better

BEST PRACTICES. Training for sharing of best practices has been a key pillar of resilience-building efforts.

land-use planning, disaster management, and climate resilience initiative.

For the KMC, the following satellite mapping and analysis was done for Kolkata City:

- urban and peri-urban land use and/or land cover,
- urban extent,
- imperviousness,
- urban green areas, and
- informal settlements.

Preliminary analysis of the geo-analytics clearly confirms that urban expansion, increased urban density, and shrinking water surface areas are the most important phenomenon affecting the runoff and drainage of the city.

Capacity building will include the development of a flood history of Kolkata, training on the risk maps with archived satellite images, and modeling work to illustrate the potential extent of flooding under various climate-change scenarios. The maps and training will help the KMC decide future investments and policy to improve the city's resilience to flooding related to climate change.

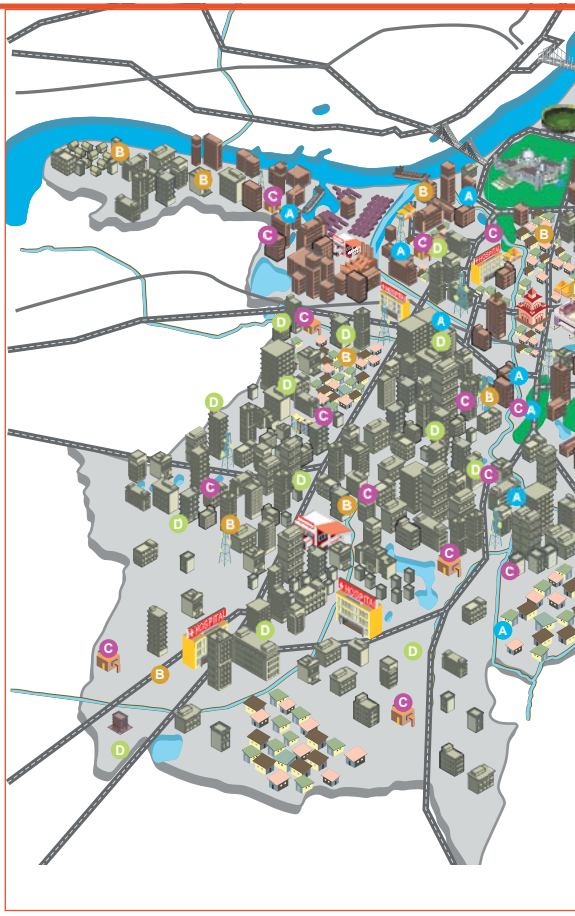
The land-use map is being updated through KEIIP to consider prioritizing present and future investments. Figures 12 and 13 show maps generated using data collected and satellite imagery in 2017 by the European Space Agency for Kolkata City.

RESILIENCE MATTERS. Efforts to beef up Kolkata's resilience will mean a better future.

BOX 18

PROJECT LESSON NO. 12:

Flood-Prone City Needs State-of-the-Art and Citizen-Friendly Flood Forecasting and Early Warning System



Key features of Kolkata's new flood forecasting and early warning system (FFEWS):

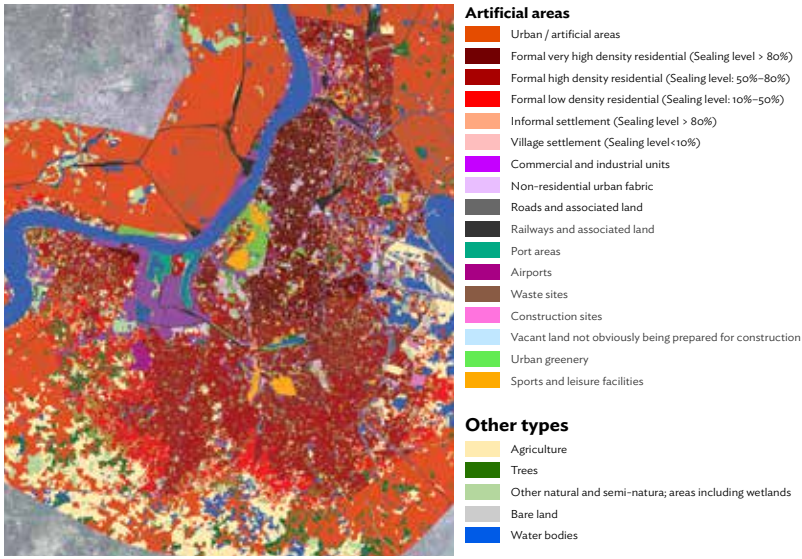
- All stakeholders can provide support by installing and managing the sensor nodes in their premises.
- Community organizations, schools, and colleges can monitor local flooding and alert people staying in low-lying areas.
- Ownership of the early warning system by people and community organizations will ensure regular data collection and sustainability of the system.
- Partnerships between different groups and organizations will make Kolkata ready to face extreme events with reduced damage and loss.
- The early warning system will result in less disruptions of traffic through timely rerouting, faster management of waterlogging, and reduced disruptions to livelihoods, especially of the poor.

KMC = Kolkata Municipal Corporation.

- By providing street- or neighborhood-level granular information, the system enables citizens to plan their commutes better and for businesses to reduce damage to their assets from inundation.
- This hybrid network is cost-effective and will address issues of affordability, maintenance, and sustainability of FFEWS.

Source: Taru Leading Edge Pty Ltd, August 2018.

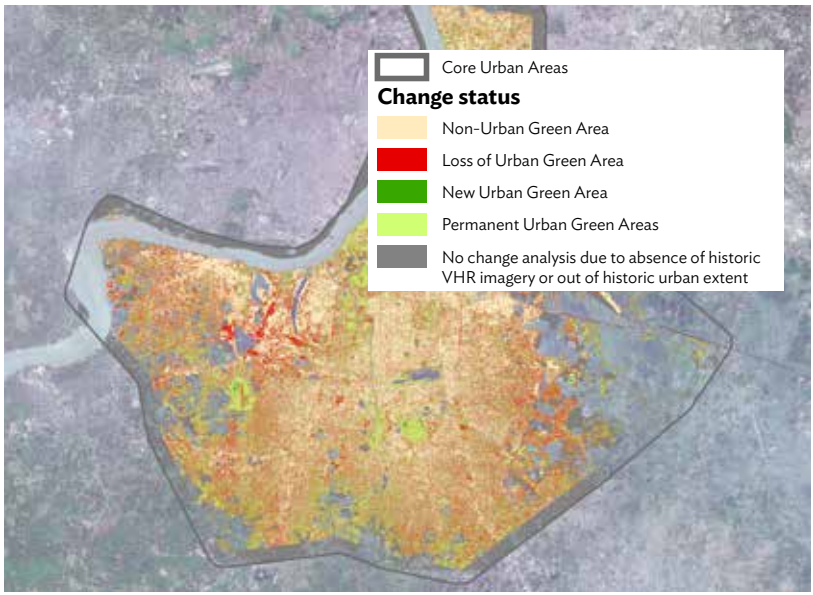
Figure 12: Land-Use Map Derived from Satellite Images in 2017



km = kilometer, N = North.

Source: Earth Observation for Sustainable Development, through ADB and European Space Agency Partnership for Kolkata 2017.

Figure 13: Status and Trends of Urban Green Areas Derived from Satellite Images in 2005–2017



Source: Earth Observation for Sustainable Development, through ADB and European Space Agency Partnership for Kolkata 2017.

BOX 19

PROJECT LESSON NO. 13:

Space Technology: A Fit Tool for a Growing City

A study of land use as seen from space over the 12-year period during 2005–2017, was conducted through ADB's partnership with the European Space Agency for Kolkata City. The remote-sensing data analysis showed how Kolkata is spreading and also changing some of its land type (Table 3). Like other cities in the region, built-up areas increased while agricultural land diminished. Over the period, the urban extent increased by more than 17 square kilometers (km^2). These new built-up areas (often large units) have developed mainly on the peripheral ring of the city, accounting for more than half of the changes over the period (57%), or even more than two-thirds in the core area (68%).

The other notable change concerns water bodies, part of which are dried up and converted into agricultural land. This phenomenon accounts for 12% of the total area undergoing a mutation, which appears more significant in the core urban area (21%) than in the peri-urban area (4%). Nevertheless, this only slightly compensates for the loss of agricultural land in favor of urban expansion; as the table reveals, the area covered by agriculture decreased by 12.3%, from 94.35 km^2 in 2005 to 82.73 km^2 in 2017.

Changes in Land Use and Cover Statistics as Seen from Space

LU/LC Classes	2005	2017	Changed Area %	Annual Change %
	Area (sq km) and %	Area (sq km) and %		
Built-up Areas	462.95 (66.0%)	480.12 (68.5%)	+3.7%	+0.3%
Agricultural Areas	94.35 (13.5%)	82.73 (11.8%)	-12.3%	-1.0%
Woods	23.53 (3.4%)	22.58 (3.2%)	-4.0%	-0.3%
Bare soil	0.33 (0.0%)	1.31 (0.2%)	+302.4%	+25.2%
Natural-seminatural	24.44 (3.5%)	20.21 (2.9%)	-17.3%	-1.4%
Water	95.45 (13.6%)	94.09 (13.4%)	-1.4%	-0.1%

LU = land use, LC = land cover, sq km = square kilometer.

Source: European Space Agency, April 2017, based on models by Earth Observation for Sustainable Development, through ADB and European Space Agency Partnership for Kolkata.

Summing Up: Success Lies in Building Institutions

The KMC and its project management unit for KEIP and KEIIP investments have come a long way from the early days of major delays and other issues that jeopardized the partnership. The initial results and the slow pace of progress between 2000 to 2004 were not promising. Both ADB and the KMC realized that things needed to change and the KMC needed to gear up for the task ahead, particularly to put in place capable leaders as project directors, and build the right cadre with the right authority, systems, and structure in a dedicated PMU to implement such a large infrastructure project. It needed to improve its own monitoring and methodology as well. In those early days, ADB also realized it needed to further support the KMC to learn fast, adapt, and consider alternatives for construction work in one of the oldest and densest cities in the world. It took a few

TEAMWORK.
When city officials work as a team, residents get better services.

> ADB realized it needed to further support the KMC to learn fast, adapt, and consider alternatives for construction work in one of the oldest and densest cities in the world.

years before the project and the partners saw the way forward open up, but eventually it did. Some of the people involved in the projects—consultants, staff of KEIP, contractors—who helped bring the project up to speed in those early days are now experts in urban rehabilitation.

The PMU under the KMC is now a juggernaut project-implementing entity, with more than 100 full-time staff. It has become renowned for its extraordinary and consistent performance in handling complex engineering projects in India. KEIIP was named the best performing ADB-funded project in India in 2017, after joint annual evaluation by the Ministry of Finance, the Government of India, and ADB during their tripartite review of projects. Having such an entity within a local municipal body is rare anywhere in Asia.

KEIP has also received awards and commendations for its social safeguard measures, such as providing permanent apartments for project-affected people and placing ownership of them in the name of the female head of household. The KMC retained a majority of KEIP's original PMU staff and added more staff to implement KEIIP. The KMC is now capable of disbursing more than $35 million in project funding annually.

Here are some of the other notable practices and lessons in project management from KEIP and KEIIP:

Housing all PMU staff and consultants in a single office building. Having all project consultants, contractors, and administrative units under one roof helped streamline project management. "Before making a decision on anything, I don't have to go a half hour down the road to anyone's office or across town. I walk a half minute to the consultant's floor, the engineer's, and ask them my questions and talk and decide," said Anujit Dutta, deputy team leader for the KEIIP management consulting team. "We work as a team. We always feel like a team, and it helps that we are in one building."

Transitioning the social development unit into a safeguards monitoring unit. The KMC has turned the PMU's social development unit into a safeguards monitoring unit (SMU). The SMU is now co-headed by senior officials in charge of monitoring three aspects of safeguards: environment, social issues, and gender. SMU staff function as compliance officers on these three aspects of safeguards. "Safeguards existed in other projects but not in such a systematic manner. Labor laws and licenses were there, but in such projects it is not left to the labor department to monitor and implement such safeguards," said KEIIP Project Director Yadab Mondal. "In ADB projects, it is directly the responsibility of the employer, the implementing agency, to ensure scheme-wide, site-wide safeguards. The systemization of such a mechanism has been part of our learning."

Creating, empowering, and sustaining a "juggernaut" project implementation unit within the municipal body. At the onset of KEIP, the KMC established a dedicated PMU headed by a senior Indian administrative services officer vested with sufficient authority to decide on project-related matters. To improve efficiency and project management capabilities, a contract management unit headed by a chief engineer, an SMU headed by a safeguard expert, and a project accounting

TECHNOLOGY MATTERS.
Appropriate technology and systems are essential for successful project implementation.

unit headed by a senior financial cadre officer were created for the project. This arrangement helped to define clear roles and responsibilities and promoted quick decision making, showing the intrinsic value of a well-organized corporate entity. The PMU is supported by expert teams of project consultants preparing detailed designs, tendering, and contract execution. In India, where most municipal bodies are weak in their capacity to execute complex urban infrastructure projects, the KMC through KEIIP offers a unique alternative. Although a major share of the KMC's effort goes toward maintenance of the existing utilities and services, the KMC did not lose sight of its prime focus on longer-term development plans carried out by its dedicated, fully staffed, and capable PMU.

PREPARING FUTURE GENERATION. Kolkata Municipal Corporation, through ADB-funded projects, has intensified outreach to schools to raise awareness on water conservation.

Intercoordination between utility departments and delays in obtaining clearances for utility shifting and right-of-way are common issues faced by executing agencies in India. The KMC set up a dedicated cell within the PMU to liaise with other utility providers on a day-to-day basis and to build robust internal monitoring mechanisms so that timely clearances are in place. Should the need arise, the highest KMC decision makers actively support and guide the PMU on this.

ADB interventions in Kolkata helped the PMU of the KMC become fully conversant with internationally adopted tendering processes. The PMU adopted e-tendering in 2016 to bring more transparency and efficiency into the tendering process. With ADB's support, the PMU formulated complex performance-based design, build-and-operate contract packages and successfully awarded

those contracts at reasonable rates to specialized contractors. This, in itself, is a great achievement, as no other PMU has done this before in India.

The PMU is always keen to adopt the latest technological advancements, whether they are advanced trenchless technologies like microtunneling or the online project accounting system for e-measurement of civil works. By reducing losses in the existing water supply network, the PMU is targeting to supply 24/7 water in three pilot areas of Kolkata without any increase in the intake of water supply. Very soon the PMU expects to operationalize the upgraded SCADA system and overhaul its maintenance depots.

> Capacity of an organization is not built in a day. It requires concerted effort, tenacious follow up, and a long-term partnership to result in a strong entity such as the Project Management Unit of the Kolkata Municipal Corporation. The strategy of building institutional reforms into the loans that we provided also played a significant part in capacity building.

NEETA POKHREL
Principal Urban Development Specialist, KEIIP Team Leader, ADB.

REFLECTION

Bebedel Fabe, project officer, ADB

I was first involved with KEIP in 2007, as a new project analyst at ADB, during the initial implementation of the supplementary loan to KEIP. The project was then delegated to the India Resident Mission so I was involved briefly at that time. In 2015, I got involved again during the early implementation stage of KEIIP Project 1 when bidding of one of the first performance-based design, build, and operate contracts for nonrevenue water loss reduction failed and the contract had to be revised and rebid.

Incoming Project Officer Neeta Pokhrel and I then had to buckle up and work hard with the KMC, and internally with the legal and procurement units, to refine this new type of contract for ADB. To help the KMC open the bid to a bigger market and to more able bidders, we decided to allow for parent and/or subsidiary company guarantees, which was a new thing in ADB. It took a while, because of its innovative nature, but I was happy to see this contract awarded in 2016 and doing very well now.

I also liked the fact that the KMC injected many smart project implementation initiatives to improve the speed and efficiency from their side. They switched to full electronic tendering under KEIIP Project 2 in 2016, to bring more transparency and efficiency to the tendering process. They were amenable to the latest technological advancements, being the first to embrace the advanced trenchless technologies for laying sewer pipes in 2007 to reduce implementation time and disturbances to the people. They developed an online project accounting system for e-measurement of civil works, which resulted in a transparent and efficient certification process.

In ADB, project analysts work closely with the project officers on the administration of the project. KEIP and KEIIP's project management unit has a reputation for being efficient and expect us to also be prompt and on top of everything. We sometimes joke that we have to be on our toes 24/7 when working on this project. I like it though, when our clients are fast and smart, we move with the same speed and learn together.

REFLECTION

Ashok Srivastava, **senior project officer (urban), ADB India Resident Mission**

I was ADB's project officer for KEIP from 2007 until the project was completed in 2013. I have very fond memories of the project and the people I worked with at the KMC.

It was challenging for us in the beginning since we were trying very hard to catch up for lost time—the project was not performing as expected until 2005. We had to build the capacity of the project management unit that had been restructured, with staff who were added to make this project successful by the previous KEIP project director, Rajiv Sinha. Rajiv had just left then, and Shantanu Basu had joined, who was equally dynamic and driven. The PMU staff were technically very competent but had never implemented a project of this size and complexity. They had also never used consultants before to help them implement such projects, as we routinely do in ADB. So the consultants who were part of the project were basically driving the project. We had to encourage and quickly build the confidence and capacity of staff to drive the project and manage consultants and contractors. This was very important to ensure ownership and that the project had right policy decisions being pushed by the right people.

Another aspect of the project and its staff that I really liked was that the KMC staff implementing the project had excellent connections to, and consulted very often with, both the KMC's public representatives and project beneficiaries. Perhaps the KMC with its long history of decentralized powers, governance, and the connection to its local ward and borough levels, already had this as a culture embedded in its workings and staff. This is something we rarely see in our other projects where the local bodies are not fully involved with project implementation. I believe this aspect was a key in leading this project to a successful completion in one of the most difficult urban environments. We have highlighted and showcased this aspect with our other clients and hope the other implementing agencies working in urban development in India will learn from this.

FROM THE PRESS

News Excerpts Spanning 2 Decades of Partnership

■ It is a photo identity card with a difference. The Calcutta Municipal Corporation authorities have started distributing photo identity cards to thousands of people living along both sides of city's drainage outfall canals like Churial, Tollygunge-Panchannagram, intercepting Manikhali and lead canals in a phased manner. It is more than voting rights for them. The cards will ensure alternative shelters for them as they have been stamped as "encroachers" by the civic body authorities. The canals need to be dredged as part of the drainage modernisation plans taken up by the CMC. The process aims at saving the city from severe waterlogging by renovating the century old drainage system of the city. The Asian Development Bank has already sanctioned Rs1,200 crore[18] for the purpose. ***The Times of India*, 17 January 2001**

■ More than half the Kolkata's population do not perceive the drinking water supplied to be safe. Almost two-thirds are worried about the quality of the drinking water in general. On an average, a resident of Kolkata spends around Rs 1,000[19] a year for purification of water. These were some of the findings reported in a survey done by Weston International, a US-based firm engaged by the Calcutta Municipal Corporation and the World Bank in preparation for a project loan of around $250 million[20] to the civic body. The loan would be used to fund a revamp of the water supply system of the area under the CMC, along with the sewerage and drainage system of the city proper (excluding the 41 wards in the added areas, which is being covered under the $250 million Asian Development Bank project). ***The Times of India*, 6 February 2001**

[18] About $168.6 million. Currency conversions at time of editing, 4 September 2018.

[19] About $4.00. Currency conversions at time of editing, 4 September 2018.

[20] About ₹17.7 trillion. Currency conversions at time of editing, 4 September 2018.

■ The water distribution system in the city is set to be modernised with the Kolkata Municipal Corporation (KMC) chalking out a plan to this effect, according to the city mayor, Mr. Subrata Mukherjee. Participating in an interactive session with the members of the Merchants Chamber of Commerce on Friday, he said that the KMC has sketched out a Rs 200-crore[21] plan to revamp the water supply distribution network inherited from the British.... "If the century-old distribution system is not overhauled, people will continue to get contaminated water even as crores are spent to set up water treatment facilities," he said. ***The Hindu Business Line*, 5 June 2004**

■ Imagine leaving the smoke and grime of the city behind and driving down a never-ending stretch lined with manicured fruit trees and medicinal plants. Sounds like a fairy tale? If a Kolkata Municipal Corporation plan is implemented, this could soon turn into a reality. The civic body, under its Kolkata Environment Improvement Project (KEIP) funded by the Asian Development Bank (ADB), has planned green belts that will run along three key stormwater canals for a total length of 41 km. ***The Times of India*, 21 October 2008**

■ City mayor Bikash Ranjan Bhattacharya today handed over the keys of low-cost houses constructed for the resettlement of the canal bank dwellers of Shampa Mirzanagar in the southern outskirts of the city. Speaking on the occasion, Mr. Bhattacharya said, "It is a long cherished dream of the slum dwellers which came true today. It will be a ray of hope as Pt Jawaharlal Nehru, the country's first Prime Minister, had once said, the very spirit will only be fulfilled or realised when people from below the strata of the society, will be able to avail of the basic requirements of average life expectancy which

[21] About $28.1 million. Currency conversions at time of editing, 4 September 2018.

is food, shelter and clothing." The housing project is a joint endeavour of Kolkata Municipal Corporation (KMC) and Kolkata Environmental Improvement Project (KEIP) towards the resettlement of poor dwellers. ***United News of India*, 12 January 2009**

■ Gone are the days when the not-so-sweet stench of open garbage would hit the city's olfactory senses like a sledgehammer. In a unique, but much needed, initiative by the Kolkata Municipal Corporation, modern portable compactors and a scientific solid waste compactor station was unveiled at Kalighat Park on Friday. ***Hindustan Times*, 22 December 2012**

■ A citizens' park that had pushed the state government in the eye of storm has now become the pride of the city. Victoria Square on Albert Road has shed its depleted look has turned into a swanky park, courtesy the beautification drive of the Mamata Banerjee government. On Monday, [The Times of India] spotted people queuing up at the entrance of the park after giving it a miss for months. ***The Times of India*, 24 February 2014**

■ Through Kolkata' s punishing midsummer nights, as the rest of the city sleeps, a small strike force of men prowls the city's putrid underbelly. These days they work right in the heart of south Kolkata, at Gariahat, a bustling junction day and night, dotted with kiosks selling everything from bed sheets to doormats. Wearing helmets, safety jackets and masks, the men shimmy down a six-meter steel ladder to enter a dank, brick sewer tunnel filled with murky water.... Built back in 1875 by the British rulers, this elaborate underground sanitation network in eastern India was, at the time, matched only by the systems in London and Hamburg, Germany. Almost 130 years later, in 2006 and 2007, the Kolkata Municipal Corporation (KMC) began cleaning the tunnels, which had become choked with silt. The task was monumental, but today, the challenge has nearly been met by the KMC engineers and contractors. This small stretch of tunnel in south Kolkata is the final phase of the project. ***Next City*, 11 April 2014**

■ Kolkata Municipal Corporation (KMC) on Tuesday introduced the helium gas technology to detect leakages in supply pipelines that carry potable water from the Tallah tank and to areas in north and central Kolkata. The civic body has roped in a firm for the job. The firm, which has been lending technological support to KMC under the water loss management policy under Kolkata Environment Improvement Project (KEIP) funded by Asian Development Bank, injected helium into the 10-inch pipe that carries filtered water from Tallah to Cossipore, Paikpara and Belgachhia areas. ***The Times of India*, 16 November 2017**

A MORE LIVABLE KOLKATA. The partnership of ADB and the KMC aims to transform Kolkata into a more livable city.

Transforming Kolkata

A Partnership for a More Sustainable, Inclusive, and Resilient City

This publication summarizes the outcomes achieved to date and explores the views of stakeholders in the two decades of partnership between the Asian Development Bank and the Kolkata Municipal Corporation in India. The Asian Development Bank supported Kolkata's integrated planning and phased investments of over $1 billion toward building resilience, inclusiveness, and improved and sustainable urban services. Essential lessons provided in this publication may be useful for other megacities in the region seeking to become more livable.

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ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members—49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

ASIAN DEVELOPMENT BANK
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org

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