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The World Bank

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Report No: PAD2218

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF

US$150.0 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

HEZHOU URBAN WATER INFRASTRUCTURE AND ENVIRONMENT IMPROVEMENT PROJECT

MAY 22, 2018

Water Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS

Exchange Rate Effective November 6, 2017

Currency Unit	=	Chinese Yuan (CNY)
CNY1.00	=	US$0.1505
US$1.00	=	CNY 6.6427

FISCAL YEAR

January 1 - December 31

ABBREVIATIONS AND ACRONYMS

AWPB	Annual Work Plans and Budget
BOD	Biological Oxygen Demand
BP	Bank Procedure
m3/d	Cubic Meter per Day
COD	Chemical Oxygen Demand
CPS	Country Partnership Strategy
CRR	Cost Recovery Rate
DA	Designated Account
DRC	Development and Reform Commission
DSCR	Debt Service Coverage Ratio
EA	Environmental Assessment
ECOP	Environmental Code of Practices
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
ESMP	Environmental and Social Management Plan
FBS	Selection under a Fixed Budget
FM	Financial Management
FMM	Financial Management Manual
FYP	Five-Year Plan
GDP	Gross Domestic Product
GPFB	Guangxi Provincial Finance Bureau
GRS	Grievance Redress Service
HEPB	Hezhou Environment Protection Bureau
HFB	Hezhou Municipal Finance Bureau
HMEAB	Hezhou Municipal Engineering Administration Bureau
HWRB	Hezhou Water Resources Bureau
IBRD	International Bank for Reconstruction and Development

IDA	International Development Association
IFI	International Financial Institutions
IFR	Interim Financial Reports
IPF	Investment Project Financing
LCS	Least-Cost Selection
M&E	Monitoring and Evaluation
MOF	Ministry of Finance
MOHURD	Ministry of Housing and Urban-Rural Development
O&M	Operations and Maintenance
OPRC	Output- and Performance-Based Road Contracts
PAD	Project Appraisal Document
PCR	Physical Cultural Resource
PDO	Project Development Objective
PIU	Project Implementation Units
PLG	Project Leading Group
PMO	Project Management Office
PPSD	Project Procurement Strategy for Development
QCBS	Quality- and Cost-Based Selection
RAP	Resettlement Action Plan
RFB	Request for Bids
RFP	Requests for Proposals
RFQ	Request for Quotations
STEP	Systematic Tracking of Exchanges in Procurement
SWMM	Storm Water Management Model
TOR	Terms of Reference
VfM	Value-for-Money
UMIC	Upper Middle-Income Country
USD	United States Dollar
WA	Withdrawal Application
WB	World Bank
WBG	World Bank Group
WWTP	Wastewater Treatment Plant

Regional Vice President:	Victoria Kwakwa
Country Director:	Bert Hofman
Senior Global Practice Director:	Guang Zhe Chen
Practice Manager:	Sudipto Sarkar
Task Team Leader(s):	Gang Qin

BASIC INFORMATION

Country(ies)	Project Name	
China	Hezhou Urban Water Infrastructure and Environment Improvement Project	
Project ID	Financing Instrument	Environmental Assessment Category
P158622	Investment Project Financing	A-Full Assessment

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[ ] Fragile State(s)
[ ] Disbursement-linked Indicators (DLIs)	[ ] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
13-Jun-2018	30-Jun-2024

Bank/IFC Collaboration

No

Proposed Development Objective(s)

The objectives of the Project are to improve flood risk management and reduce discharge of water pollutants in Hezhou Municipality。

Components

Component Name	Cost (US$, millions)
Component 1: Improving He River Flood Risk Resilience of the He River	137.55

Component 2: Improving Urban Drainage and Wastewater Management	189.10
Component 3: Institutional Strengthening, Capacity Building and Project Management	15.82

Organizations

Borrower:	People's Republic of China
Implementing Agency:	Hezhou Project Management Office

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	359.35
Total Financing	359.35
of which IBRD/IDA	150.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	150.00

Non-World Bank Group Financing

Counterpart Funding	209.35
Borrower	209.35

Expected Disbursements (in US$, Millions)

WB Fiscal Year	2018	2019	2020	2021	2022	2023	2024	2025
Annual	0.00	5.00	10.00	20.00	25.00	35.00	35.00	20.00
Cumulative	0.00	5.00	15.00	35.00	60.00	95.00	130.00	150.00

INSTITUTIONAL DATA

Practice Area (Lead)	Contributing Practice Areas
Water	Social, Urban, Rural and Resilience Global Practice

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?	
a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF	Yes
b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment	Yes
c. Include Indicators in results framework to monitor outcomes from actions identified in (b)	Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Low
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	Substantial
7. Environment and Social	High
8. Stakeholders	Moderate
9. Other	
10. Overall	Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04	✓	
Forests OP/BP 4.36		✓
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11	✓	
Indigenous Peoples OP/BP 4.10		✓
Involuntary Resettlement OP/BP 4.12	✓	
Safety of Dams OP/BP 4.37	✓	
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

Section I.A.2 of Schedule 2 to the Loan Agreement

Financing Arrangements: The Borrower shall cause the Project Implementing Entity to: (a) manage, operate, monitor, transfer and reconcile the proceeds of the Loan made available to it pursuant to Section I.A.1 of Schedule 2 to the Loan Agreement in accordance with arrangements and procedures satisfactory to the Bank; (b) take all required actions, including provision of timely consents and approvals as may be necessary, to facilitate the utilization of said Loan proceeds and the implementation of the Project and, to enable the Project Implementing Entity to comply with its undertakings under the Project Agreement; and (c) maintain all relevant records and documents related to the Loan and the Project and provide promptly such documents and records, including all other information, as may be requested by the Borrower or the Bank from time to time.

Sections and Description

Section I.B of Schedule 2 to the Loan Agreement

Safeguards and Dam Safety Measures: The Borrower shall take, and shall cause the Project Implementing Entity to take, all measures necessary to comply with, or all measures necessary to enable the Project Implementing Entity to comply with, the provisions of Section I.B and I.C of the Schedule to the Project Agreement.

Sections and Description

Section II of Schedule 2 to the Loan Agreement

Project Monitoring Reporting and Evaluation: The Borrower shall furnish to the Bank each Project Report not later than sixty (60) days after the end of each calendar semester, covering the calendar semester.

Sections and Description

Section III.A.1 of the Schedule to the Project Agreement

Upon completion of the construction of the Jiangnan sewage treatment plant under Part 2(d) of the Project the Project Implementing Entity, through Hezhou Municipality, shall enter into an agreement with a qualified service provider to operate such plant, under terms and conditions acceptable to the Bank.

Sections and Description

Section I.C.1 of the Schedule to the Project Agreement

The Project Implementing Entity, through Hezhou Municipality, shall: (a) no later than September 30, 2018 establish and thereafter maintain the Dam Safety Panel under terms of reference, including a time-table and adequate budget for its activities, acceptable to the Bank to, inter alia, inspect and evaluate the safety status of Upstream and Downstream Dams and recommend any needed remedial work or safety related measures to upgrade the dam(s) to an acceptable standard of safety; and (b) cause the Dam Safety Panel to: (i) carry out its function as set out in its terms of reference and (ii) provide to the Bank and Project Implementing Entity, no later than October 31 in each year, beginning on October 31, 2019, annual reports of its findings and recommendations for any safety related measures.

Sections and Description

Section II.B of the Schedule to the Project Agreement

Without limitation to the provisions of Section II.A of the Schedule to the Project Agreement, the Project Implementing Entity shall: (a) prepare, under terms of reference acceptable to the Bank, and furnish to the Bank no later than October 31, 2021 a consolidated mid-term review report for the Project, summarizing the results of the monitoring and evaluation activities carried out from the inception of the Project, and setting out the measures recommended to ensure the efficient completion of the Project and to further the objectives thereof; (b) review with the Bank the mid-term report, on or about the date one month after its submission, and thereafter take all measures required to ensure the continued efficient implementation of the Project and the achievement of its

objectives, based on the conclusions and recommendations of the said report and the Bank's views on the matter.

Conditions

CHINA
HEZHOU URBAN WATER INFRASTRUCTURE AND ENVIRONMENT IMPROVEMENT PROJECT

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I. STRATEGIC CONTEXT

A. Country Context

1. Over the past forty years, China has experienced rapid economic growth, with gross domestic product (GDP) averaging 9.6 percent per annum from 1978 to 2015[1]. Since the early 1980's, China has been shifting towards a market-based economy with Chinese characteristics, resulting in rapid economic and social transformations that have lifted more than 800 million people out of poverty. Today, China has a population of 1.4 billion; with an estimated GDP close to US$11 trillion (in 2015). China achieved all the Millennium Development Goals (MDGs) by 2015 and contributed greatly to the achievement of the MDGs globally.

2. Urbanization in China has been significant, but uneven. Urbanization has been proceeding at a fast rate over the past three decades, and China's urban population rose from less than 20 percent of the total population in 1978 to 52 percent in 2012[2]. However, most of the urban growth has been in larger, eastern cities supported by improved infrastructure services; while for many medium- and small-sized cities[3], there is still need for better infrastructure services. This is especially true for urban, water-related assets where lack of proper wastewater collection and treatment has led to water pollution of local rivers and waterways. At the same time, inadequate urban flood protection has left many cities more vulnerable to flood risks.

3. Improving urban water infrastructure and environmental management for medium- and small-sized cities is therefore an important national development goal. Lack of such adequate infrastructure directly affects people's health, negatively impacts the urban environment, and is a barrier to development and social-economic prosperity. Recognizing these challenges, China has set as top national priorities the sustainable improvement of water quality and water management, to be achieved through a series of recently adopted and ambitious policies. China's national 13th Five-Year Plan for Social and Economic Development (FYP, 2016-2020) prioritizes the ideas of '*Ecological Civilization'* and *'Beautiful China'* as goals in China's overarching development vision. These goals together look to ensure China's economic development is characterized by more "harmonious coexistence between humans and nature" – balancing priorities of GDP growth, with a new legal and policy framework that facilitates green, low-carbon, and development. Furthermore, for the water sector, China has introduced a policy framework known as the "*Three Red Lines",* which aims to ensure the "strictest water resources management", as based upon: (a) limiting water abstraction to ensure sustainable use of scarce resources; (b) improving water use efficiency and productivity to ensure better allocation of water resources and sustain socio-economic objectives; and (c) reducing water pollution to achieve environmental objectives.

4. China's 13th FYP also prioritizes improvements in urban flood protection infrastructure. According to a survey carried out by China's Ministry of Housing and Urban-Rural Development, between 2008 and 2010, around 60 percent of cities experienced urban flooding, and direct economic losses associated with urban floods were estimated to be around US$40 billion in 2010 (World Bank 2010[4]).

5. China's national plans also highlight the need to allocate more resources to support the less-developed western provinces to improve their infrastructure, strengthen environmental protection, promote green

[1] National Data published by National Bureau of Statistics of China
[2] World Bank Report "Urban China - Toward Efficient, Inclusive, and Sustainable Urbanization"
[3] Cities w/ population under 500,000 are "small-sized"; cities between 500,000 to 1 million are "medium-sized" (State Council Notice, 2014)
[4] World Bank Report "China Country Water Resources Partnership Strategy (2013-2020)"

growth, and balance regional economic development. However, the challenge remains to translate these forward-looking policies into effective implementation on the ground. This project aims to address the above mentioned water challenges in Hezhou, a city located in a western province of Guangxi.

B. Sectoral and Institutional Context

6. Guangxi Zhuang Autonomous Region (Guangxi) is a western province, and one of the least developed in China, ranked by per capita GDP as 27th out of 31 provinces. Guangxi has a total population of 48 million people. First-tier municipalities in Guangxi (including Nanning, Liuzhou and Guilin) have recently made investments in improving infrastructure, and will continue to do so. China's central government and the Government of Guangxi now intend to focus on infrastructure development in second-tier cities, such as Laibin, Chongzuo, and Hezhou. These municipalities require further development of basic infrastructure, and particularly improved provision of public good services such as flood control and wastewater management.

7. Hezhou is one of the poorest cities in Guangxi, with a per-capita GDP of US$3,264, compared to a national per-capita GDP of US$ 8,820. Based on the 2012 census data, the city has a total population of 2.3 million, of which one million is urban. Hezhou is located in northeastern Guangxi Province, bordering Hunan Province to the north and Guangdong Province to the east. The Municipality is comprised of two districts (Babu District and Pinggui District), and three counties (Zhaoping, Zhongshan, and Fuchuan Yao Minority Autonomous County). Babu District is the central urban area of Hezhou, with a population of 350,000 inhabitants.

8. Hezhou has abundant surface water resources, and a complex water system. The He River is the dominant water body – running from the northwest, through the center of the city, and to the southeast. There are nine tributary rivers/streams and irrigation canals that traverse Hezhou. These tributaries are the source of water for the population but they are also the water bodies that receive stormwater drainage and wastewater. Two flood regulation dams are located on the He River, upstream and downstream of Hezhou municipality. Within the city limits, there are three small-scale hydropower stations along the He River. These power stations were constructed in the 1960s and 1970s, when Hezhou was mostly rural. All three stations still generate power; but because of age and lack of maintenance (i.e. the gates cannot automatically open/close), and because of complex ownership by multiple organizations[5], operation of the dams is uncoordinated, and the power stations/dams can block the flow of the river and increase flood risks.

9. Hezhou municipality experiences severe recurrent flooding, and the combination of insufficient urban flood control facilities and improper operation of the river system have left the city vulnerable to severe losses. A total of 32 floods have been recorded since 1950, with the frequency of flooding increasing in more recent years. Urban areas of Hezhou now flood at least once a year, and sometimes twice. The 1994 flood was the highest recorded, registered as having 1 in 50 years return period. The 2015 flood impacted 33 towns, flooded streets in two districts and three counties, affected 83,450 people and caused more than 70 million RMB in economic losses over 3,100 ha of crop land[6]. With new urban development along river banks, the number of homes flooded and the number of people affected are increasing. Furthermore, flood risks may increase with higher precipitation and runoff from climate change.

10. Improving flood management, water quality, and resilience in Hezhou faces a number of interrelated

[5] The power stations are operated under contract by different State-Owned Enterprises affiliated to the local water resources bureau.
[6] Data Source: Water Resource Bureau of Hezhou Municipality

challenges. Three specific problem areas were identified to be addressed under this project:

- ***Recurrent flooding along the mainstream He River, and waterlogging in the central urban area***. Currently, Hezhou is the only prefecture-level city in Guangxi without a flood control system. The mainstream He River, as well as tributary rivers and canals, have insufficient flood discharge capacity. Most of the riverside section is without a dike or revetment; and over time, some areas of the riverbed have become heavily silted. At the same time, Hezhou's system of rivers, tributaries, canals, and lakes are not fully connected and managed in an integrated manner. As a result, flood waters during storms have a limited number of pathways to flow, instead concentrating in bottleneck points, flooding low-lying lands, and causing water-logging in the city. Hezhou's traditional city center, known as Babu District, has the highest population density in Hezhou and is located in a low-lying area immediately adjacent to the mainstream He River (with many commercial establishments, residential buildings, and enterprises concentrated along the river). This area also includes Hezhou's historic "Xiyue Jie" old street – a winding network of alleyways with hundred-year-old buildings and considerable tourism potential. Babu District and Xiyue Jie areas routinely suffer some of the worst waterlogging and localized flooding in Hezhou, leading to economic damage and disruption to local residents.
- ***Water pollution from combined-sewer overflows and direct wastewater discharge***. Hezhou does not have a fully-separated drainage system for stormwater and sewage, and treatment facilities are limited. As a result, the municipality suffers from significant water pollution – especially during heavy storm events, when combined sewers overflow and sewage is released to local streets and waterways. Rainwater aprons and pipe ditches are often undersized and/or filled with silt, and a portion of the industrial and sanitary sewage is drained directly via combined sewers to the nearby tributaries and the He River. As a result, the water quality of these water bodies is poorer than Class V. Wastewater treatment differs in the older urban area (Babu District) and the newer development areas south of the He River. In Babu District, household, commercial, and small-industrial wastewater is collected and transported to the Hezhou WWTP. However, only 70-80 percent of the sewerage in Babu District is collected because not all of the community sewer networks are connected to main trunk lines, and instead they directly discharge untreated wastewater into local waterways. Meanwhile, in Hezhou's rapidly developing urban area south of the He River, there currently is no municipal wastewater collection network, nor treatment. Some larger residential developments, schools, and other public buildings have temporary septic and treatment facilities onsite; but the majority of scattered developments discharge sewage directly into drains and local waterways. This area has a current population of 15,000 people, but is expected to see an influx of new residents. Thus this area needs proper sewage collection and wastewater treatment.
- ***Limited institutional capacity and coordination for integrated flood and urban drainage management***. Water affairs in Hezhou are administered by multiple institutions, with limited coordination of planning and management activities. In Hezhou, no single institution has a clear role and authority for integrated planning, management, and operation of flood protection and urban drainage infrastructure. As a result, the various sectoral masterplans and strategies are made separately by different institutions, and this can lead to un-coordinated operations, and increased vulnerability to floods. At the same time, Hezhou lacks modern information systems for monitoring and managing flood risks, water resources, and environmental quality. Both flood protection and urban drainage in Hezhou need to be considered together, with coordination across agencies, and better systems for monitoring and control, so that water-related masterplans can be integrated and properly implemented.

Rationale for the Bank's Involvement, and Unique Areas of Value Add

11. Over the years, the Bank and China have developed a robust partnership in the water sector to address policy and institutional weaknesses and challenges, and to test new approaches. The current Bank program supports the Government's priorities in China, and it also provides global lessons learned from China that can be shared within China and with other countries. Bank-supported programs in China focus on addressing complex development challenges, underpinned by robust analytics, technical work based on international best practices. In this project, the Bank's interventions bring added-value in the form of: (i) *technology and innovation*; (ii) *leveraging economic growth*; and (iii) *contribution on delivery of global public goods*. Replicability is also an important consideration, with the value added in Bank projects expected to demonstrate benefits that can be a driver for similar interventions –inside China and globally. The Hezhou project particularly brings value added as follows:

(i) Technology and Innovation: Globally, it is becoming increasingly clear that cities need integrated approaches that combine structural and non-structural measures to successfully and sustainably reduce urban flooding risks. The proposed project will tap into the Bank's experience and global knowledge to introduce an approach in Hezhou that integrates both the institutions and physical infrastructure for urban water management. In this project, the Bank is introducing a multi-agency, integrated flood risk assessment approach (underpinned by analytical scenario-based hydraulic modelling and hazard mapping), and an ongoing "Coordination Platform" and "Operations Protocol" to regularly bring together various agencies responsible for water management in Hezhou. During project preparation, the Bank supported changing the original design from a traditional reliance on hard-engineered flood defenses (i.e. large concrete infrastructure, designed to convey large flood volumes out of the city as fast as possible) towards more adaptable mix of structural and non-structural solutions (based on principles of connecting water systems, enhancing drainage, and increasing storage). This is an innovative approach for China, producing benefits such as a reduced infrastructure footprint, which in turn reduce project costs and requirements for land acquisition, while maintaining more natural river landscapes, more water for ecological purposes, and an improved urban quality of life. A smart internet-based information system will be developed during project implementation for flood monitoring and early warning, water quality monitoring and early warning and integrated water system control and optimization.

(ii) Leveraging Economic Growth: This project's improvements in urban flood risk management and water quality support a strong enabling environment for further investment and economic development in Hezhou. The project aims to reduce pollution in local waterways and develop a "green ring" around Hezhou's urban center. Together, these will clean and connect the tributary rivers and lakes into a network of urban parks, waterfronts, and green landscapes for a more attractive and livable city. This multi-purpose water infrastructure is expected to increase the value of local real-estate, attract additional public and private investments, and be a new driver of economic growth in Hezhou. At the same time, this project has the potential to influence significant future investment in water management and flood protection projects in China. China annually spends about US$ 98 billion for improvements in the water sector; and Guangxi province alone spends about US$3.1 billion per year in flood management. The techniques learned through this project could be applied to similar investments in Guangxi, or more broadly scaled up across China, supporting economic growth through better management of water quantity and quality in cities.

(iii) Contribution on Delivery of Global Public Goods: This project will provide significant public goods benefits to the people of Hezhou, through the protection from floods, promotion of urban climate resilience, and reduction of water pollution for a clean urban water environment. At the same time, the

project contributes to global public goods by reducing GHG emissions and providing valuable knowledge on innovative water management approaches to share across China and globally. Under the project, more than 100,000 people will be protected from floods through the integrated flood management. By separating combined sewers and building treatment facilities, water pollution loads will be reduced, which will in turn reduce environment and public health risks. Responding to climate change, on average, the net annual GHG emission reductions from the project's investments in new and improved wastewater collection and treatment facilities will be 1,697 tCO2-eq per year. Finally, the lessons learned from this project can be shared globally through the Bank's information portals and serve as a useful model for other countries that face similar urban water management challenges.

C. Higher Level Objectives to which the Project Contributes

12. The World Bank Group's 2013-2016 Country Partnership Strategy (CPS) (Report No. 67566-CN) was discussed by the World Bank's Board of Executive Directors on November 6, 2012 and is aligned with the challenges and priorities for more balanced development and protection of environmental and water resources outlined in China's 13th Five Year Plan. The CPS focuses on three main themes: (i) supporting greener growth; (ii) promoting more inclusive development; and (iii) advancing mutually beneficial relations with the world by supporting China's South-South cooperation and role as a global stakeholder.

13. This proposed project directly supports the first theme of the CPS by assisting Hezhou to enhance urban environmental services, including flood risk management and urban drainage, as well as wastewater collection and treatment. The project also supports the second theme of the CPS in enhancing secondary town development by helping local governments design integrated urban development plans that include adequate water supply, wastewater and floods management solutions. These collective efforts and benefits, delivered through better water management in one of China's poorer second-tier cities, are aligned with the WBG's twin goals of ending extreme poverty and boosting shared prosperity in a sustainable manner.

14. Finally, it can be noted that the CPS and the proposed project are consistent with China's broader vision for development, as characterized in its national policy priorities and programs, such as the *Ecological Civilization* and *Beautiful China* initiatives, and the *Three Red Lines* policies of the water sector. In particular, Hezhou Municipality has been assigned by the Chinese central government as a pilot city for integrated, multi-agency urban planning; and this project is closely aligned with that mandate. The integrated, multi-benefit approach introduced by the Bank in this project will have strong support for replication and scale-up across China.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

15. The objectives of the Project are to improve flood risk management and reduce discharge of water pollutants in Hezhou Municipality.

B. Project Beneficiaries

16. The main beneficiaries of this project are the residents of Hezhou who will benefit from increased flood risk protection as a result of the project investments and interventions, as well as the residents who will benefit from reduced water pollutants discharged to the rivers, canals, and lakes in the urban areas of Hezhou. It is expected that about 105,600 residents who currently live in Hezhou city will benefit from improved flood risk protection. It is also expected that about 100,000 Hezhou residents will benefit from access to an improved sewer system under the project, while a broader part of the municipality population will benefit from reduced water pollution in the local water bodies due to the efforts of the project (Hezhou total municipal population is 2.3 million people). The indirect benefits of the project will include an overall improved environment, which will improve the quality of life for Hezhou residents and attract tourists to support local economic development. The Hezhou Municipal Government will also benefit from the project, through strengthened institutional capacity and a better ability to make informed decisions, conduct water resources monitoring, and protect local residents with new early warning systems for floods.

C. PDO-Level Results Indicators

17. The key PDO-level results indicators for the project include*:*

To improve flood risk management:

1) People protected by improved flood mitigation infrastructure[7] (number);
2) Development and implementation of a flood risk management system[8] (yes/no)
3) Completion of an integrated flood risk and urban drainage masterplan for Hezhou Municipality (yes/no)

To reduce discharge of water pollutants:

4) People provided with access to improved sewer systems under the project (number);
5) Volume of Biological Oxygen Demand (BOD) pollution loads removed by the completion of the sewer system under the project (disaggregated by the sewer system constructed in the south of the He River, and the one in the north of the He River) (metric tons/year)

III. PROJECT DESCRIPTION

A. Project Components

18. This project aims to improve flood risk management, reduce water pollution, and improve institutional coordination through an integrated system view of urban water and flood management. The five elements of the project are:

- *Connecting the system* – connect the mainstream river to tributaries to have more options to disperse flood waters along different pathways – reducing peak flows and bypassing the central urban area.
- *Enhancing drainage capacity* – in both the mainstream river and tributaries, to allow more flow along

[7] PDO Indicator 1 is defined as counting the number of people who used to be threatened by flood risks, and who are now protected by improved flood mitigation infrastructure built under the project. The number of people is defined by the flood risk maps generated through the hydraulic model, using population numbers from surveys or statistical data, and assuming infrastructure designed to protect against flooding associated with 20-year storm event (for urban drainage works) and 50-year storm event (for mainstream river flood protection works).

[8] PDO Indicator 2 will be measured for example by the flood monitoring and early warning system established, and information made available to the public (see results framework for full definition).

each pathway by improving banks, clearing silt, restoring flood zones, and removing obstructions.

- *Increasing storage and absorption capacity* – hold, store, and absorb more floodwaters in different parts of the system (lakes, channels, landscaping) with added benefit of requiring smaller pump stations.
- *Separating sewage from stormwater; fully collecting & treating wastewater* – separate storm drains from sewers in urban areas; and intercept and fully treat all urban wastewater in a dedicated sewer system.
- *Improving institutional coordination and tools for integrated water management* – establish mechanisms for multi-institution coordination, operationalized through tools such as an *Integrated Flood Risk & Urban Drainage Masterplan*, an *Integrated Flood Risk Management and Urban Drainage Operations Protocol*, and a smart water information system.

19. This project approach is structured into three components, accordingly to different parts of the system. Component 1 applies at the Mainstream He River. Component 2 applies at the urban areas, and tributary rivers and canals. And Component 3 focuses on institutions, information, and project management. The scope of these components is briefly listed below, and they are described in more detail in Annex 1.

20. **Component 1: Improving Flood Risk Resilience of the He River (Cost of US$137.55 million, with Bank financing of US$49.35 million).** The objective of this component is to reduce flood risks along the mainstream He River by connecting mainstream to tributaries, improving flood drainage capacity, removing obstructions, and upgrade river infrastructure in the mainstream channel. Specific activities under this component include:
    a) Connection of the main channel of the He River and its tributaries – in order to divert, dissipate and store flood water - through such activities as carrying out works to connect Donggan canal with Mawei tributary river and the Lining river with mainstream He River.
    b) Removal of river flow obstructions at the three in-stream power stations along the He River through such measures as: (i) carrying out facilities improvement at those power stations; (ii) acquiring and decommissioning Fanglin and Hejiang power stations; (iii) refitting the dam at Huangshi power station; and (iv) optimizing the operational rules of Xiadao power station.
    c) Improvement of flood drainage capacity along select parts of the He River through such activities as rehabilitation of the river banks, dredging silt from the riverbed and restoring flood protection zones.

21. **Component 2: Improving Urban Drainage and Wastewater Management (Cost of US$189.10 million, with Bank financing of US$74.79 million).** The objectives of this component are to reduce urban waterlogging by diverting flood waters, enhancing tributary drainage capacities, and storing/absorbing flood waters in lakes, improved canals, and elements of green infrastructure; and at the same time, reduce water pollution by separating storm and sewage systems, and providing full collection and treatment of wastewater. The specific activities under this component include:
    a) Connection of Shizigang canal to its upstream lake system to allow diversion of water away from the Hezhou central urban area.
    b) Improvement of flood drainage capacity of tributaries of the He River and related canals through such activities as rehabilitation of the banks of - as well as dredging silt on - these waterways, and restoring flood protection zones along these tributaries.
    c) Installation of sewage interceptors (approx. 15.1 km) in Babu district to separate wastewater from storm water, re-routing of the main-line sewer collectors and diversion of sewage to the Hezhou WWTP.
    d) Construction of Jiangnan sewage treatment plant (15,000 m^3/day) and associated facilities including the

pumping station, primary and secondary sewer mains (5.4 km) and access roads (5.6 km).

e) Construction of storm water control gates and installation of pump stations at the confluences of the He River and some of its tributaries.
f) Construction of water sightseeing corridor ("green ring") linking parks and green spaces with existing mountain and water system, such construction entailing inter alia embankment building, landscaping, and construction of water-centric park facilities along He River, Dongwu canal, and Donggan canal.
g) Construction of a continuous landscape belt ("green corridor") connecting the Lining River and the Changlong River with rehabilitated lake areas, green landscaped boulevards, and waterfront trails.
h) Development of an ecological and historic corridor along historic Xiyue Old Street comprising inter alia waterfront green land, constructing revetments, and integration of street with existing roads / bridges.

22. **Component 3: Institutional Strengthening, Capacity Building and Project Management (Cost of US$15.82 million, with Bank financing of US$11.32 million).** The objectives of this component are to strengthen the capacity and coordination of local institutions by using the development of an Integrated Flood Risk & Urban Drainage Masterplan as a 'Coordination Platform' for coordinated water planning and management (led by Hezhou Municipality), support the development of smart water and flood monitoring systems, and support effective project management. The specific activities under this component include:

a) *Capacity building and technical assistance*. Provision of technical assistance to support the improved coordination of water planning and management through: (i) development of an integrated coordination platform for flood risk and urban drainage management; (ii) development of an integrated flood risk and urban drainage masterplan; (iii) development of an integrated flood risk management and urban drainage operations protocol in Hezhou Municipality (iv) provision of technical assistance as well as Training and Workshops to enhance the capacity of Hezhou Municipality officials and institutions involved in water management in Hezhou Municipality; and (v) carrying out knowledge-sharing and dissemination activities about the Hezhou experience and lessons from integrated water management within China and beyond.
b) *Smart system*. Planning, designing and installation of a smart internet-based information systems for controlling Hezhou water system comprising, inter alia: (i) flood monitoring and early warning system; (ii) water quality monitoring and early warning system; and (iii) integrated water system control and optimization system.
c) *Project management*. Supporting the overall capacity of the Project Implementing Entity to coordinate, manage and supervise the implementation of the Project, including: (i) undertaking preliminary and final engineering designs and preparing bidding documents; (ii) construction supervision; (iii) procurement of third party (external) environmental and social safeguards monitoring services; and (iv) hiring of experts to constitute the Dam Safety Panel.

B. Project Cost and Financing

23. The total project cost is US$359.35 million, with World Bank financing of US$150 million and counterpart funding of US$209.35 million. The IBRD Loan will be a US Dollar denominated, commitment-linked variable spread loan, based on six-month LIBOR plus an additional variable spread loan, with all conversion options, and level repayment amortization profile. It will have a repayment period of 32 years, including a grace period of 7 years.

24. **Retroactive Financing.** It was agreed during project appraisal mission that loan withdrawals up to an

aggregate amount not to exceed US$20,000,000 may be made for payments made prior to the date when the loan agreement is countersigned but on or after April 1, 2018, for eligible expenditures under category 1 of the disbursement table (good and works for the project). The disbursement table is set forth in section III.A of schedule 2 to the loan agreement.

Project Components	Project cost (US$ million)	IBRD Financing (US$ million)	Counterpart Funding (US$ million)
Component 1: Improving Flood Risk Resilience of He River	137.55	49.35	88.20
Component 2: Improving Urban Drainage and Wastewater Management	189.10	74.79	114.31
Component 3: Institutional Strengthening, Capacity Building and Project Management	15.82	11.32	4.50
Total Project Costs	**342.47**	**135.46**	**207.01**
Financial Charges during Construction	16.88	14.54	2.34
Total Financing Required	**359.35**	**150.00**	**209.35**

C. Lessons Learned and Reflected in the Project Design

25. ***Ensure coordination and integrated planning among different line departments.*** A typical shortcoming in integrated water resources management is that planning and implementation is fragmented, with several different agencies having separate responsibilities and making separate agency plans and operational decisions in an uncoordinated manner. In Hezhou, the institutional complexity reduces the effectiveness to manage water resources and floods. Similar Bank-financed projects, such as the Uberaba Project in Brazil (P089011, BR Municipal APL1: Uberaba, closed in 2013), have shown how better coordination among water agencies and stakeholders can improve strategic planning and help to develop harmonized and integrated management options for urban infrastructure investments and for operation and maintenance of assets. These lessons are applied in this project by setting up formal mechanisms for coordination of municipal institutions during the preparation/design stage, the implementation stage, and the ultimate operational stage. During preparation, all of the municipal government line departments participated in analysis and design activities - including reviewing results from the project's hydraulic flood risk model and the preliminary designs for facilities and infrastructure. In this process, the agencies were better able to understand how the project integrates with the various water-related masterplans in Hezhou. To ensure continued coordination during the project implementation and operations, the project will establish an *Integrated Coordination Platform for Flood Risk and Urban Drainage Management* ("Coordination Platform", to be headed by Hezhou Municipal Government), and will also develop an *Integrated Flood Risk & Urban Drainage Masterplan* and an *Integrated Flood Risk Management and Urban Drainage Operations Protocol* ("Operations Protocol"). The "Coordination Platform" will be comprised of leaders from relevant agencies in Hezhou, and will be responsible for coordinating technical, institutional, and policy matters. The masterplan will integrate the operations and investments of multiple institutions and will include recommending management policies and projects that can be implemented by the respective agencies. The "Operations Protocol" will set out specific operational parameters and rules to be followed by the relevant water and land-use planning

agencies responsible for operating various parts of the Hezhou flood management and urban drainage system, thus ensuring coordinated operations, including during periods of flood and other emergency events. Decision-making and coordination will also be facilitated by accurate and readily available information to be provided by the smart water system.

26. ***An integrated flood management plan should be used, and it also should take into account the needs of the population, including the vulnerable people***. International experience, such as the Bank-financed project in Poland (Odra-Vistula Flood Management Project, currently under implementation, P147460) suggests that project strategies need to consider a holistic cost-benefit approach, taking into account affordability of investments and acceptable risks. Structural measures will always be needed, but focus should also be put on non-structural measures such as increasing connectivity and low-impact storage in urban water systems, coordinating system operations for water management and flood regulation, and preparing emergency response systems and protocols. This project applied these lessons to flood risk reduction in Hezhou. The overall project approach uses connected water bodies, enhanced drainage capacity, and increased storage to design holistic flood management system that reduced the footprint of hard infrastructure such as dikes and pump stations. The project also invests in non-structural measures such as a early flood warning systems geared toward meeting the needs of the vulnerable members of the community. Other Bank-financed projects, such as the Jiangxi Wuxikou Integrated Flood Management Project (currently under implementation, P128867), have shown the importance of communication and education campaigns, and flood warning systems that prioritize risk communication and responses to women, children, elderly, and disabled members of the community.

27. ***Minimize land acquisition and resettlement.*** Complications around land acquisition and resettlement can lead to project delays, complaints from land owners, and/or changes to technical designs to fit available land - all of which can affect project implementation. For instance, in the Nanning Urban Environment Management Project (also located in Guangxi province; the project closed on June 30, 2016, P108627), land acquisition challenges caused planned river rehabilitation works to be dropped, and the project closing date to be extended by six months. This project aimed to minimize the total amount of land to be acquired, and to better manage the land acquisition process in a number of ways. During the alternatives analysis and design of the project preparation, land requirement was one of the key factors in selecting specific project interventions. Another measure was to consider phasing of the river and lake rehabilitation activities: a step-wise approach with targeted smaller-scale, shorter-term interventions was selected rather than a large-scale project that would be disruptive to the environment. Finally, the government was involved early in the process to plan decisions on land acquisitions. As a result of these efforts, the project has a design with an overall reduced amount of land for acquisition and resettlement, with the added benefit of reducing the amount of counterpart funding needed, and thus reducing implementation risks.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

28. The institutional arrangement for the project is shown in Figure 1 below. A Project Leading Group (PLG) has been established at the municipality level. The PLG is chaired by the Mayor of Hezhou, and its key members include: Hezhou Development and Reform Commission (DRC), Hezhou Municipal Finance Bureau (HFB), Hezhou Water Resource Bureau (HWRB), Hezhou Municipal Engineering Administration Bureau (HMEAB),

and Hezhou Environment Protection Bureau (EPB), as well as other agencies involved in the project preparation and implementation. The PLG will be responsible for strategic project oversight and providing guidance to the PMO and PIUs throughout the project preparation and implementation.

29. The Hezhou Project Management Office (PMO) has also been established as an affiliated body to the Hezhou Development and Reform Commission (DRC). The three Project Implementing Units (PIUs) are: Hezhou Water Resource Bureau (HWRB), Hezhou Municipal Engineering Administration Bureau (HMEAB), and Hezhou Environment Protection Bureau (HEPB).

30. Additionally, Component 3 of the Project (*Institutional Strengthening, Capacity Building and Project Management*) establishes a "Coordination Platform" (headed by Hezhou Municipality) to lead multiple agencies in the development of an Integrated Flood Risk & Urban Drainage Masterplan. Convening this "Coordination Platform" and integrated plan will be the responsibility of the PLG and will provide a valuable venue for agency coordination and integrated management of water affairs in Hezhou. The "Coordination Platform" will be established and functional during the first year of project implementation.

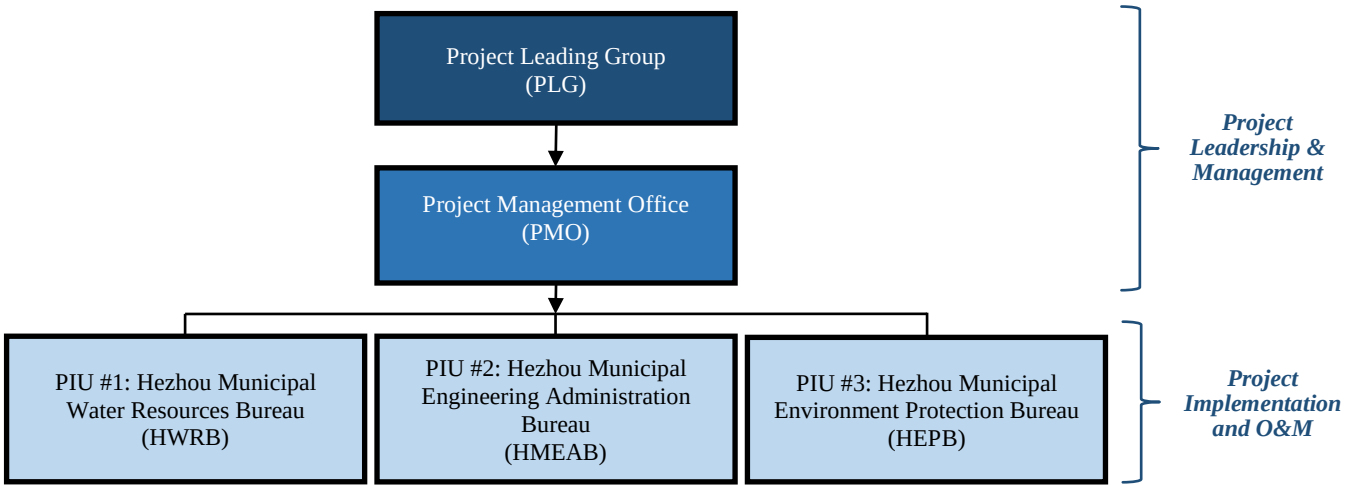
31. The PMO will be responsible for overall project coordination, preparation, management, supervision, and external monitoring (i.e. Sub-component 3.2); as well as the dam safety panel and the integrated master planning of Sub-component 3.1. In order to contribute to coordinated implementation, a Construction Supervision Engineer will assist the PMO to perform common supervision over the contracts executed by all three PIUs and will also have a role to ensure that the integrated management design principles are maintained throughout. The three PIU agencies will also be responsible for operating the facilities that will be constructed under this project, and following the project-developed "Integrated Flood Risk Management and Urban Drainage Operations Protocol" (to be led by Hezhou Municipal Government (HMG) in order to ensure that water management systems and flood control infrastructure are operated in a coordinated manner over the long-term. Below are the roles and responsibilities of each PIU:

    - ***Hezhou Water Resource Bureau***: to plan and implement the subprojects; to operate the assets for flood risk resilience and urban drainage improvement under Components 1 and 2; to prepare and implement the development of the Integrated Flood Risk & Urban Drainage Masterplan (under the leadership of the HMG), along with the associated TAs under Component 3; and to coordinate with State-Owned Enterprises (SOEs) operating the power stations along the He River.
    - ***Hezhou Municipal Engineering Administration Bureau***: to plan and implement the subprojects; to own the assets for sewerage collection and treatment under Component 2; to be responsible for contracting/outsourcing the O&M of said facilities; and to implement the associated TAs under Component 3.
    - ***Hezhou Environment Protection Bureau***: to plan and implement the subprojects; and to operate the asset for environment and ecological monitoring under Component 3.

32. The Hezhou Municipal Government (HMG) will play an important leading role in the project. The HMG will chair the PLG. HMG will also be the 'owner' in charge of the Integrated Flood Risk & Urban Drainage Masterplan developed under the project (although HMG will delegate the preparation and implementation of the integrated plan to the Hezhou WRB). The HMG will also be the head of the "Coordination Platform" established under the project; and HMG will take charge to ensure that the "Operations Protocol" is followed by all relevant water agencies during the operational stage of the project (i.e. after project design and implementation). This "Operations Protocol" specifies how the different water agencies operate their assets

in a coordinated way, particularly in times of emergency or flood.

Figure 1: Project Institutional Arrangement Diagram



B. Results Monitoring and Evaluation

33. Monitoring and Evaluation (M&E) will be done by an experienced consultancy team, including an external social monitoring consultant, and with the support of the PMO, PIU, and the current Design Institute. The team will: (i) prepare the design of an M&E system (ii) carry out a baseline survey for the key performance indicators; and (iii) prepare an M&E baseline survey report during Project preparation. The designated institute, with support of the PMO and PIUs, will also carry out M&E activities during project implementation, including: (a) collect data; (b) analyze and evaluate performance based on data collected; and (c) prepare semi-annual M&E reports.

C. Sustainability

34. The flood management aspects of this project will be sustainable in the long-term because of Hezhou municipal government's strong commitment to reducing vulnerability to floods, and because of the "Coordination Platform" and "Operations Protocol" to be established under the project. Hezhou has been assigned by the Chinese central government as a pilot city for integrated multi-agency urban planning, and this project helps to achieve that mandate. The three agencies most responsible for water management in Hezhou (HWRB, HMEAB, and HEPB) were actively involved in the project preparation and design and will continue as the PIUs. The “Coordination Platform” and “Operations Protocol” defined in Sub-Component 3.1 serve as long-term, sustainable mechanisms to integrate the planning and operations of the PIUs and other agencies responsible for aspects of water management in Hezhou (including through the development of an Integrated Flood Risk & Urban Drainage Masterplan, as well as through their ongoing operations.

35. The wastewater aspects of this project will be sustainably operated in the long-term via an outsourced service agreement with a public-private company. Hezhou Municipal Government for the past number of years has entered a concessional agreement, setting up a joint-owned public and private service provider to operate

and maintain the city's water supply and wastewater management facilities (with an ownership split of Beijing Enterprise Water Group 75 percent, Hezhou municipality 25 percent). The current service provider is a state-owned company publicly-listed in Hong Kong SAR, China that manages water supply and wastewater treatment systems, with a capacity of 15,000m^3 wastewater treatment per day; the additional capacity undertaken under this project is a small part of their overall service operations around China. A company with the same or equivalent experience would be expected to also operate the new system developed under this project (subject to receiving the contract). One typical concern with wastewater utilities in China is that wastewater fees are typically too low to cover operating costs. However, HMG has already committed to providing financial support to the service provider in order to meet any financial gap in operating costs and depreciation. According to the project Financial Analysis, HMG will need to provide additional resources of RMB 4.46 million in the first year of operation, to RMB 3.69 million in the fifth year. This amount of subsidy is not large (around 0.1 percent of total HMG's budget), so the sustainability risk of the WWTP is low.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

36. The overall project risk is Substantial. Specifically, the following key risks were identified during project preparation, and which might influence project implementation.

37. **Technical design of the project (Substantial):** Complexities in integrated technical designs, and required institutional coordination pose risks in the project. Preparing the feasibility study report (FSR) required high technical competency, as well as accurate hydrological and topographical data to support the calibration of the hydraulic modelling. To mitigate these risks, the project engaged a highly technically proficient Design Institute to prepare the FSR; and a robust hydraulic and flood risk model was developed and deployed in preparing all of the engineering designs. Additionally, the technical options proposed under the project need to integrate water masterplans of different sectors and require consultation with multiple water administrative institutions. This technical coordination has already begun in the project FSR and design stage and relied on the strong leadership at the municipality level. This coordination will continue, which will further mitigate project risks, through the coordination committee and Integrated Flood Risk & Urban Drainage Masterplan activities.

38. **Institutional Capacity for Implementation and Sustainability (Substantial)**. Although several cities in Guangxi province have extensive experience in managing externally-financed projects[9], the PMO and the PIUs for this project in Hezhou are inexperienced with managing World Bank financed projects. Their project management capacity and technical expertise to manage and supervise operations are also limited. To mitigate this risk, an experienced consultant team—with project management and contract supervision experience—will be hired by PMO at the beginning of project implementation to provide advisory services to the PIUs and support them in building their project management capacity. The Bank team will also advise the PMO and PIUs through regular supervision missions and capacity building trainings. In terms of

[9] First-tier municipalities in Guangxi (including Nanning, Liuzhou and Guilin) have been engaging with international financial institutions such as the World Bank and the Asian Development Bank (ADB) for more than a decade to improve their flood protection infrastructure and surface water quality. Each of these cities has successfully implemented two World Bank financed urban environment projects. The central government and the Government of Guangxi intend to continue engagement with the World Bank, and particularly to focus on infrastructure development in second-tier cities of the Province.

institutional sustainability, as mentioned earlier, this project was designed to include strong institutional arrangements that will contribute to long-term sustainability.

39. **Fiduciary (Substantial)**. The project will be implemented by the PMO and municipal agencies, HWRB, HMEAB, and HEPB. These agencies have limited financial management capacity, and limited experience with either large-scale national investment projects or internationally financed projects. To mitigate the risk, financial management during implementation will be carried out by qualified staff with financial management experience in implementing large scale infrastructure projects, and the project will maximize the use of existing internal controls in the above three PIUs. In addition, an experienced consulting company will be hired under the project to provide further quality assurance in financial management and performance. The Bank will also provide necessary guidance and training to the project financial staff as needed.

40. The total investment from this project is around US$359.36 million, with US$209.36 million financed through counterpart funds. The overall counterpart funding has already been agreed upon and the funds for 2018 have already been secured, including the fund allocated by the Ministry of Water Resource. Nonetheless, timely provision of counterpart funding remains a risk to be considered that could affect smooth project implementation. To mitigate this risk, the Hezhou Municipality has developed a realistic counterpart funds contribution plan – specifying the source, amount, and timeframe for allocations, which the Bank team will monitor frequently.

41. **Environmental and Social (High):** During the project implementation, adverse risks on social and environment impacts such as resettlement, solid waste production, water pollution, etc. are expected as a result of the associated construction works, dredging of the canals, river diversion, and land acquisition. Particularly, during the implementation phase, an increase in sludge volume due to the dredging of rivers and canals is expected, and attention should be paid to the whole process of dredging, transportation, treatment and final disposal; the EA process also identified some Physical Cultural Resources (PCR) sites to be indirectly affected by project implementation. To minimize these risks, the Hezhou municipality has been working closely with the design consulting firm to produce technical design options that entail a minimum of social and environment disruption during project implementation. The Bank team has worked closely with the Hezhou municipality ensuring that all risks and mitigation measures have been included in the environmental and social monitoring frameworks. In addition, the municipality will hire and provide capacity building to its staff to increase its capacity in monitoring and supervision of the adverse project risks. Finally, experienced safeguards monitoring consultants will also be hired by the PMO to ensure that for the selected option, all Bank safeguard procedures are followed.

42. This project also has potential social risks: notably, there is a significant population that will need to be resettled from the flood-prone areas that will be upgraded and improved under the project. Because the resettlement activities will be managed by the local government, there is some risk that local funding will not be sufficient for proper resettlement activities. This project will improve flood risk management, reduce water pollution, create green ring and corridor in the city, thus fitting in the Municipality's development strategy that will substantially improve living conditions of local people. Because of this, they will prioritize the project, and has already approved the counterpart funding. Another social risk from the planned resettlement is that the resettlement sites might not be built up at timely manner. In case some displaced families might have to spend transitional period prior to the completion of the resettlement sites as scheduled, a transitional fee will be paid by the government on a monthly basis. However, the social survey

conducted as part of project preparation has shown that most of the affected people accept the resettlement plan, see the benefits from avoiding flood risks, and are also see the value of the better living environment and increased property values produced under the project. Therefore, through the project preparation, these social risks have been substantially mitigated.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

43. **Economic analysis.** A cost benefit analysis was carried out to assess the economic viability of the project investment over a 30-year period, inclusive of a five-year construction period at an economic discount rate of 6.0 percent. Economic benefits and costs of the project were identified and quantified, based on design optimization. Quantifiable economic benefits consist of avoided public and private costs of flood damages and boosted local economic outputs especially in the floodplain where land value has long been suppressed due to heightened flood risk. Moreover, the investment will also generate environmental benefits along with less quantifiable public safety and health benefits. The economic impact of the flood risk management component was quantified as the difference between the with- and without- project scenarios. The physical impacts of a flood were assessed using a hydrological and hydraulic simulation model and were then converted to economic values based on the historical records of major floods.

44. The project investment in flood mediation is estimated to yield an economic internal rate of return (EIRR) of 11.6 percent in avoided flood damages alone, and 13.2 percent after taking into account its additional boosting effect to the local economy, using a conservative 5.0 percent land appreciation in the flood-prone area as a proxy. In either case, the EIRR exceeds the hurdle rate of 6.0 percent. Thus, the project investment is economically justified. To test the uncertainty of cost estimates, a sensitivity analysis was conducted; with results suggesting that even with total costs (both investment and O&M costs) being 20 percent higher, the total project as well as its components would still yield EIRRs exceeding 6.0 percent. Additional details are provided in Annex 2.

45. **Financial Analysis.** A financial analysis was carried out to assess the impact of the project on local government finances, and to assess the financial sustainability of the proposed Jiangnan WWTP. The financial analysis conducted for Hezhou Municipality, shows that the initial capital investment for project construction and implementation (through the provision of counterpart funds) may pose substantial financial pressure during project implementation, as Hezhou Municipality Government's fiscal revenues rely heavily on transfer payments received from upper level governments. Hezhou Municipality needs to seek grants from central government to contribute to the project. Some high-value funds at the central government level have already been secured to support the World Bank project, particularly through the Ministry of Water Resources' Pearl River Water Resource Commission. This Commission approved in 2012 a RMB470 million fund at the Central Government level to support Hezhou Municipality to implement a program to improve flood-related infrastructure. As of December 2017, a RMB270 million fund had been disbursed to finance some dikes and roads constructed between 2013 and 2016. This program is still on-going and has an undisbursed RMB200 million fund available to support the planned remaining flood-related infrastructure in the city. These remaining flood-related infrastructures will be part of the World Bank project, jointly funded by the World Bank loan and the undisbursed fund allocated by the Ministry of Water Resource. Therefore, before implementation of the World Bank project starts, the RMB200 million (US$30 million) in counterpart funds

has already been secured for Component 1. However, the provision of counterpart funds during project implementation remains a financing risk. HMG's contribution to the project will likely to pose some financial pressure on HMG's fiscal expenditures of other activities, which poses moderate financing risk during implementation. To mitigate this risk, HMG has developed a realistic counterpart funds contribution plan – specifying the source, amount, and timeframe for allocations, which the Bank team will monitor frequently.

46. At the implementing entity level, a financial analysis was carried out to assess the longer-term operational sustainability of the Jiangnan WWTP, the sewer mains, and the pumping station. After construction, Hezhou Municipal Engineering Administration Bureau (HMEAB) will setup an entity to operate or outsource the operation of the assets of sewer mains and WWTP to a professional operator. In the analysis, a proxy was used to simulate the operation and maintenance costs of Jiangnan WWTP, using the operating WWTP in Hezhou Municipality. According to the analysis, to ensure financial sustainability of Jiangnan WWTP, the wastewater tariff should be increased from current RMB0.97/m^3 to RMB1.41/m^3. The tariff increase will help increase revenues to be more in line with operating costs. Until cost recovery tariffs are in place, HMG would need to provide financial support to ensure the financial sustainability of the Jiangnan WWTP. Additionally, HMG has already committed to providing financial support to subsidize operating costs and depreciation of the WWTP built under this project. This operational financial support is affordable to HMG, and the sustainability risk of the WWTP is low – because the amount of the subsidies is not large (around 0.1 percent of total HMG's available budget).

B. Technical

47. The preparation and preliminary designs for this project have been completed and are technically sound. The PMO and qualified design institutes prepared a high-quality feasibility study report and project implementation plan. All of the relevant Hezhou urban and water masterplans were consulted in the project design phase, detailed analysis and simulations were carried out using a hydraulic flood risk assessment model, and detailed alternative analysis was used to select the most beneficial, cost effective investments for the project. Finally, mitigating the effects of climate change was considered in the project, both in terms of improving urban resilience, reducing GHG emissions. Relevant notes for these technical factors are briefly described below, and additional details can be found in Annex 1 and the project files.

48. **Consultation of Hezhou Masterplans**: Hezhou municipality has already issued a number of relevant plans for urban development and water management. These plans were consulted and used to guide the project analysis and design. Specific requirements stated in the relevant plans will be adhered to, and all project investments will, to the extent possible, contribute to the overall vision and intent outlined in the plans. The list of plans consulted include: *Master Urban Plan for Hezhou (2009-2030); Urban Flood Control Planning Report for Hezhou, Guangxi Province (2015-2030); Master Plan for the City Ring Water System Project for the Ecological Town of Hezhou (2014-2030); Plan for Urban Drainage & Water Logging Control in Hezhou (2016-2030); Special Plan of Sponge City, Hezhou;* and *Special Drainage Plan for Urban Area of Hezhou (2010-2030)*.

49. ***Flood Risk Modelling:*** In this project, an *integrated analytical model* was built to simulate flood risk and compare different flood risk mitigation measures. To help design and determine the effectiveness of flood risk management interventions (Component 1 and 2), the hydrodynamic model was used to simulate scenarios of flood conditions and flood damage from storms of different recurrence periods. Multiple flood risk mitigation interventions were considered and *modelled as alternatives* in the hydrodynamic model to verify their functionality and effectiveness; and these simulations were then used in the project's economic

analysis to assess the costs of flood damage. In the end, the project selected a combination of structural and non-structural interventions that provided sufficient flood risk benefits at a cost affordable to Hezhou Municipality. Structural measures (such as the river diversions, levees, embankments, dredging, etc.) are selected and designed to handle the runoff generated by the 20-year design storm. Non-structural measures, such as a flood early warning system and an emergency preparedness/responsiveness plan will be adopted to help minimize losses caused by flooding from storms above the design standard.

50. ***Climate Change Considerations:*** The hydrodynamic modeling approach used for this project also allows consideration of the expected changes in rainfall and flooding as a result of climate change. Based on some projections for the Pearl River Basin (where Hezhou City is located), annual precipitation and temperature levels are predicted to rise in the future, as a result of climate change. Rising precipitation levels have the potential to increase flood frequency and severity, which can cause potential loss of lives, temporary displacement of people, damage to infrastructure (such as roads, houses, public utilities, etc.), and negative impacts on the economy in Hezhou. For this project, a number of climate adaptation and mitigation aspects were considered.
    - *Resilience to potential increases in rainfall*: There is considerable uncertainty in the predicted effects of precipitation. While an overall trend of increased rainfall is predicted, it is not expected that there will be an abrupt change in precipitation patterns, but rather smaller, gradual increases over time. In this project, because the design rainstorm and design flood were already designed quite conservatively, the project's design provides a sufficient buffer to cope with uncertain climate change variability. As noted above, the project's physical interventions were designed to protect against the floods resulting from the 20-year storm; and the project has also planned non-structural disaster contingency plans, early warning systems, and communication systems, which will specifically help with adapting to climate change.
    - *Project Related GHG Emissions Analysis*: A GHG accounting analysis was carried out to estimate the reduction in emissions as a result of project investments regarding the potential emissions from the new WWTP in Jiangnan under Component 2. On average, the net annual GHG emission reductions from the project's investments in new Jiangnan WWTP (displacing septic tank use) and improved wastewater collection (improving wastewater collection going to the Hezhou WWT) is 1,697 tCO2-eq per year. Further details on the GHG accounting can be found in Annex 1.

C. Financial Management

51. An assessment was made of the financial management (FM) arrangements of the PMO and three PIUs (HWRB, HMEAB, and HEPB) under the project. It was determined that the existing internal controls of the PMO and PIUs as well as GPFB, satisfy the World Bank's requirements under OP/BP 10.00. Basic elements of the internal control system that are in place comprises, but is not limited to, the following: (a) the PMO will be responsible for primary FM activities, including, but not limited to: providing guidance to PIUs' FM work, reviewing expenditure reporting and financial reports submitted by the PIUs, consolidating and submitting project financial reports to the World Bank in compliance with legal documents, and overseeing of the project activities; (b) GPFB will oversee the project designated account (DA) and the use of the Bank loan for its intended purposes; (c) each PIU will conduct appropriate FM duty segregation and apply financial controls; (d) the PMO has prepared the project financial management manual (FMM) to unify the FM work of PMO and PIUs; and (e) Guangxi Provincial Audit Office will conduct an annual external audit to evaluate the performance of the overall internal control system.

52. Furthermore, the FM roles and responsibilities for different project entities are identified as follows:

- The PMO will prepare detailed annual work plans and budgets (AWPB), to be approved by the PLG. The PMO will submit the approved AWPB to the World Bank, for review and no objection.
- A Project Designated Account (DA) will be set up and managed by the GPFB; and loan proceeds from the World Bank will flow into this account. To ensure proper usage of project funds, payment requests will be prepared by PIUs and reviewed by the PMO and GPFB as well as Hezhou Municipal Finance Bureau (HMFB). The World Bank loan proceeds will be disbursed from the DA by GPFB to HMFB and then to contractors or PIUs based on the Withdrawal Application (WA) instructions.
- The PMO and PIUs will manage, monitor, and maintain project accounting records by establishing a separate cost center for the project activities within their existing accounting system, either manual or computerized, in accordance with Circular #13: "Accounting Regulations for the Bank-financed Projects" issued in January 2000 by MOF.
- The PMO will prepare the consolidated Interim Financial Reports (IFR) and submit to the World Bank within 60 days after the end of the calendar semester period. The PMO and each PIU will also annually produce their standalone project financial statements, which comply with MOF requirements and acceptable to the Bank.
- The PMO will submit audited project financial statements satisfactory to the World Bank every year during the life of the project within six months after closure of each fiscal year.
- Disbursements under the project will be carried out in accordance with the provisions of the Disbursement Guidelines ("World Bank Disbursement Guidelines for Investment Project Financing" dated February 2017), the Disbursement and Financial Information Letter (DFIL), and the Loan Agreement. The GPFB will open and manage the DA in a commercial bank acceptable to the Bank. Further details on the disbursement arrangements are provided in the project's DFIL and Loan Agreement.

D. Procurement

53. **Applicable Procurement Rules and Procedures.** Procurement for the project will be carried out in accordance with the World Bank's Procurement Regulations for IPF Borrowers, dated July 2016 and revised November 2017 as required by the provisions of the Loan Agreement. Also applicable to the project will be the World Bank's Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants, dated October 2006, and thereafter revised in January 2011 and July 1, 2016. In this project, the Bank's planning and tracking system, (Systematic Tracking of Exchanges in Procurement, STEP) will be used to prepare, clear and update Procurement Plans and conduct all procurement transactions. Accordingly, all the procurement activities under the proposed project will be entered into, tracked, and monitored online through the system.

54. **Procurement Risk Assessment (Moderate).** The procurement risk is rated as Moderate. The Hezhou Project Management Office (PMO) has been established and will be responsible for overall project coordination, preparation, management and supervision, while the three PIUs, namely HWRB, HMEAB and HEPB, will be responsible for procurement, contract signing and implementation of those activities under their respective components or sub-components. The procurement capacity assessment of the PMO and the three PIUs determined that these agencies and their staff do not have experience with Bank procurement procedures. However, the PMO is affiliated to the Hezhou Development and Reform Commission (DRC) and has a strong capacity in coordinating different government agencies within the government, and the three PIUs have the experience in carrying out procurement and implementation of works, goods and consulting services contracts financed by the counterpart funds. The key risks identified by the procurement capacity and risk

assessment were: (a) inaccurate cost estimates; (b) possible delays and/or non-compliance because of differences between the Bank Procurement Regulations (November 2017) and domestic procurement practice; and (c) inadequate contract management practices. With implementation of the proposed actions to strengthen procurement capacity (see below), the assessment concluded that the PMO and the three PIUs will have adequate capacity to carry out procurement activities of the project.

55. **Mitigation Measures.** Mitigation actions are proposed to enhance the procurement capacity of the PMO and three PIUs and to strengthen procurement and contract management under the project and to mitigate potential procurement risks have been agreed as follows:
    - A procurement agent with experience in World Bank and other multilateral institutions financed projects was hired by the PMO in August 2017 to assist the PMO and the PIUs in procurement of goods, works, non-consulting services and consulting services.
    - A project management consulting firm will be hired by the PMO to assist the three PIUs in reviewing the procurement documents, including commercial parts, technical specifications, bills of quantities, designs, terms of references (TORs) for all civil works, goods, non-consulting and consulting services. A resident supervision firm will be hired to assist the PIUs in supervising the contracts on-site during construction.
    - The PMO and PIUs, project management consultant and/or the Procurement Agent's representatives will be included in the bid evaluation committee. The PMO's representatives will be present and witness the bid evaluation, introduce the Bank's policies on the evaluation and clarifications and the main requirements in the RFP and RFB documents before the evaluation starts. If the evaluation experts are identified to have no knowledge or experience in procurement under the Bank or other International Financial Institutions (IFIs) financed projects, they should be trained on the site before the evaluation.
    - The PMO and PIUs have sent their staff to attend procurement training on the Bank's new Procurement Regulations and will continue to do so throughout the project implementation.

56. Project Procurement Strategy for Development (PPSD). Based on the Procurement Regulations, a Project Procurement Strategy Document (PPSD) has been developed for the project by the PMO with the Bank team's support. The PPSD informs that the local market will be interested and is capable to execute the contracts (goods and works) included in the project. Works and goods will be procured through open competition by approaching the national market, following national procurement procedures, and using the harmonized model bidding documents agreed with the Bank. Nevertheless, foreign contractors are still allowed to participate if they wish to do so. For the consulting services including project management and construction supervision, Quality-and Cost-Based Selection (QCBS) will be used for selection of the consultants, which will be carried out through Open Competition by approaching international markets considering that the participation of foreign firms is most likely to achieve the best fit-for-purpose and value-for-money, especially for the project management consulting services.

57. **Procurement Plan**. Based on the PPSD, the procurement plan for the project has been prepared by the PMO and is acceptable to the Bank. The Procurement Plan will be updated at least annually to (a) reflect project implementation; (b) accommodate changes to be made; and (c) add new packages as needed for the project.

E. Social (including Safeguards)

58. **Involuntary Resettlement (OP4.12).** The Bank safeguards policy of Involuntary Resettlement is triggered. A resettlement action plan (RAP) was prepared for the project, which describes the adverse impacts related to land acquisition and structure demolition required for this project, along with the arrangements and

measures planned to mitigate them. The RAP aims to ensure that income and living standards are improved (or restored) for all project-affected people, and this is compliant with World Bank Policy OP 4.12 on Involuntary Resettlement. Special care has been taken in resettlement planning to ensure that rehabilitation measures are sufficient in urban and peri-urban areas where the proportion of low-income families is comparatively high.

59. A number of studies and surveys of the project areas were conducted, including: an inventory of affected assets, a census of the affected people, a social assessment, and consultations with local government agencies. According to these studies, the project will affect 21 villages/communities in two municipal districts in the urban and peri-urban areas of the city. Permanent land acquisition in villages will be about 251 hectares of collective land and temporary acquisition of about 70 hectares. Structure demolitions will total 164,192 square meters, including 93,207 square meters of living housing spaces, 49,278 square meters of shelters, 14,249 square meters of municipal administrational units, and 7,458 square meters of state owned shops (with 124 employers). The project will affect a total of 1,880 families/units, having a total population of 10,044 people (including the people who will be affected by land acquisition, housing demolition, temporary land uses at the period of project civil works, workers in enterprises, and shop owners). Among these, the permanent land acquisition will affect 759 families (with a total of 4,563 people). The housing demolitions will affect 690 families with a population of 3,105 (including 373 families with 1,837 population in rural areas, and 317 families with 1,268 population in peri-urban areas). Most peri-urban villagers, however, derive relatively little or no income from agricultural production. In each case, compensation rates meet or exceed legal requirements and meet or exceed replacement cost valuation. Villagers themselves decide on appropriate rehabilitation measures and social security will be an alternative livelihood restoration measure to mitigate the adverse impacts.

60. The RAP includes several features that go beyond minimum resettlement requirements. These include: a) special arrangements for poor and vulnerable households to obtain subsidized rental apartments or to obtain discounts and subsidies on purchase of replacement housing; and b) a scheme to provide households losing very small residential units with additional compensation so they may purchase replacement housing meeting community minimum size standards. Moreover, every displaced person will be entitled to purchase “economically suitable” apartments.

61. A number of other points relevant to land acquisition and resettlement area as follows:
    - The project cut-off-day for accounting the resettlement impacts was set as the day of March 15, 2016. This day was the starting day for resettlement census survey and agreed up by the project authority.
    - Relatively minor design changes are likely to continue until implementation. Typically, final designs result in marginal decreases in land acquisition and structural demolition, as well as changes in proportion among categories of affected land and structures.
    - Screening for ethnic minority communities was undertaken, and the analysis concluded there are no such communities in the project areas. As such, an *Indigenous People Development Plan* was not triggered.
    - A resettlement policy framework was prepared as a guide if additional involuntary resettlement occurs.
    - Due diligence reviews were undertaken. Six local-funded projects were identified as linked projects. The review concluded there were no legacy resettlement issues and no further actions were requested. Out of these six linked projects, four projects had been completed while two projects are being implemented at the time of project appraisal. Delay of these two linked projects will not cause the delay of the project implementation.

62. **Implementation Arrangement:** The PIU will be responsible for the resettlement funds. All the resettlement funds will be paid by cash to the property owners through assigned local bank and the resettlement administrative management fees will be paid to the executive agencies yearly. Levels of resettlement offices from municipality, district and township/village will be established to supervise the resettlement implementation. The project city land and resources bureaus will be responsible for guiding the resettlement activities and release land approval for both the project and the resettlement sites. An experienced national consulting team will be contracted to serve as the independent monitoring agency of the resettlement program. The project will be monitored, and the living standards of the project-affected people will be evaluated over the course of project implementation. The monitoring results will be regularly reported twice a year and, if needed, remedial actions will be taken.

63. **Information dissemination:** All displaced households and village communities have been identified through the census survey. The RAP and participatory report focused on peoples' needs, and the resettlement plans have been advertised on the municipal website on December 14, 2017. Also, for those interested in the project, information and the resettlement policy will be available at no change in the Hezhou Municipal Library. Hotlines for information disclosure have been setup, and appointed staff in the project office will answer any questions related to the project and resettlement policy. Relevant project information has been provided to the affected villages through newspaper reports, posters and public meetings. A resettlement information booklet providing details regarding compensation rates, other entitlement policies and grievance procedures will be distributed to the affected people prior the resettlement implementation. The draft RAP and RPF were disclosed at Hezhou municipal website on October 20, 2017 and December 14, 2017 respectively, and at World Bank's external website on October 24 and December 17, 2017 respectively.

64. **Citizen Engagement:** The project has significant social benefits, as it supports the improvement of municipal infrastructure, the enhancement of flood management in both urban and peri-urban areas, the improvement to citizens' living environment, and the promotion of village-based and rural family-based tourism development. Citizens in the city will be the project's main beneficiaries, and they will be involved in planning and supervision during the project implementation through village level supervision committees. The project will have a beneficiary feedback system in two levels: (i) establishing a hotline at the PMO level, and (ii) assigning village level supervision group to be a focal point for residents to receive any issues related to resettlement and project implementation. The village level supervision group needs to submit the complaints and issues from the residents to the PMO verbally or in writing. The PMO needs to respond to the complaints within 15 days, based on the government requirement.

65. **Participation strategy:** Focus group discussions and key informant interviews have been used to consult with potentially affected persons and the project stakeholders benefited from the project development. The primary focus of consultations has been on obtaining views to the public needs and the resettlement preferences regarding resettlement impacts and mitigation measures, including land creation and rehabilitation measures. These views and preferences have been considered during the project design, RAP revision, and the majority of potentially affected persons agree that the resettlement and rehabilitation measures planned under the RAP would be adequate to address and mitigate any adverse impacts.

66. **Social Assessment and Gender:** In preparing the RAP, a social assessment was carried out through public consultation meetings, focus-group discussions, and in-depth interviews. The assessment involved various

stakeholders (government agencies in charge of rural and urban construction, water resources management, agriculture, urban planning, and land resources), as well as village representatives and project beneficiaries.

67. This project provides particular attention to gender mainstreaming, in order to ensure that women and girls, as well as men and boys, benefit equally from the project interventions. A gender analysis, which was a part of the social assessment, reveals that women in project areas have lower participation than men in public affairs and public consultations due to their lower educational background and social and cultural norms. For example, the analysis says that only 23 percent of women participated in meetings during project preparation. This not only limits the knowledge available to women about project information, benefits, and compensation mechanisms, but it also restricts their voice and needs to be reflected in project design and implementation. Moreover, learning from a similar Bank-financed project in China (Jiangxi Wuxikou Flood Management Project), the PMO and PIU acknowledge that there is a need to revise city flood evacuation plans to take into consideration vulnerable people, such as women, children, elderly, and disabled citizens, who have not previously been paid specific attention, so that these plans become more inclusive and effective to save the lives of people in the project areas. Currently, most women engage in non-skilled labor with lower wages, although the gender analysis suggests that they are interested in seeking economic opportunities through the project. Based on these findings, the activities below have been incorporated into the project design, so as to mitigate the issues and strengthen the inclusion of genders and vulnerable groups. The PMO and the PIU (along with expert consultancy staff dedicated to these activities) are responsible for implementing these activities. Indicators tracking progress of selected activities are included in the project Results Framework.
    - Ensure that compensation paid under the project (e.g. for resettlement of project affected men and women, etc.) is equal and follows the government and Bank requirements for gender equality.
    - Establish rural community committees to involve beneficiaries in project supervision (village level supervision group should have representation of women, particularly female-headed households, and the poor). The rural community committees will engage during the project implementation stage, and participate to help the supervision company conduct construction supervision (e.g. related to river rehabilitations near urban/rural villages relevant to impacts on their livelihoods.)
    - Improve the participation ratio of women and men in public consultations and village supervision meetings (moving closer to equal participation) by organizing meetings at a convenient time and venue for women to attend. The PMO, PIUs and contractors are trained to engage with women and encourage them to be part of project implementation and supervision, so that their needs and demands are reflected.
    - Provide technical training for project affected people, particularly women and vulnerable people, at vocational schools, so that they have better chances to be employed after resettlement. Training may include (but not be limited to): business training for family-based hotel/restaurant management, housekeeping skills, raising small livestock (chickens, ducks, etc.), and small-scale garden farming for markets (mushrooms, strawberries, etc.).
    - Encourage employment of women and vulnerable people for non-skilled or non-technical jobs during project construction and O&M, such as cooking for contractors, construction and maintenance of river embankment (this applies to contractors and institutions responsible for O&M).
    - Develop a human-sensitive communication plan as part of flood risk management system, for effective evacuation for urban floods, taking into consideration of women and vulnerable people. The flood risk management system entails flood forecasting and monitoring, early warning, government and public response command and control protocols, and public communication and alert functions.

68. **Grievance Redress Mechanism**: The project will be covered by two grievance redress mechanisms: the World Bank mechanism and a project-level mechanism. The World Bank grievance redress mechanism is described in Section G below. For the project-level mechanism, different levels of agencies, such as the PIUs of the subprojects, the Hezhou PMO, the Hezhou municipal department in charge of citizen complaints, municipal courts in the city, and the resettlement monitoring institute, will be established prior to the project implementation to deal with concerns or complains related to the project from citizens. Grievances will be resolved within the standard response time (15 days), both by the PMO hotline and the village level.

F. Environment (including Safeguards)

69. The project activities anticipate diverse and significant environmental and social impacts, thus it is assigned as an Environmental Category A project. Four Bank environmental safeguards policies are triggered: (i) OP4.01 Environmental Assessment (EA); (ii) OP4.04 Natural Habitats; (iii) OP4.11 Physical Cultural Resources; and (iv) OP4.37 Safety of Dams. Full impact assessment was conducted during the project preparation following domestic EIA law and Bank safeguard policy requirements. The reports include (a) Environmental Impact Assessment (EIA) report; (b) Environmental and Social Management Plan (ESMP), including PCR management plan and the Environmental Code of Practices (ECOPs); and (c) an Environmental and Social Assessment Executive Summary.

70. **Environmental Assessment (OP4.01).** The environmental assessment concluded that the project implementation will not lead to irreversible impacts to the environment and local ecosystems. On the other hand, by adopting an integrated river rehabilitation approach, the planned and anticipated developments identified, will bring about the following overall positive cumulative impacts in the river basin: a) By 2030, the flood control system of the He River will be completed, which is designed for a return period of 50 years; b) the storm drainage capacity of Hezhou Municipality will be improved to cope with a storm return period of 20 years; c) it is estimated that the annual reduction of flood-resulting economic loss will accumulate to a total amount of RMB202.4milion by 2030; d) and in terms of wastewater management, the construction of wastewater interception and treatment facilities (including Jiangnan WWTP and wastewater interceptors under the project) in the basin will make significant contribution to the improvement of river water quality by reducing the pollutants discharge into the He River as shown in the Results Framework. The negative cumulative impacts anticipated from the project, in combination with other identified development activities, will be limited to the construction period in relation to large-scale resettlement and traffic disturbance in the city, which could be mitigated to an acceptable level with the carefully designed implementation plan and effective project management by the municipal governmental agencies.

71. The project involves extensive construction activities in the central urban areas of Hezhou Municipality, some buildings will be demolished as part of the construction, and there will be some temporary and site-specific environmental and social impacts during construction, including soil erosion, noise, dust, wastewater, solid waste, traffic disturbance and public health and safety risk. As part of the ESMP, a set of ECOPs were prepared to cope with various impacts resulting from the construction of three types of investments, including embankment, small-scale water conservancy works, roads and pipeline network.

72. As part of river rehabilitation works, the dredging of He River and its tributaries will lead to the generation of dredged material at a total amount of 184,590 m^3 (95 percent water content). The dredging process,

sediments dewatering, transportation and their final disposal has been carefully designed to minimize its potential adverse impacts on the environment and nearby communities, such as odor and noise nuisance, water pollution and solid waste pollution. Two temporary drying sites have been proposed beside the He River to dewater the dredged sediments from the main stream at Huang'ansi and Shizigang to reduce the water content to 50 percent; and the sediments from the other smaller tributaries will be directly collected and dewatered with the mobile dewatering system on the sites to the water content of 50 percent for transportation. During the EA process, two rounds of extensive monitoring of the dredged sediments have been conducted, and the analysis results confirmed that none of the tested river sediments from the project areas was classified as hazardous waste; however, the failure to comply with the Class III requirements of national soil quality standard[10] made it impossible to apply the dewatered sediments for farming and greening as the final disposal. Therefore, the dewatered sediments will be sent to the adjacent Hezhou Sanitary Landfill Site for final disposal as per the national standard requirements.

73. **Natural Habitats (OP/BP 4.04).** During environmental assessment, the survey on local aquatic and terrestrial ecosystem was conducted in the project-affected area and no critical/sensitive natural habitat has been identified. The project has been developed in an environmentally sustainable way considering the protection of local species and biodiversity. The project-related ecological impacts will be generally positive, and the anticipated adverse impacts are short-term, site-specific and limited to the construction phase. Adequate mitigation measures have been incorporated into the ESMP and ECOPs to ensure the potential adverse ecological impacts will be sufficiently addressed during construction and operation.

74. The anticipated adverse impacts during project operation are mainly related the operation of Jiangnan WWTP. Based on the EA, the impacts of Jiangnan WWTP in terms of water pollution, odor nuisance and noise impacts will be very limited. The generated 0.1t/d of screenings and 3t/d of sewage sludge will be dewatered at the Hezhou Sludge Treatment Centre to the water content of 60 percent and then be sent to the landfill site for final disposal.

75. **Physical Cultural Resources (OP/BP 4.11).** The EA process confirmed that the river rehabilitation subprojects of He River main stream (from Guangming Bridge to Lingfeng Bridge) and Huang'ansi Flood Discharge Channel will have indirect impacts on some nearby ancient buildings on Xiyue Street during construction. Particularly, the 120m-long downstream section of Huang'ansi Channel is part of the provincial-level protected historic quarter, which will require special attention and protection during construction. A PCR management plan has been developed as part of the ESMP to specify mitigation measures to avoid, minimize and compensate the project-related impacts on identified physical cultural resources. In addition, the RAP survey also found that the subproject of central green corridor will affect 53 rural households' graves, which might be viewed connecting to local tradition. All the compensation and relocation measures for the affected rural households' graves have been formally developed in the RAP based on detailed survey and extensive consultation among the owners.

76. **Safety of Dams (OP4.37).** The project investments will include the rehabilitation of three small hydroelectric stations on the He River and another eighteen existing dams upstream in the river basin were identified as relevant to the project per the policy of OP4.37 considering their potential impacts on the safety of proposed interventions.

[10] Chinese National Code: GB15618—1995

77. Two rounds of public consultation and information disclosure were conducted during EA preparation through questionnaire surveys, interviews, and public meetings. The general public, relevant governmental agencies and local experts were consulted, and their opinions have been taken into account in the project design and in EA reports. The full EIA and the full ESMP were disclosed to the public in October 2017. The EA documents were disclosed at the Bank's external website on October 22 and 23, 2017, respectively.

78. **Implementation Arrangements**. Since the PMO and PIUs have no experience with Bank-financed project, a comprehensive safeguard capacity building program has been integrated into the project ESMP to ensure adequate and effective project management in accordance with the Bank safeguards policies and procedures. The ESMP also details the environmental monitoring program for construction and operational phases to track its effectiveness. The ESMP, including the ECOPs and the PCR management plan, will be included in the bidding documents and the corresponding contracts to ensure their implementation. In addition, an experienced project management consultant will be engaged during project implementation to support day-to-day project management and construction supervision to the PMO and PIUs, including the implementation of applicable safeguards policies.

G. World Bank Grievance Redress

79. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

Project Development Objective(s)

The objectives of the Project are to improve flood risk management and reduce discharge of water pollutants in Hezhou Municipality。

PDO Indicators by Objectives / Outcomes	DLI	CRI	Unit of Measure	Baseline	Intermediate Targets						End Target
					1	2	3	4	5	6	
To improve flood risk management											
People protected by improved flood mitigation infrastructure			Number	0.00	0.00	0.00	0.00	0.00	0.00	105,600.00	105,600.00
Development and implementation of a flood risk management system			Yes/No	N	N	N	N	Y	Y	Y	Y
Completion of an integrated flood risk and urban drainage masterplan for Hezhou Municipality			Yes/No	N	N	N	N	Y	Y	Y	Y
To reduce discharge of water pollutants											
Number of people provided with access to improved sewer system under the project			Number	0.00	0.00	0.00	0.00	79,500.00	79,500.00	100,000.00	100,000.00
Volume of Biological Oxygen Demand (BOD) pollution loads removed by the completion of sewer system under the project			Metric tons/year	0.00	0.00	0.00	71.50	1,022.00	1,022.00	1,073.10	1,073.10
BOD removal by the sewer system constructed south of the He River			Metric tons/year	0.00	0.00	0.00	0.00	766.50	766.50	766.50	766.50
BOD removal by the sewer system constructed north			Metric	0.00	0.00	0.00	71.50	255.5	255.5	306.6	306.60

PDO Indicators by Objectives / Outcomes	DLI	CRI	Unit of Measure	Baseline	Intermediate Targets						End Target
					1	2	3	4	5	6	
of the He River			tons/year					0	0	0	

Intermediate Results Indicators by Components	DLI	CRI	Unit of Measure	Baseline	Intermediate Targets						End Target
					1	2	3	4	5	6	
Component 1: Improving Flood Risk Resilience of the He River											
Length of river rehabilitated to improve flood risk management and prevent water pollution			Kilometers	0.00	0.00	1.23	4.94	17.55	36.69	68.14	68.14
Component 2: Improving Urban Drainage and Wastewater Management											
Length of sewer pipeline constructed			Kilometers	0.00	0.00	13.28	13.28	13.28	13.93	16.93	16.93
Sewer pipelines constructed south of the He River			Kilometers	0.00	0.00	5.38	5.38	5.38	5.38	5.38	5.38
Sewer pipelines constructed north of the He River			Kilometers	0.00	0.00	7.90	7.90	7.90	8.55	11.55	11.55
Number of water quality monitoring stations constructed and operational			Number	0.00	0.00	0.00	4.00	4.00	4.00	4.00	4.00
Component 3: Institutional Strengthening, Capacity Building and Project Management											
Number of person days of training for local officials and staff (person-time)			Number	0.00	55.00	110.00	165.00	220.00	275.00	330.00	330.00
Percentage of women in rural community committees			Percentage	0.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Number of person days of employment/ vocational training for local women(person-time)			Number	0.00	50.00	100.00	150.00	200.00	200.00	200.00	200.00

Percentage of grievances received and responded			Percentage	0.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
An integrated 'coordination platform' for flood risk and urban drainage management is established and functioning			Yes/No	N	Y	Y	Y	Y	Y	Y	Y
An integrated flood risk management and urban drainage operations protocol is prepared			Yes/No	N	N	N	Y	Y	Y	Y	Y

Monitoring & Evaluation Plan: PDO Indicators	
Indicator Name	People protected by improved flood mitigation infrastructure
Definition/Description	This indicator is measured as the number of people who live in areas that were previously flood-prone, and which are now are no longer flood-prone, as a result of the project. The flood-prone areas (before and after) are identified by the flood risk maps generated through the hydraulic model, and assuming project infrastructure designed to protect against flooding associated with 20-year storm event (for urban drainage works) and the 50-year storm event (for mainstream river flood protection works). The population in those areas is determined from surveys or statistical data.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Development and implementation of a flood risk management system
Definition/Description	This indicator measures whether or not a flood risk management system has been established and implemented under the project. The flood risk management system includes: flood forecasting and monitoring, early warning, government and public response command and control protocols, and public communication and alert functions; with information available in the public domain. In particular, the flood risk management system (including public communication functions) is designed to be 'human-sensitive', with effective flood evacuation plans taking into consideration diverse and vulnerable populations (i.e. women, children, elderly, disabled citizens, and poor citizens, etc.)
Frequency	One time event (by Year 4)
Data Source	Confirmation of actual completion and functioning of the system
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Completion of an integrated flood risk and urban drainage masterplan for Hezhou Municipality
Definition/Description	This indicator measures the development, drafting, review, submittal, and approval of an 'integrated flood risk and urban drainage masterplan' (known here as the "masterplan") for Hezhou Municipality. The masterplan will be the responsibility of the Hezhou Municipal Government, and preparation of the masterplan may/will be delegated to the Hezhou Water Resources Bureau. The masterplan will be reviewed and approved by the Integrated Coordination Platform for Flood Risk and Urban Drainage Management (known here as the "coordination platform"; see indicator below) established under this project, and under the guidance of the Project Leading Group. The masterplan will integrate and coordinate flood risk and urban drainage plans and planning documents from relevant water and land-use planning agencies in Hezhou, and will setup mechanisms for multi-agency water sector coordination and improve the consistency and efficiency of flood and drainage in the city. The masterplan will develop specific integrated management policies and projects that can be implemented by the respective agencies.
Frequency	One time event (by Year 4)
Data Source	Confirmation of actual completion of master plan
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Number of people provided with access to improved sewer system under the project
Definition/Description	This indicator measures the cumulative number of people who benefited from improved sanitation facilities that have been constructed under the project. This includes people newly provided with access to “improved sanitation facilities”, as well as people benefiting from rehabilitation works.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs
Indicator Name	Volume of Biological Oxygen Demand (BOD) pollution loads removed by the completion of sewer system under the project
Definition/Description	This indicator measures the cumulative volume (mass) of Biological Oxygen Demand (BOD) pollution loads removed by the treatment plant supported under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	BOD removal by the sewer system constructed south of the He River
Definition/Description	This indicator measures the cumulative volume (mass) of Biological Oxygen Demand (BOD) pollution loads removed by the treatment plant supported under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	BOD removal by the sewer system constructed north of the He River
Definition/Description	This indicator measures the cumulative volume (mass) of Biological Oxygen Demand (BOD) pollution loads removed by the treatment plant supported under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Monitoring & Evaluation Plan: Intermediate Results Indicators	
Indicator Name	Length of river rehabilitated to improve flood risk management and prevent water pollution
Definition/Description	This indicator measures the length, in kilometers, of rivers, streams, canals, or tributaries (to be specified separately, and in aggregate), that have been rehabilitated under the project, including with: revetment, embankments, dredging, restoration of flood zones, and/or green landscaping. The lengths of rehabilitation should be specified by type of waterway and by type of rehabilitation works.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs
Indicator Name	Length of sewer pipeline constructed
Definition/Description	This indicator measures the length of the sewer collection pipelines constructed or rehabilitated/upgraded under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Sewer pipelines constructed south of the He River
Definition/Description	This indicator measures the length of the sewer collection pipelines constructed or rehabilitated/upgraded under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Sewer pipelines constructed north of the He River
Definition/Description	This indicator measures the length of the sewer collection pipelines constructed or rehabilitated/upgraded under the project.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Number of water quality monitoring stations constructed and operational
Definition/Description	This indicator measures the number of water quality stations constructed, operational, and integrated into the municipality water, flood, and environment monitoring and early warning system.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Number of person days of training for local officials and staff (person-time)
Definition/Description	This indicator measures the number of days of training provided to local government officials and staff (including consultants or contracted staff in charge of flood, urban drainage, and wastewater systems' implementation, operations, and maintenance). This indicator specifies the number of officials/staff who completed training multiplied by the duration of training expressed in days (full days of training or aggregating partial days/hours to full days). Training organized or provided by the project may include: flood risk analysis and management, cross-agency or cross-discipline knowledge sharing/training, disaster risk management and emergency response, technical training in new design/construction methods, etc. Training may be through formal or informal training degree and non-degree courses, vocational, on the job training, field demonstrations, study tours, etc.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Percentage of women in rural community committees
Definition/Description	This indicator is to measure the representation of women in project planning meetings as well as rural community committees during project implementation. It is calculated based on the number of women participated divided by the total number of participants.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Number of person days of employment/ vocational training for local women(person-time)
Definition/Description	This indicator measures the number of days of training provided to project affected people, particularly women and vulnerable people, for technical / vocational / employment training and skill building under the project so that they have better chances to be employed after resettlement. Training may include for family-based business management, housekeeping skills, small-scale garden agriculture (livestock, vegetable production), among other topics. This indicator specifies the number of women/people who completed training multiplied by the duration of training expressed in days (full days of training or aggregating partial days/hours to full days).
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	Percentage of grievances received and responded
Definition/Description	This indicator captures the effective beneficiary feedback systems established for the project. It is based on the number of grievances and complaints resolved within the standard response time (15 days) divided by the number of grievances and complaints reported, both by the PMO hotline and the village level.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	An integrated 'coordination platform' for flood risk and urban drainage management is established and functioning
Definition/Description	This indicator measures the establishment and ongoing, effective functioning of an 'integrated coordination platform for flood risk and urban drainage management' (known here as the "coordination platform") under this project. The Coordination Platform will be comprised of leaders from the relevant water and urban development agencies in Hezhou. The coordination platform will be chaired by the deputy mayor of Hezhou Municipality, with leadership and guidance from the Project Leading Group (PLG). The coordination platform will be responsible for multi-agency integration and coordination during the project implementation and operations stages, including technical, institutional, and policy matters that emerge during project implementation. The coordination platform will also serve as a venue for exchanging knowledge and experience learned during the project (including through regular dissemination workshops).
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

Indicator Name	An integrated flood risk management and urban drainage operations protocol is prepared
Definition/Description	This indicator measures the preparation and submittal of an 'integrated flood risk management and urban drainage operations protocol' (known here as the "operations protocol") under the project. The operations protocol will set out specific operational parameters and rules to be followed by the relevant water and land-use planning agencies responsible for various parts of the Hezhou flood management and urban drainage systems, thus ensuring coordinated operations including during periods of flood and other emergency events.
Frequency	Once a year
Data Source	Actual data collection and monitored
Methodology for Data Collection	
Responsibility for Data Collection	PMO and PIUs

ANNEX 1: DETAILED PROJECT DESCRIPTION

1.1 Description of Project Approach and Components

1. This project aims to improve flood risk management and reduce water pollution through an innovative, integrated systems view of urban water and flood management. The scope of the project is outlined below:

   - *At the Mainstream He River (Component 1)* – reduce flood risks by connecting mainstream to tributaries, improving flood drainage capacity, removing obstructions, and upgrade river infrastructure in the mainstream channel.
   - *At the Urban Areas, and Tributary Rivers and Canals (Component 2)* – reduce urban waterlogging by diverting flood waters, enhancing tributary drainage capacities, and storing/absorbing flood waters in lakes, improved canals, and elements of green infrastructure. At the same time, reduce water pollution by separating storm and sewage systems, and providing full collection and treatment of wastewater.
   - *With Institutions, Information, and Project Management (Component 3)* – strengthen the capacity and coordination of local institutions by using the development of an Integrated Flood Risk & Urban Drainage Masterplan, an "Operations Protocol" and installing a "Coordination Platform" for water planning and management; support the development of a smart water and flood monitoring system; and support effective project management.

2. **Component 1: Improving Flood Risk Resilience of the He River (Cost of US$137.55 million, with Bank financing of US$49.35 million).** The objective of this component is to reduce flood risks along the mainstream He River. This will be accomplished by providing new connections between the mainstream river and its tributaries, thereby allowing flood waters to be diverted through different pathways, dissipating floods, reducing peak flows, and storing water through different parts of the system. At the same time, the flood drainage capacity of the mainstream He River will be enhanced by improving the river banks, restoring flood protection zones, removing flow obstructions, and removing silt buildup. This approach will improve the flood management capacity of the river, with a reduced need for major infrastructure such as large dams, large dykes, and large pumping stations. The specific activities under this component include:

   - Connect Donggan canal to the Mawei tributary river, and connect the Lining river to the mainstream He River to provide system connectivity and alternative pathways for routing floodwaters.
   - Remove flow obstructions at the three in-stream power stations along the He River (at Fanglin hydropower station: Municipalty Government to repurchase and de-commission the power station[11], dismantle the sluice gate, and improve the facilities; at Huangshi station: refit the dam with a hydraulic lift gate, and improve facilities; and at Xiadao station: optimize scheduling, and improve facilities).
   - Improve the flood drainage capacity along three reaches of the mainstream He River (i.e. Huangshi power station to Guangming Bridge (12.7 km); Guangming Bridge to Lingfeng Bridge (2.1 km); and Lingfeng Bridge to Xiadao power station (6.9 km)). This includes: developing both banks (in balanced, ecologically sensitive fashion, and by incorporating green infrastructure and landscaping); cleaning/dredging silt from the riverbed on both sides of the mainstream river channel; and demolishing buildings located within the flood protection zone adjacent to the flood-prone river banks. These activities will be coordinated with

[11] Fanglin hydropower station is currently owned and operated by a state-owned enterprise (SOE). To resolve the issue of river flow obstruction by the power station, in relation to this project the facility will be repurchased from the SOE by Hezhou Municipal Government (within the first two years of project implementation). The facility will then be de-commissioned. The river-crossing power station superstructure will remain in place, but the sluice gates will be removed. Project funds will not be used for purchase of the hydropower stations.

the "Ecological Landscape" works in Component 2 below.

3. **Component 2: Improving Urban Drainage and Wastewater Management (Cost of US$189.10 million, with Bank financing of US$74.79 million).** The objectives of this component are to reduce urban waterlogging, and to reduce water pollution loading into local waterways from urban sewage discharges. Whereas Component 1 focuses on the mainstream He River, this component focuses on the tributary rivers, canals, and lakes in and around the central urban area of Hezhou. Waterlogging will be reduced by providing additional connections among tributaries and lakes (allowing diversion of flood waters away from the urban area), enhancing the flood drainage capacity of tributary rivers and canals, and providing increased system storage in lakes, improved canals, and green infrastructure. Water pollution will be reduced by separating stormwater and sewer drainage systems and ensuring collection and treatment of wastewater from old and new urban development areas. The specific activities under this component include:

   - *Managing Urban Drainage and Sewage*
     - Connect Shizigang canal to its upstream lake system to allow diversion of water away from the central urban area and substantially decrease the water flows that lead to the worst waterlogging; and ensure full connection of internal lakes with tributary rivers and canals, to provide more flow pathway options to manage the river as a system.
     - Enhance the drainage capacity of tributaries and canals, by improving their banks (approximately 27.4 km), removing/demolishing buildings in the flood protection zone adjacent to the flood-prone tributary banks, and removing silt buildup.
     - In the older urban area (Babu District): install dedicated sewage interceptors to separate wastewater from stormwater (approx. 15.1 km), retrofit those existing sewer connections and 'community sewer networks' that currently discharge untreated to local drains and waterways (i.e. re-route to the main-line sewer collectors), and divert all sewage to the existing Hezhou WWTP.
     - In the newer urban area: construct the new Jiangnan Sewage Treatment Plant and pumping station (i.e. Anaerobic/anoxic/oxic micro aeration oxidation ditch WWTP with capacity of 15,000 tons/day), and install a separated sewage collection pipe network (5.4 km). Also, construction of the WW treatment plant requires the construction of 5.6 km of access roads.
     - Construct two stormwater scheduling/control gates and lift pump stations at the outlets of two tributaries flowing through the low-lying urban areas and into the He River mainstream (i.e. at Huang'ansi canal and Shizigang canal).
   - *Employing Green Infrastructure and Ecological Landscapes*
     - Construct an outer city "Green Ring" linking parks and green spaces with the city's existing mountain and water system, in a connected urban activity and ecology ring with diversified functions; and composed of embankment, landscaping, and construction of water-centric park facilities to build a water sightseeing corridor along three river systems: He River, Dongwu Canal, and Donggan Canal.
     - Construct a central-axis "Green Corridor" connecting the Lining River and the Changlong River with rehabilitated lake areas, green landscaped boulevards, and waterfront trails to create a continuous landscape belt, highlighting the environment, culture, and other elements of urban life.
     - Develop a Waterfront street at Xiyue old street as an ecological and historic corridor for enhanced public space, commercial activity, and tourism; with waterfront green land, different forms of revetment, and integrated with the existing road network and bridges; and located between Huang'ansi and Shizigang flood drainage rivers, utilizing the upstream Guposhan Huangtian canals as the water source.

4. **Component 3: Institutional Strengthening, Capacity Building and Project Management (Cost of US$15.82 million, with Bank financing of US$11.32 million).** The objectives of this component are to strengthen the capacity and coordination of local institutions by using the development of an Integrated Flood Risk & Urban Drainage Masterplan as a 'Coordination Platform' for coordinated water planning and management (led by Hezhou Municipality), support the development of smart water and flood monitoring systems, and support effective project management. The specific activities under this component include.
    a) Capacity building and technical assistance. Provision of technical assistance to support the improved coordination of water planning and management through:
        i. *Development of an integrated coordination platform for flood risk and urban drainage management* -- establish a "Coordination Platform" for multi-agency integration during the project implementation and operations stages. The "Coordination Platform" will be a "virtual agency", comprised of leaders from the relevant water and urban development agencies in Hezhou, and will continue the close coordination of the various agencies that took place during project preparation and design stages. The "Coordination Platform" will be chaired by the deputy mayor of Hezhou Municipality, with leadership and guidance from the Project Leading Group (PLG). The "Coordination Platform" will be responsible for coordinating technical, institutional, and policy matters that emerge during project implementation. The "Coordination Platform" will also serve as a venue for exchanging knowledge and experience learned during the project with participating experts and administrators from other parts of China, and other parts of the world (including through regular dissemination workshops every 1-2 years).
        ii. *Development of an integrated flood risk and urban drainage masterplan* -- the project will support development of a masterplan that brings together the operations and investments of multiple institutions for coordinated water planning. The masterplan will be prepared by the Water Resources Bureau (with the support of an expert consultancy team), and will be reviewed and approved by the "Coordination Platform", under the guidance of the PLG. The masterplan will include tailored recommendations on: i) setting up mechanisms for multi-agency water sector coordination and improving the consistency and efficiency of overall water management in the city, and ii) developing specific integrated management policies and projects that can be implemented by the respective agencies
        iii. *Development of an integrated flood risk management and urban drainage operations protocol in Hezhou Municipality* -- the project will support development and adoption of an "Operations Protocol" that sets out specific operational parameters and rules to be followed by the relevant water and land-use planning agencies responsible for operating various parts of the Hezhou flood management and urban drainage system, thus ensuring coordinated operations, including during periods of flood and other emergency events
        iv. *Provision of technical assistance as well as Training and Workshops* -- to enhance the capacity of Hezhou Municipality officials and institutions involved in water management in Hezhou Municipality; and
        v. *Carrying out knowledge-sharing and dissemination activities* -- about the Hezhou experience and lessons from integrated water management within China and beyond.
    b) Smart Information System for Integrated Water Monitoring. Planning, designing and installation of a smart internet-based information systems for controlling Hezhou water system comprising, inter alia: (i) flood monitoring and early warning system; (ii) water quality monitoring and early warning system; and (iii) integrated water system control and optimization system. The project will provide technical assistance to plan and design a modern, integrated, and internet-based system for data

collection, monitoring, and control of the Hezhou water system. The major functions of the system include: *Flood Monitoring and Early Warning*, *Water Quality Monitoring and Early Warning*, *and Integrated Water System Control* (for dams, pump stations, tributary connections, etc.). The technical assistance will include guidance on design and installation of monitoring stations, integrated data systems, and public communication systems to alert vulnerable populations

c) Project management. Supporting the overall capacity of the Project Implementing Entity to coordinate, manage and supervise the implementation of the Project, including: (i) undertaking preliminary and final engineering designs and preparing bidding documents; (ii) construction supervision; (iii) procurement of third party (external) environmental and social safeguards monitoring services; and (iv) hiring of experts to constitute the Dam Safety Panel.

1.2 Project Technical Details

5. This project adopted a technical approach that is emerging as international best practice for integrated urban flood risk management and drainage. Different from "traditional" design practice that focuses on local *flood prevention*, this project applies the concept of *flood risk management* – as an integrated approach to understanding the flood potential in the entire He River watershed upstream of the project area, and identifying and designing systematic water management interventions that can dissipate and reduce flood risks in the vulnerable, downstream project areas. This kind of *flood risk management* approach involves using robust and quantitative analysis and a computerized hydrodynamic flood simulation model (including flood risk mapping, design storm analysis, and engineering software) to compare alternative structural and non-structural flood management interventions, and select an overall system design that provides reduced flood risk and multiple benefits to Hezhou residents and local government.

6. **Consultation of Hezhou Masterplans:** All of the project activities and interventions comply with the various urban and water-related masterplans endorsed by Hezhou Municipal Government. The project and the design institute, in preparing the FSR, adhered to the vision and requirements of the various city plans; and these plans were used as a guide for project interventions and activities. The relevant plans consulted include: *Master Urban Plan for Hezhou (2009-2030); Urban Flood Control Planning Report for Hezhou, Guangxi Province (2015-2030); Master Plan for the City Ring Water System Project for the Ecological Town of Hezhou (2014-2030); Plan for Urban Drainage (Stormwater) & Water Logging Control in Hezhou (2016-2030); Special Plan of Sponge City for Hezhou;* and *Special Drainage Plan for Urban Area of Hezhou (2010-2030)*.

7. ***Hydrodynamic Model for reduced flood risk:*** In this project, an integrated analytical model was built to simulate flood risk and different levels of flood risk protection measures. To capture the flood dynamics of urban Hezhou Municipality located adjacent to the He River and its tributaries, the analytical model combined a number of 2D modelling tools, with coupled analysis of the rivers, terrain, and urban pipe network. The DHI-MIKE series numerical simulation software was selected for use in this project. Professional software packages were used to create the 1D hydrodynamic model, the hydrologic model, the 2D surface/terrain model, the pipe network model, and the coupling module to simulate the hydrologic and hydraulic features of the He River basin. The project employed an experienced design institute to use the suite of software packages to setup and run the hydrodynamic model consistent with the river system connectivity and urban terrain of the project area.

8. ***Design Rainfall, Design Flood, and Hydrology Data:*** A *design rainstorm* and *design flood* were constructed quantitatively from the historic time-series of local hydrologic data. This design flood was tested and calibrated in the model, and was then used to simulate the rainfall and flooding patterns for different

scenarios of project flood management interventions. Hezhou has five reliable meteorological/hydrology stations with long time series (60 years) of accurate rainfall and river-level data (one upstream station, one midstream station, and three downstream stations). The measured maximum annual 10min, 30min, 1h, 3h, 6h, 12h and 24h rainfall data of Hezhou Meteorological Station from 1957 to 2016 were used for frequency calculation. From this data, statistical rainfall parameters and close-fit theoretical frequency curves (i.e. "design rainstorms") were generated for the 10min, 30min, 1h, 3h, 6h, 12h and 24h rainfall frequencies in the urban areas of Hezhou. These design rainstorms were compared with published values in the *'Study on Rainstorm Statistic Parameter Contour Map of Guangxi'* (Hydrology and Water Resources Bureau of Guangxi Zhuang Autonomous Region, March 2010). The difference between the project's data-fitting and the government contour map were around 10 percent, so the project's design rainstorms were confirmed for use in the subsequent modeling. The time-distribution pattern of the design rainstorm over a 24-hour period was similarly analyzed and confirmed with historic data, and compared to the government published *'Calculation Chart of Rainstorm Runoff Data of Guangxi & Atlas of Possible Maximum Rainstorms of Guangxi'*.

9. ***Model Calibration, Boundary Conditions, and Validation:*** The Hezhou hydrodynamic model was calibrated by inputting actual historic rainfall and flood data from the 1994 flood (worst flood event on record), and adjusting model parameters until the simulated river, tributary, and urban pipe network performance matched the corresponding observed system performance. The period selected for model parameter calibration was the flood on July 22-27, 1994. Values for the model parameters were determined by matching simulated performance versus observed performance at system boundary conditions. To test the accuracy of the model, the simulation results and model parameters were further validated with data from a separate actual historic storm event (in 2002), according to observed data not involved in model parameter calibration. A separate storm water management model was also used to test the adequacy of modeling. This validation process found that the difference between model-simulated and historic-observed performance for both the Flood Peak and the Flood Volume was not larger than 10 percent, suggesting that the model is accurate and that analysis results from the model could be used to guide engineering design.

10. ***Alternative Analysis for Project Interventions:*** To help design and determine the effectiveness of flood risk management interventions (Component 1 and 2), the hydrodynamic model was used to simulate scenarios of flood conditions and flood damage from storms of different recurrence periods, both with and without project interventions in place. Significant urban waterlogging and localized flooding occurs at the central urban area of Hezhou. The present urban central area of Hezhou covers the Shizigang River area, the Huang'ansi River, the Dongwu Branch Canal area, the Donggan Canal area, the Dongliu Branch Canal area, the Taoyuan River area, and the areas with direct flood discharge to the main stream. Multiple flood risk mitigation interventions were considered and modelled as alternatives in the hydrodynamic model to verify their functionality and effectiveness. Simulations with and without these project interventions were conducted and verified by the model.

11. ***Economic Analysis to Define Flood Protection Standard:*** In this project, flood simulations and alternatives analysis were conducted for storms with different return periods: 10 years, 20 years, 50 years and 100 years. For each of these storm severity levels, the model produced flood risk maps that showed which areas of the city were inundated, as well as the depth of floods, and the duration of flooded/waterlogged conditions. These flood depths and inundation areas were then used in the project's economic analysis to assess the costs of flood damage for each storm severity level, both with and without project interventions. This process was used to determine tradeoffs in flood mitigation costs and benefits. In the end, the project selected a set of system intervention that provided sufficient flood risk benefits at a cost affordable to Hezhou Municipality.

The economic analysis helps to determine the boundary between the structural and non-structural measures. A combination of structural and non-structural measures will ensure the city is protected against the floods up to a selected design storm standard, and minimize losses caused by flooding from storms above design standard. Under the project, structural measures (such as the river diversions, levees, embankments, dredging, etc.) are selected and designed to handle the runoff generated by the 20-year design storm. Non-structural measures, such as a flood early warning system and an emergency preparedness/responsiveness plan will be adopted to help mitigate floods above the design storm recurrence level.

12. ***Project Related GHG Emissions Analysis***: A GHG accounting analysis has been carried out regarding the potential emissions from the new WWTP in Jiangnan under Component 2. The net emissions of the project are estimated at -20,356 tCO2-eq over the 12-year life of the project, while the gross emissions are estimated to be 47,327 tCO2-eq. On average, the project generates estimated net emissions of -1,697 tCO2-eq annually. The combination of displacing septic tank use and lower fugitive emissions from wastewater entering bodies of water contribute to these net emissions reductions. The net emissions from the project's investments in the new Jiangnan WWTP are estimated to be -12,531 tCO2-eq, while the net emissions due to the investments in wastewater collection for the existing Hezhou WWTP are estimated to be -7,825 tCO2-eq. Further details on the GHG accounting can be found in the project files.

ANNEX 2: ECONOMIC ANALYSIS

Hezhou Urban Water Infrastructure and Environment Improvement Project

1. ***Population, GDP and income.*** Based on the 2012 census data, the city has a total population of 2.3 million, of which one million is urban. In the period of 2010-2015, the city's GDP grew at an average annual rate of 9.5 percent; from RMB 29.7 billion to RMB 46.8 billion; and its per capita disposable income grew at an average annual rate of 9.7 percent from RMB15,802 to RMB 25,194.

2. ***Urban core***. Hezhou's urban core consists of two districts and four townships with an estimated population around 340,000 and a buildup area around 40 km^2 in 2015. According the Urban Masterplan, the population in the urban core will grow at average annual rate around 4.6 percent to 450,000 by 2020, and to 650,000 by 2030; and the buildup area, at an average annual rate around 4.4 percent to 54 km^2 by 2020, and to 78 km^2 by 2030. Most urban buildup areas in Hezhou are situated on the low plain between 104 meter and 106 meter above the sea level. The city has three urban drainage zones, namely Shizigan (11.4 km^2), Huangansi (29.5 km^2) and Nanshetang (14.83 km^2). Shizigang and Huangansi are both heavily populated urban districts.

3. ***A cost benefit analysis*** was carried out to assess the economic viability of the project investments over a 30-year period, inclusive of a six-year construction period at an economic discount rate of 6.0 percent.[12] The economic impact was evaluated as the difference between the with- and without- project scenarios. All economic benefits and costs are expressed in domestic currency and constant 2017 prices, excluding transfers (tax and duties) and financing charges. International costs are converted to local currency at an exchange rate of RMB 6.60 to US$1.00.

4. ***Project costs*** include (i) an estimated investment costs of RMB 1,674 million in flood remediation, including civil works, land acquisition and resettlement, design, construction supervision and management; and (ii) annual O&M costs assumed at 1.7 percent of the total asset value.

5. ***Project Benefits.*** The project investments in flood remediation will reduce both public and private costs of flood damages while boosting the local economy especially in previously flood-prone areas. Moreover, the investment will also generate less quantifiable public safety and health benefits. For the above-mentioned benefits, the following quantification methods are applied:

6. Benefit 1: avoided flood damages to assets, the avoided loss of income (output) due to slower or no economic activity and the avoided costs of repairs and clean-up after flood. Depending on the incidence and the nature of the damage, flood damages can be classified into:

    - *Direct damages:* such as destruction of buildings, equipment, stock, loss of furniture, crops, etc. Flood damage is estimated using a depth-damage relationship formula where damage from a flood is estimated between 10 percent and 40 percent of the original asset value (see table A2.1 below). The loss of output value is calculated based on the duration of shutdown (the sum of flooding during and

[12] The economic analysis was carried out in accordance with both (i) the World Bank Guidelines of Economic Analysis of Investment Operations and Economic Analysis Guidance Note; and (ii) the Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects.

production recovery time). The output value per unit time can be calculated based on the average output value per quarter. Economic outputs by industry/sector is conservatively assumed at an average annual growth rate of 6.0 percent.

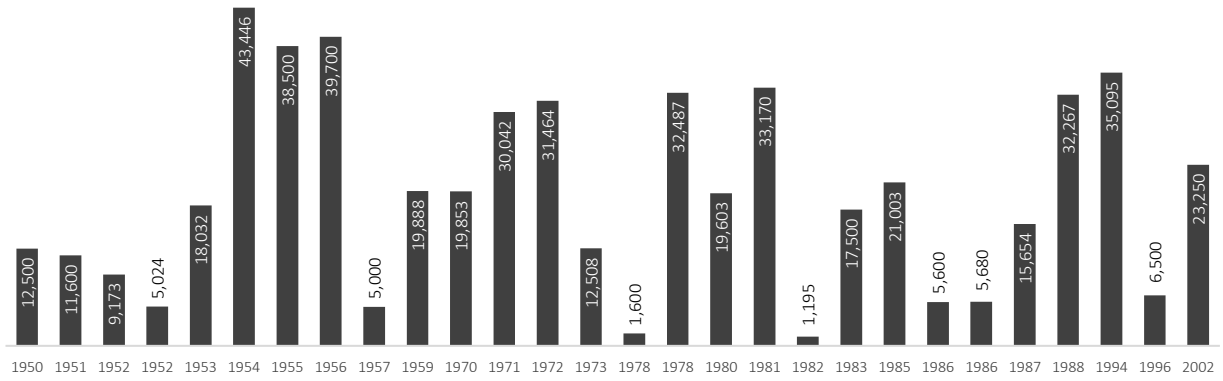
- *Indirect damages*, i.e., second-order impact of a flood, such as disruption of economic activities due to the destruction of buildings and infrastructure, expenditures for cleaning up, moving, rehousing, organizing rescue and substituting services, etc. The indirect damage value is calculated using a coefficient of the value of direct damages. Based on a survey of the flood history in Hezhou, the coefficient is estimated at around 30 percent.

Table A2.1 Flood damage rate assumptions by industry/sector

	Depth under 3m		Depth 3-4m		Depth over 4m	
	Fixed assets	Liquid assets	Fixed assets	Liquid assets	Fixed assets	Liquid assets
Industries	20%	30%	30%	35%	30%	40%
Commercial services	20%	20%	30%	30%	30%	40%
Transport	15%	20%	20%	25%	25%	30%
Non-productive sectors	10%	15%	15%	20%	25%	30%
Residential	20%		30%		35%	

7. ***History of floods.*** In the period between 1950 and 2017, Hezhou's urban core had been inundated 32 times, about once every two years. (see Figure A2.1). At times, multiple floods could strike in a single year aggravating the overall damage. The table below provides a summary of the affected farm arrears from the recorded floods since 1950. With a growing economy, more value is at risk of flood damages. For example, in spite of less severity, the flood on July 2, 2002 had resulted in 25 percent higher in economic damages than the one on July 23, 1994. (see Table A2.2)

Figure A2. Flood a1ffect farm land (mu) 1950-2002



Data source: Hezhou Urban Flood Management Urban Plan, 5th ed. (2014)

Table A2.2 Physical impact and economic damage from four major floods in the history

	Flood July 23, 1994	Flood July 2, 2002
Flood level in the urban area (m)	106.5	105.7
Affected households	26,850	23,500
Affected farm land (mu)	35,095	23,250
Affected urban streets	23	22
Average water depth (m)	1.7	0.9
Affected people (persons)	68,120	57,680
Casualties (persons)	1	1
Economic damage (in 2007 RMB million)	1,879	2,349

Data source: Hezhou Urban Flood Management Urban Plan, 5th ed. (2014)

8. The physical impacts of a flood were assessed using a hydrological and hydraulic simulation model, and were then converted to economic values based on the historical records of major floods. A range of measures were evaluated to determine the optimal level of intervention based on the estimated marginal costs and benefits. The project intervention will help reduce the economic damage of floods of different severity. The project files contain maps showing the flood risk reduction areas of the with and without project cases. Based on the cumulative flood damage in the period of 1950-2017, average annual flood damage saving is estimated at approximately RMB 130 million in 2017, growing at the pace of the economic development assumed at 6.0 percent a year.

9. Benefit 2: boosting the local economy. Along with the investments in flood mediation, the project will also develop a green-ring around the urban center, which will attract public and private investments, especially in the previously flood-prone areas. It is estimated a total of 12,144 mu (810 ha) residential, commercial and market land will be affected by the project intervention. In the floodplain, land value and overall economic activities have been suppressed due to heightened flood risk, poor physical and environmental conditions, and a general lack of investor confidence. Using land value as a proxy, even with a conservative 5 percent appreciation, the project investment will result in an economic boost of RMB 419 million. Baseline land value is assessed using recent residential and commercial land transaction prices in Hezhou (See Table A2.3).

Table A2.3 Sample land transaction prices in Hezhou (2015-16)

	Land area (Mu)	Total sales (million RMB)	Unit price (million RMB/mu)
Residential and commercial	**306.68**	**211.46**	**0.69**
• Plot 1 (2015)	12.69	11.76	0.93
• Plot 2 (2015)	37.75	23.23	0.62
• Plot 3 (2015)	145.63	71.97	0.49
• Plot 4 (2016)	89.83	82.2	0.92
• Plot 5 (2017)	20.79	22.3	1.07
Market	**142.59**	**79.31**	**0.56**
• Plot 1 (2016)	118.27	65.44	0.55
• Plot 2 (2016)	24.32	13.87	0.57

10. ***Outcomes of the Economic Analysis.*** Based on above assumptions, at a 6.0 percent discount rate, the project

investment is expected to yield an economic net present value (ENPV) of RMB 1,549 million from avoided flood damage alone. If additional economic boost is taken into account – with a conservative 5.0 percent land appreciation in the flood-prone areas as a proxy – the ENPV will increase to RMB 1,844 million. The project investment is estimated to yield an economic internal rate of return (EIRR) of 11.6 percent in avoided flood damage alone, exceeding the economic hurdle rate of 6.0 percent. After accounting for the project's boosting effect to the economy, the EIRR will increase to 13.2 percent. Thus, the project is economically justified. Sensitivity analyses are carried out to assess the robustness of the result in light of potential cost overrun and/or under delivery of promised benefits. The outcomes of the sensitivity analysis suggested that with 20 percent cost overrun and 20 percent under delivery of its promised benefits, the project will continue yielding EIRRs well exceeding 6.0 percent hurdle rate. (see Table A2.6)

Table A.2.6 Outcomes of the Economic Analysis

	In avoided flood damages only		**Plus additional boost to the economy (with 5% land appreciation as a proxy)**	
	EIRR (%)	**ENPV @ 6.0%** (RMB million)	**EIRR** (%)	**ENPV @ 6.0%** (RMB million)
Base case	11.6%	1,549	13.2%	1,844
+ 20% costs	9.9%	1,208	11.2%	1,504
- 20% benefits	9.5%	899	10.8%	1,135
+20% cost/- 20% benefits	8.0%	558	9.0%	795

ANNEX 3: FINANCIAL ANALYSIS

1. A financial analysis of the project was conducted to assess: (i) the availability of Hezhou Municipal Government (HMG) to provide counterpart funds, and (ii) the financial sustainability of Jiangnan WWTP.

Project cost estimate

2. The total project cost was estimated at RMB 2,387.3 million (equivalent to US$359.4 million), which includes the costs for engineering, equipment, land acquisition and resettlement, environment management, contingencies, and financial charges during construction. The World Bank loan is US$150 million and the remaining will be provided by HMG as counterpart funds.

Financial analysis for Hezhou Municipal Government

3. The sources of the counterpart funds include special transfers from central government, government bond, local government funds, and etc. Given the uncertainties of these funds, Hezhou Municipality's fiscal revenue was analyzed, as it is an important source of counterpart funds.

4. HMG's fiscal revenues mainly come from tax and non-tax revenues and transfer payments from upper level governments. The transfer payments from upper level governments mostly consist of tax-sharing arrangements, general transfers, and earmarked funds. Since the earmarked funds are allocated to HMG with a specific purpose, only the first two sources of transfer payments from upper level governments can be used as counterpart funds to the project. The following table summarizes HMG's all fiscal revenues over the past three years.

Table A3.1 HMG's Fiscal Revenues from 2014 to 2016

(million)

	2014		2015		2016	
	RMB	%	RMB	%	RMB	%
Tax Revenues	306.56	15	381.99	8	428.17	10
Non-tax Revenues	279.74	14	392.48	8	472.62	11
Transfer Payments	933.69	46	1,942.50	39	1,472.02	35
Tax-sharing Arrangements	*133.39*		*136.48*		*121.81*	
General Transfers	*383.86*		*514.49*		*554.37*	
Earmarked Funds	*416.44*		*1,291.53*		*795.84*	
State Bonds	280	14	1,903.82	38	1,207.71	29
Revenues from other Sources	234.99	12	342.88	7	589.12	14
Total Revenues	**2,034.98**	**100**	**4,963.67**	**100**	**4,169.64**	**100**

5. The above table also shows that main sources of HMG's revenues come from transfer payments from upper level governments and state bonds, which implies that the Bank financing will complement the limited funds available for local development. On the other hand, there is a financing risk of provision of counterpart funds during project implementation.

6. Based on its historic fiscal revenues and features of fiscal sources, HMG's fiscal availability for the project was projected as follows:

Table A3.2 Projection of HMG's Fiscal Availability for Project
(RMB million)

	2017	2018	2019	2020	2021	2022	2023	2024
Tax Revenues	502.89	553.18	608.50	669.35	736.28	809.91	890.90	979.99
Non-tax Revenues	438.00	608.50	669.35	736.28	809.91	890.90	979.99	1,077.99
Tax-sharing Arrangements	140.34	154.89	170.38	187.42	206.16	226.77	249.45	274.40
General Transfers	452.03	488.19	522.37	558.93	598.06	639.92	684.72	732.65
Available for Project	**1,533.26**	**1,804.76**	**1,970.59**	**2,151.98**	**2,350.41**	**2,567.50**	**2,805.06**	**3,065.02**

Note: The assumptions of making the projection includes:

- The projection for 2017 was made by HMG.
- The annual increase of tax revenue is 10 percent and the non-tax revenue is projected by 110 percent of tax revenue.
- Tax-sharing arrangements are 28 percent of tax revenues.
- The annual increase of general transfers is 7 percent .

7. The implementation period of the project is six years from 2018 to 2024. The implementation plan was prepared according to the procurement plan which indicates that the Bank will finance 80 percent of civil works and equipment, and 100 percent of consultant service and study tours. Following the implementation plan and Bank financing ratio, the required HMG's contribution was calculated and shown in the following table.

Table A3.3 Required HMG's Contribution
(RMB million)

	2018	2019	2020	2021	2022	2023	2024
Project Investment	11,380	64,255	52,832	41,293	34,451	27,211	7,312
Bank Financing	3,435	17,805	18,370	21,921	19,516	14,894	3,699
Grant from MWR	639	11,075	12,546	2,739			
HMG Contribution to Project	7,306	35,374	21,916	16,633	14,935	12,317	3,613
Availability of HMG for Project	180,476	197,059	215,198	235,041	256,750	280,506	306,502
% of Availability	**4.0%**	**18.0%**	**10.2%**	**7.1%**	**5.8%**	**4.4%**	**1.2%**

8. By comparing HMG's contribution to the project with its availability, it shows that HMG's contribution to the project in 2019, 2020, and 2021 will likely to pose some financial pressure on HMG's fiscal expenditures of other activities, which poses moderate financing risk during implementation. To mitigate this risk, HMG will explore more ways to mobilize funds for the project implementation, including application for subsidies for construction from central government, issuance local government debts.

Financial Analysis for WWTP

9. The project will support the construction of primary and secondary sewer mains and Jiangnan wastewater treatment plant (Jiangnan WWTP) with a capacity of 15,000 m^3/d to treat wastewater from the region. These sewer mains and WWTP will be constructed by Hezhou Municipal Engineering Administration Bureau (HMEAB). After the construction, HMEAB will setup an entity to operate or outsource the operation of the assets of sewer mains and WWTP to a professional operator. The financial analysis at implementing entity level is to see how these assets can be sustainably operated. A proxy was used to simulate the operation and maintenance costs of Jiangnan WWTP, using the operating WWTP in Hezhou Municipality. This existing

WWTP has a capacity of 30,000 m^3/d and currently it is operating at its full capacity and has a technology that is similar to the proposed Jiangnan WWTP.

Costs of Construction and Operation

10. The total cost of construction is about RMB179.60 million, including RMB151.42 for Jiangnan WWTP, RMB18.56 million for sewer, and RMB9.62 million for pumping station. Assuming the residual value of these assets is 5 percent of the total construction cost and the lifespan is 20 years, the annual depreciation is about RMB8.53 million. The operation and maintenance costs of the existing WWTP was used as proxy for Jiangnan WWTP. Over the past three years (2014 - 2016), the average annual volume of wastewater treated was 10.6 million m3 and the average unit cost for wastewater treatment was RMB0.33 per m^3. Meanwhile the average annual volume of water sold was 20.2 million m^3. The design capacity of Jiangnan WWTP is 15,000 m^3/d. Considering that this region is a new development area of Hezhou Municipality, with a current the population of only 67 million, it was assumed that the volume of wastewater treated in the 1st year of operation is 60 percent of the design capacity, then it grows gradually reaching its full capacity by the 5th year. The average annual operation and maintenance cost of sewer and pumping station was assumed at 0.1 percent of the total investment.

Tariff Revenue

11. Currently, the average wastewater tariff in Hezhou Municipality is RMB0.97/m3, which is collected together with water tariff by the water company. The collected wastewater tariff is transferred to Hezhou Municipal Finance Bureau. Based on some conditions such as volume of wastewater treated and the quality of the water discharged to river which is stipulated in the agreement between HMG and the operator of WWTP, wastewater tariff is then transferred to the operator. The tariff revenue is calculated based on the volume of water sold, not the volume of wastewater treated.

Full Cost Recovery Rate and Debt Service Coverage Ratio

12. Two indicators for sustainable WWTP are: full cost recovery rate (CRR) and debt service coverage ratio (DSCR). If CRR is greater than 1 and DSCR is greater than 1.2, it means that the tariff revenue can cover the operation cost and the cash flow of tariff can serve the debt service (i.e. the WWTP can be considered financially sustainable). Based on the scenario described above, the CRR under the current tariff structure is 0.7 and the DSCR is 0.8 (and therefore, not currently considered financially sustainable). To ensure financial sustainability of Jiangnan WWTP, the wastewater tariff should be increased to RMB1.41/m^3 which is 46 percent higher than current tariff. A tariff increase is necessary to meet costs and until tariffs are increased HMG would have to provide adequate financial support to ensure the financial sustainability of the Jiangnan WWTP. The minimum increase in tariff should be to that level where revenues can cover operating costs of wastewater collection, transfer, and treatment; as well as the depreciation of assets. HMG has already committed to providing subsidies that meet operating costs and depreciation; and with other subsidies will also service the debt. Taking the fifth year of operation as an example (i.e. when the WWTP is assumed to be in full operation), the tariff level should increase to 1.04 RMB/m^3 (and this is 7 percent higher than current tariff). Therefore, HMG will need to subsidize 0.37 RMB/m^3. Among that tariff, 0.19 RMB/m^3 (18 percent) will be used to cover operating costs and 0.85 RMB/m^3 (82 percent) will be used to service debt. The annual amount of HMG's subsidies would range from RMB 4.46 million in the first year of operation (60 percent of capacity was assumed to be used), to RMB 3.69 million in the fifth operation year (full capacity was assumed in operation).

13. Considering that the increase in wastewater tariff to this minimum level is not high, and that the amount of HMG's subsidies is not large (around 0.1 percent of total HMG's available budget), the sustainability risk is low.


CHINA
HEZHOU URBAN WATER INFRASTRUCTURE AND ENVIRONMENT IMPROVEMENT PROJECT
GUIZHOU
HUNAN
YUNNAN
GUANGDONG
VIETNAM
Gulf of Tonkin
To Luoyang
To Kunming
To Hanoi
To Guangzhou
Ziyuan
Sanjiang
Guilin
XingAn
Guanyang
RongAn
Yongfu
Gongcheng
Fuchuan
Hezhou
Zhaoping
Tiane
Longlin
Fengshan
Hechi
Lingyun
Baise
Liuzhou
Luzhai
Jinxiu
Mashan
Laibin
Heshan
Wuxuan
Pingnan
Wuzhou
Tengxian
Guigang
Napo
Jingxi
Daxin
NANNING
Yongning
Chongzuo
Yulin
Pubei
Qinzhou
Fangchenggang
Beihai
Tieshan
Hechi
Liuzhou
Laibin
Baise
Guilin
Hezhou
Wuzhou
Guigang
Nanning
Chongzuo
Yulin
Qinzhou
Fangchenggang
Beihai
106°E
108°E
110°E
112°E
26°N
24°N
22°N
IBRD 43598 | APRIL 2018
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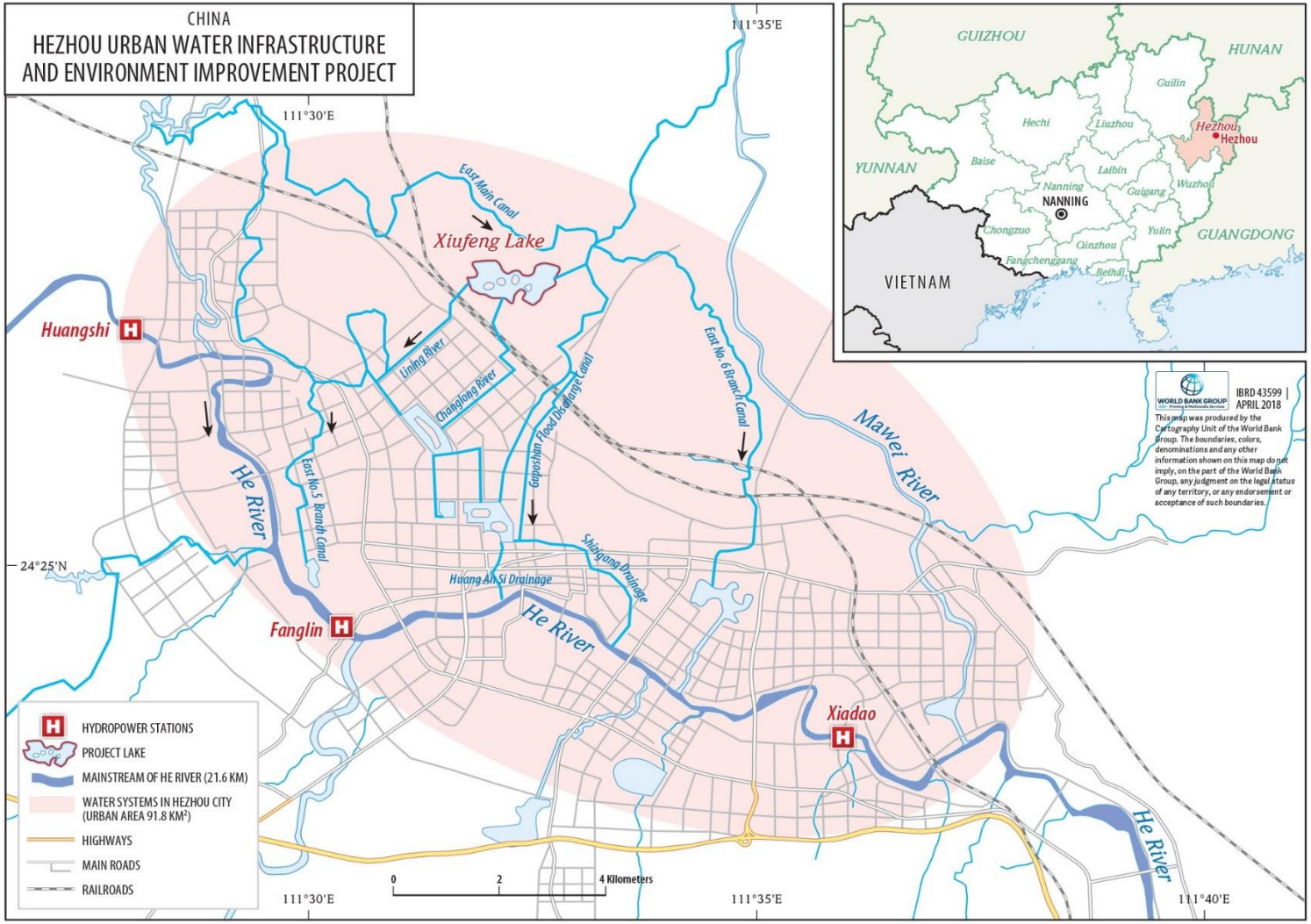
HEZHOU PREFECTURE
MAIN HIGHWAYS
MAIN ROADS
RAILROADS
SELECTED CITIES
PREFECTURE CAPITALS
PROVINCE CAPITALS
PREFECTURE BOUNDARIES
PROVINCE BOUNDARIES
INTERNATIONAL BOUNDARIES
0 50 100 Kilometers
RUSSIAN FEDERATION
MONGOLIA
BEIJING
GUANGXI
VIETNAM
PHILIPPINES
JAPAN
Sea of Japan
East China Sea


CHINA
HEZHOU URBAN WATER INFRASTRUCTURE AND ENVIRONMENT IMPROVEMENT PROJECT
111°30'E
111°35'E
111°40'E
24°25'N
East Main Canal
Xiufeng Lake
Huangshi
Liming River
Changlong River
Gaoshan Flood Discharge Canal
East No 6 Branch Canal
Mawei River
He River
East No 5 Branch Canal
Huang An Si Drainage
Shaigang Drainage
Fanglin
Xiadao
HYDROPOWER STATIONS
PROJECT LAKE
MAINSTREAM OF HE RIVER (21.6 KM)
WATER SYSTEMS IN HEZHOU CITY (URBAN AREA 91.8 KM²)
HIGHWAYS
MAIN ROADS
RAILROADS
0
2
4 Kilometers
GUIZHOU
HUNAN
YUNNAN
GUANGDONG
VIETNAM
NANNING
Guilin
Hechi
Liuzhou
Hezhou
Baise
Laibin
Nanning
Guigang
Wuzhou
Chongzuo
Yulin
Qinzhou
Fangchenggang
Beihai
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