Initial Environmental Examination

Project Number: 48102
June 2016

People's Republic of China: Qinghai Haidong Urban Rural Eco Development Project

Prepared by the Government of Haidong Municipality of Qinghai Province for the Asian Development Bank

CURRENCY EQUIVALENTS

(As of 20 May 2016)

Currency Unit	–	Yuan (CNY)
CNY 1.00	=	$ 0.15
$ 1.00	=	CNY 6.54

ABBREVIATIONS

ADB	–	Asian Development Bank
BOD	–	Biological Oxygen Demand
CNY	–	Chinese Yuan
CSC	–	Construction Supervision Company
COD	–	Chemical Oxygen Demand
dB(A)	–	A-Weighted Decibel
DI	–	Design Institute
DPA	–	Direct Project Area
EA	–	Executing Agency
EEM	–	External Environmental Monitor
EIA	–	Environmental Impact Assessment
EIS	–	Environmental Impact Statement
EMC	–	Environmental Monitoring Center
EMDP	–	Ethnic Minority Development Plan
EMP	–	Environmental Management Plan
EMS	–	Environmental Monitoring Station
EPB	–	Environmental Protection Bureau
EPD	–	Environmental Protection Department
FSR	–	Feasibility Study Report
FYP	–	Five-Year Plan
GAP	–	Gender Action Plan
GDP	–	Gross Domestic Product
GHG	–	Greenhouse Gas
GRM	–	Grievance Redress Mechanism
HMG	–	Haidong Municipal Government
HPLG	–	Haidong Project Leading Group
IA	–	Implementing Agency
IEE	–	Initial Environmental Evaluation
LIC	–	Loan Implementation Consultancy
LIEC	–	Loan Implementation Environment Consultant
MEP	–	Ministry of Environmental Protection
MRM	–	Management Review Meeting
NO_2	–	Nitrogen Dioxide
O&M	–	Operation & Maintenance
PLG	–	Project Leading Group
PM_{10}	–	Particular Matter smaller than 10 micrometers
PMO	–	Project Management Office
PPTA	–	Project Preparatory Technical Assistance
PRC	–	People's Republic of China
RP	–	Resettlement Plan
SAP	–	Social Action Plan

SEPA	–	State Environmental Protection Administration
SEPP	–	Soil Erosion Prevention Plan
SO_2	–	Sulphur Dioxide
SPS	–	Safeguard Policy Statement
SS	–	Suspended Solids
TN	–	Total Nitrogen
TP	–	Total Phosphorus
TSP	–	Total Suspended Particulates
WWTP	–	Wastewater Treatment Plant

WEIGHTS AND MEASURES

‰	–	per mill (per thousand)
ha	–	hectare
kg/d	–	kilogram per day
km	–	Kilometer
km^2	–	square kilometer
m	–	meter
m^2	–	square meter
m^3	–	cubic meter
m^3/d	–	cubic meters per day
m^3/s	–	cubic meters per second
m^3/yr		cubic meters per year
mg/m^3	–	milligrams per cubic meter
mm	–	millimetre
mu	–	unit of land area equal to 1/15 ha or 667 m^2

NOTE

In this report, "$" refers to US dollars.

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I. EXECUTIVE SUMMARY

A. Introduction

1. The Haidong City Government (HCG) of Qinghai Province, People's Republic of China (PRC) has requested the Asian Development Bank (ADB) to provide investment and technical assistance support for the Qinghai Haidong Urban-Rural Eco Development Project. The project will help the HCG to support improvements to the functions and values of Huangshui River and its watershed, including managing flood risks, improving water quality and availability, and increasing climate change resilience. The project will involve river embankment improvements along the Huangshui River, wetland and forest area restoration and rehabilitation, expansion of a landfill facility, reuse of wastewater to irrigate forested areas, and construction of water treatment plants and supply infrastructure to support the planned urbanization in Ping'an and Ledu Districts of Haidong City.

2. Haidong City is a city of 1.72 million residents. Urban development is concentrated in two districts – Ping'an and Ledu. Both districts are located along the Huangshui River, a nationally important tributary of the Yellow River. Urban development in Ping'an and Ledu is concentrated within the narrow valley of the Huanghsui River, and confined between steep mountainous areas. Buildable land is limited and the fertile valley has been experiencing a high rate of conversion from farmland to urban development. According to the *Master Planning of Haidong Urban Area (2013-2030)*, the two districts are expected to add more than half million residents by 2030. Ledu District is projected to increase from 109,800 residents to 502,000 between 2012 and 2030, while Ping'an is expected to see its population grow from 68,100 to 190,000 during the same period. This will put pressure on an already fragile landscape that is prone to flooding and considerable amount of soil erosion, as well as on existing municipal services including water supply and solid waste disposal.

B. The Project

3. The proposed project will include four main components: (i) integrated flood protection infrastructure; (ii) urban catchment soil erosion control; (iii) rural water supply and urban solid waste infrastructure; (iv) project management capacity strengthening. The components are summarized in Table I.1.

4. Flood protection will be enhanced by a program of embankments along the Huangshui River and its tributaries to improve water flow and increase flood protection capacity. The river sections will also have rehabilitated riverbanks. Riverbank improvements will be through the development of embankments as landscaped habitats and recreational areas, and wetland construction. Urban catchment soil erosion control will be achieved by irrigated shelterbelt plantations, partly using recycled treated wastewater from the Ping'an WWTP to reduce pressure on limited freshwater resources. The rural water supply infrastructure focuses on the water supply from two existing reservoirs (Fatai and Wenzukou) to be piped to small local WTPs to service the local villages in the upper Qijiachuan valley and then routed through a larger WTP to provide treated water downstream. The solid waste infrastructure is centered on the existing Ledu landfill, which will be rehabilitated and extended. The location of the main project components are shown on Figure I.1.

Figure I.1: Overview of project components

Table I.1: Summary of Project Outputs and Construction Components

Name	Description
Output 1: Integrated flood management infrastructure for Huangshui River provided	
1.1 Huangshui River Channel Ping'an Segment	River section rehabilitation and flood protection works along the Huangshui River Channel Ping'an Segment, including 14.68 km of embankments along the main channel, 6 km of embankments along tributary mouths and 100,000 m^3 of riverbed blockage removal.
1.2 Huangshui River Channel Ledu Urban Area Segment	River section rehabilitation and flood protection works along the Huangshui River Channel Ledu Urban Area Segment, including 15 km of embankments along the main channel, and 116 ha of riverside park.
1.3 Huangshui River Channel Ledu Rural Area Segment	River section rehabilitation and flood protection works along the Huangshui River Channel Ledu Rural Area Segment, including 17.57 km of embankments along the main channel, 10 km of embankments along tributary mouths and 30,000 m^3 of riverbed blockage removal.
1.4 Ping'an District Huangshui River Riverside Greenbelt	Construction of 77.9 ha of riverside greenbelt on both sides of the Huangshui River Riverside in Ping'an District.
1.5 Yizhou Wetland Ecological Conservation Area	Construction of Yizhou wetland comprising constructed wetlands (10.88 ha), wetland recreational area (4.43 ha) and a science-education area (4.69 ha).
Output 2: Haidong Urban Catchment Soil Erosion Control Measure Implemented	
2.1 Ping'an District Mountain Edge Green Belt	Construction of 104.7 ha of mountain edge shelterbelt along the southern edge of the Haidong urban area.
2.2 Ping'an WWTP Water Reclamation Phase II	Pumping stations and pipeline network for South Mountain Landscaping Water Irrigation System
Output 3: Rural Water Supply and Urban Solid Waste Infrastructure Constructed	
3.1 Wenzukou Reservoir and Fatai Reservoir Water Supply	Construction of Fatai Reservoir WTP (1500 m^3/day); Wenzukou Reservoir WTP (1500 m^3/day); and Sanhe Township WTP (20,000 m^3/d), raw water conveyance pipelines, and distribution pipelines.
3.2 Ledu Sanitary Landfill Expansion	Construction of the Phase 3 and Phase 4 of the landfill, with capacity of 670,000 m^3
Output 4: Project Management Capacity Strengthened	
4.1 Capacity building and institutional strengthening of EA/IAs	The capacity building necessary to achieve a successful project implementation comprises (i) Support during project implementation; (ii) Strengthening of O&M agencies to give assurance on project sustainability, and (iii) Creating "value added" from the Project.

C. Environmental Assessment

5. In accordance with the PRC Guideline on EIA Classification for Construction Projects (MOEP, 2015), the domestic environmental assessment reports (DEAs) were prepared on the basis of individual components. The most stringent requirement was for the landfill component which required a full EIA Report. The assessments of other components required EIA Tables (TEIA) and EIA Registration Forms respectively. The list of subcomponents and their

corresponding level of PRC environmental impact assessment are shown in Table I.2. The domestic safeguards documents were prepared in compliance with the PRC Law on Environmental Impact Assessment (2003), the Technical Guidelines for Environmental Impact Assessment (HJ/T2-93) and other relevant PRC regulations and guidelines. All domestic EIAs and SEPPs have been approved by the Haidong environment protection and water resources management authorities.

Table I.2: DEIA Status under the Guideline on EIA Classification for Construction Projects (MEP, 2015)

Component	Domestic EIA requirements	Approval Authority	Approval date
Ping'an water reuse	TEIA	Haidong Municipal EPB	2016/04/06
Urban-rural water supply	TEIA	Haidong Municipal EPB	2016/04/14
Yizhou Wetland	TEIA	Haidong Municipal EPB	2016/04/14
Huangshui River Ping'an segment	TEIA	Haidong Municipal EPB	2016/04/14
Huangshui River Ledu Rural segment	TEIA	Haidong Municipal EPB	2016/04/14
Huangshui River Ledu urban segment	TEIA	Haidong Municipal EPB	2016/04/14
Ledu landfill expansion	EIA Report	Haidong Municipal EPB	2016/05/04
Ping'an riverside greenbelt and mountain edge greenbelt	EIA registration form	Haidong Municipal EPB	2016/04/14

6. ADB's Safeguard Policy Statement (SPS, 2009) provides the basis for this project IEE. The ADB classified the Qinghai Haidong Urban-Rural Eco Development Project as Category B and accordingly the PPTA team was required to assist the Haidong City Government to prepare a consolidated initial environmental examination (IEE) and an Environmental Management Plan (EMP) which complies with the safeguard guidelines set out in SPS (2009).

7. This IEE is based on information in the domestic environmental assessment documents and Feasibility Study Reports (FSR), the comprehensive Climate Risk and Vulnerability Assessment (CRVA) prepared for the project[1], as well as investigations by the project preparatory technical assistance (PPTA). PPTA fieldwork included topical studies including biodiversity and habitat survey along the Huangshui river, water resources assessments, riverbank condition surveys and inspections; and site surveys at wetland creation, greenbelt and mountain edge shelterbelt, water supply pipelines and WTPs, and landfill. The IEE includes an environmental management plan (EMP), which will be the key guiding document for environmental-related issues in the construction and operational phases of the project.

D. Baseline Environment

8. Baseline environmental sampling and descriptions of existing conditions are presented for the project's area of influence in both Ping'an and Ledu districts. This area is centered on the reaches of the Huanhshui River, its major tributaries, and the riverbanks incorporating the construction sites of embankments and the wetland areas. Additional areas, away from the river, include the water supply pipelines from reservoirs and their WTPs, and the existing Ledu landfill

[1] Heping Zuo, Wei Ye. 2015. *Climate Risk and Vulnerability Assessment (CRVA) for TA 8846-PRC: Qinghai Haidong Urban-Rural Eco Development Project.* Manila.

site and proposed extension.

9. For the river environment, baseline information was collected and assessed for ambient conditions of air, noise, water, hydrology and flooding. Air quality and ambient noise levels met the PRC and international standards for residential areas. The baseline measurements for water quality and flooding reinforced the need for the project. Water quality in the project waterways was consistently lower than national class IV and for some parameters below class V, indicating very low quality unlikely to support valuable aquatic ecosystems. The river experiences 10-20-year recurring floods impacting large urban areas in Haidong and extensive riverbank areas in both districts.

10. Ecological baseline assessments included assessments and documentation of habitats, vegetation communities, and fauna, especially along riverbanks and within the river channel through traversing the length of the river and recording dominant vegetation, land cover type, riverbank form and riverbed for both riverbanks. Due to the long history of human activity most habitats are highly modified. Small, scattered patches of modified habitat occur in parts of the project area, mainly comprising riverbank stands of trees and shrubs up to 20 m wide. No riparian areas within the project scope qualify as *critical habitat* or *natural habitat* as defined by the SPS (2009). Fauna species richness is low and no national-level protected species have been recorded. Only one fish species in the project area lays eggs on aquatic plants (*Carassius auratus*), and will be subject to temporary habitat loss from riverbank works. *Carassius* are of least concern in IUCN lists and are too small to be a fisheries resource. Populations in the project area are low due to the modified nature of most channel sections.

11. The environment of the hinterland where mountain edge shelterbelts will be established and where the existing landfill site is located have also been examined for ambient air and noise levels. Groundwater conditions were assessed in the area around and downstream of the landfill site. Air quality and noise levels were acceptable except in close proximity to the landfill where NH_3 levels (from existing poorly managed garbage) and PM_{10} levels (caused by wind born dust from adjacent barren land) exceeded the national standard. The significant depth of the groundwater in this area (i.e. more than 55 meters) precluded sampling and will need to be re-tested after rain events to provide baseline groundwater quality. Further into the foothills where the rural water supply components are set, environmental baseline is limited to typical rural air and noise quality and site land use at the small WTP sites, and water quality of the reservoirs (which comply with PRC national Class II quality standard for water bodies).

12. Important supplementary assessments to describe the baseline environment included the following: (i) the hydrological analyses of the river basin; (ii) the CRVA; and (iii) the flood risk mapping for 1-in-10, 1-in-20 and 1-in-50 year flood levels.

E. Environment, Health and Safety benefits

13. The project components will have quantifiable and non-quantifiable benefits, including avoided flood damage, increased forest cover and landscaping to maintain soil and water resources balance, ecotourism and environmental education, improved irrigation and avoided water scarcity, sustainable rural and urban water supplies, improved sanitation and cleaner environment and reduced health risks.

14. The **river rehabilitation and riverside greenbelt** sub-components will provide protection against floods up to a minimum 30-year return period for an estimated 380 ha. Soil erosion will be reduced based on soil conservation at a yearly rate of 30 tons per ha for the greenbelt areas of 71.2 ha, totaling 2,136 tons/year.

15. The **Yizhou wetland** sub-component will provide regulating services (including flood water

storage, water treatment, micro-climate regulation), supporting services (biodiversity maintenance by providing resting, nesting, feeding and breeding habitats for wildlife), and cultural services (including research, education and recreation). The water treatment function of the wetland will reduce emissions of TP by 0.648 tons, TN by 4.86 tons, COD by 23.43 tons and ammonia by 2.025 tons annually.

16. The **soil erosion control and water reclamation** sub-component will result in soil and water conservation benefits by increasing the mountain border protection forest coverage, and by increasing the water storage capacity of mountain land. The mountain edge shelterbelt will reduce soil erosion from those localities by 3,141 tons per year and the South Mountain planted forest by 19,890 tons/yr. The reuse of treated wastewater will provide a new irrigation source, diversifying the city's water resources. The South Mountain forest will also help control urban sprawl.

17. The **rural water supply** sub-component will increase water security for communities in the Qijiachuan valley for both domestic use and livestock. It will enable users to increase consumption levels, with health benefits from improved hygiene and livelihood benefits.

18. The **urban solid waste infrastructure sub-component** will increase landfill disposal capacity and result in environmental protection that prevents threats to public health. The project will correct poor design and management at the landfill to stop the decline in local environmental values, with special threats to the quality of groundwater and soil resources.

F. Impacts and Mitigation Measures

19. **Land and vegetation affected by the project.** The IEE concludes that total loss of remnant natural vegetation will be low. This is because only 17% of the affected length of the left bank and 11% of the right bank of the Huangshui River has any form of natural regrowth or wetland. The least disturbed parts of this land cover represent "modified habitat". Marginal modified habitat is also provided by the fringing riverbank trees which border much of the riverside agriculture. Disturbed vegetation and "waste ground" (cleared and unused land), both characterized by scattered regrowth trees, weeds and grasses, will mainly be impacted. Land take for the WTPs at Sanhe, Wenzukou and Fatai and pipelines between them will be 10 ha, mostly agricultural and waste land. The reforestation and shelterbelts occur on currently degraded or denuded lands and will result in net increases in naturally vegetated areas.

20. **Construction phase.** Potential impacts during construction have been identified in the consolidated project IEE. Impact assessment for all project activities covered the following issues: (i) earthworks; (ii) soil erosion; (iii) dust and gaseous air pollution; (iv) noise; (v) construction wastewater; (vi) loss of terrestrial and aquatic habitat; (vii) risk of introducing invasive species; (viii) impacts from pipe-laying; (ix) temporary traffic management; (x) hazardous and polluting materials; (xi) worker and community health and safety.

21. For each, the severity of potential impact has been assessed in relation to the baseline environment and sensitive receptors which might be adversely affected. The main findings of the IEE are that construction will cause no loss of valuable ecology or physical cultural resources, and that construction dust, noise, erosion and local disruption to traffic and communities will be temporary and can be successfully managed. No terrestrial or aquatic species recorded in PPTA surveys or the domestic environmental assessments is on the PRC local or provincial lists for protected species, nor are they species of concern in IUCN lists. Avoidance of construction related impact through design and site management and mitigation measures through construction management have been identified for each impact and these are listed in the project EMP for the attention of contractors and the IAs. In all cases, where the EMP requirements are strictly followed, construction impacts will be kept at acceptable levels.

22. **Anticipated impacts and mitigation measures during operation**. Potential impacts during operation have been identified in the consolidated project IEE. The operation of flood protection embankments along the Huangshui River will make use of design alternatives to promote the reestablishment of riverside habitats. Induced downstream afflux effects of flood protection works have been modelled and are minimal. The natural geographic conditions immediately downstream of the project (steep-sided valleys with no riverbank settlements for 17 km) and only small riverside settlements and limited agriculture until river reaches in Gansu Province limit the magnitude of any impact. A comprehensive flood warning and emergency plan will complete the flood protection system.

23. Potential operational impacts arise from the risks of unsustainable water use for the range of irrigation applications (riverside greenbelts and mountain shelterbelts) and for the water supply components in the Qijiachuan valley. Water balances have been established to demonstrate sustainability for irrigation, and strict water allocations in the reservoir regulation plans will ensure water supply for target communities. A water safety plan for each water treatment plant will reinforce these outcomes. Additional operational safeguards at the water supply WTPs focus on the safe handling of the necessary corrosive chemicals and assurances that the legislative protections given to water sources in PRC are in place and are being enforced.

24. Landfill design, separation buffer and operational control will minimize impacts to environment and communities. The critical safeguard for the landfill site is the functioning of the leachate treatment system, methane control, and proper site management of the tip face. The leachate TP will be designed to contain leachate for periods of plant malfunction or maintenance. A methane collection system and monitoring system will be part of the detailed design.

25. Continuing control of noise, dust, odor, erosion and local transportation impacts are also parts of operational management of all components. The monitoring of water quality of treated wastewater from Ping'an WWTP is also required to ensure continued reuse as irrigation water.

G. Climate Change

26. **Greenhouse gas emissions.** The project will generate greenhouse gas (GHG) emissions in a number of ways, including use of fossil fuels and electricity for machinery and vehicles, emissions from constructed wetlands and emissions from landfill decomposition. The project construction phase is unlikely to produce large GHG emissions because existing construction equipment will be used and diverted to the current project (and therefore unlikely to result in large new GHG emissions in the context of existing city developments). The main generation of GHGs from the project will be from the operation of the wetland and landfill components. The indirect generation of GHG from power consumption for operational machinery (mainly pumps) will be a minor contribution. By the fifth full year of operations wetland and landfill will generate 51,000 and 20,000 t/yr CO_{2e} respectively, before emission savings measures are taken into consideration. At the same time, the large areas of greenbelt and shelterbelt plantations established by the project will significantly offset these emission levels through carbon sequestration. It is estimated that by year 10 after project commissioning cumulative carbon storage will be 35,000 t CO_{2e} (increasing to 220,000 t CO_{2e} at year 20) with a long term sequestration rate of 22,000 t/yr CO_{2e}. Aggregated CO_{2e} emissions are estimated at 16,000 t/yr CO_{2e} during project operation.

27. **Climate risk, climate adaptation.** Initial climate risk screening determined that the project was *medium climate risk*. A climate risk and vulnerability assessment (CRVA) was conducted at two levels: (i) at regional level to assess the vulnerability of the Integrated Water Management Plan for the Huangshui River Basin (IWMPHRB); and (ii) at Haidong city level to assess the

vulnerability of the designs of proposed project components, and the water resource management elements of the Haidong City Master Plan (HCMP). The CRVA found that (i) total water resources in Qinghai Province will not change significantly in future, but seasonal and annual variability are likely to increase; (ii) climate risks along Huangshui River are likely to increase due to increased seasonal and annual variability in precipitation and hence river flow volumes. Key recommendations of the CRVA were incorporated in the component design including (i) increased embankment heights to accommodate projected average increase in flood flows resulting from climate change (8%); (ii) provision of alternative water supply source for the Ping'an urban district to reduce increasing water security risk; and (iii) increased capacity of drainage and leachate collection system at landfill site. The project's contribution to climate adaptation was estimated to amount to 9.44 million USD (listed in Table I.3 below).

Table I.3: Adaptation Design Adjustments for Project Components

Subcomponents with climate proofing	Total Costs of sub-components	Contribution to Climate Adaptation (%)	Climate Adaptation Costs (million USD)	Notes
Flood protection works	67	0.5%	0.34	50% of embankments will be increased in height by average of 8-10 cm to accommodate projected increase in flood volumes (CRVA recommendation).
Water Reclamation	4.2	100.0%	4.20	Water reclamation was promoted by the project team at project concept stage as important measure to increase climate resilience of irrigation systems.
Mountain Forest	19.5	10.0%	1.95	Mountain forest will limit urban sprawl on fragile hills and reduce soil erosion from wind and water, which is likely to increase as a result of projected increased intensity of storms.
Water Supply	12.9	20.0%	2.58	Sanhe WTP will be used as secondary source and back-up water supply for Ping'an urban district, increasing resilience to water shortages that are projected to increase in future.
Landfill	7.6	2.0%	0.15	Stormwater interception drainage and leachate holding tank capacities increased by 10% and 20%, respectively (CRVA recommendation).
Capacity Development	2.2	10.0%	0.22	Capacity building component includes sub-module on climate adaptation (CRVA recommendation).
Total			***9.44***	

28. A capacity development sub-module for climate-resilient urban development planning and regional water resources management has been included to Component 4 of the project. The sub-module will be coordinated and provided by climate change and water resources management specialists. They will, amongst others, help the HMG to review and climate-proof the HCMP, and assess the feasibility to establish a provincial-level Huangshui River coordination body to address Huangshui water resources management issues at watershed level.

H. Public Consultation

29. Information disclosure and public consultation have been conducted during preparation of the domestic EIR and TEIAs in compliance with PRC regulatory framework, and this project IEE in compliance with ADB's Safeguard Policy Statement (2009). Information disclosure and consultation included disclosure on the internet, community posting, a questionnaire survey, and discussion forums attended by affected people and other concerned stakeholders. More than 190 government representatives, riverside residents, farmers, people living near the landfill and beneficiaries of the rural water supply were consulted. This built upon a socio-economic survey

of 250 households in 18 affected villages and communities. In addition, 30 focus group discussions were held with 200 persons including women, poor, ethnic minorities and the elderly.

30. The vast majority of people supports the Project and expects it to be put it into operation as soon as possible to truly benefit local residents. People expect that the Project will improve flood discharge capacity, ensure the safety of the embankments and local residents, reduce flood losses and waterborne diseases, and improve the living quality of people. Especially the proposed water supply works enjoy very strong support, with over 70% of respondents expressing their discontent with current water supply services. Key issues reported by residents in the first round were the potential for dust, noise and construction waste during construction. The second round comprising community representatives and agency stakeholders focused on: (i) management of Ledu Landfill site to be improved during operation; (ii) solid waste management along the Huangshui riverside to be strengthened; (iii) the EPB to monitor air quality surrounding the landfill site regularly; and (iv) the upstream of Fatai reservoir to be protected to ensure water quality for the water supply subcomponent. All respondents (100%) were supportive of the project if all mitigation measures proposed are implemented properly.

31. A plan for public consultation during construction and the initial phase of project operation has been developed and included in the EMP. The PMO and the IAs will be responsible for organizing the public consultations, with the support of the loan implementation environmental consultant (LIEC). Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractor, construction supervision company, IA, PMO), and the project level Grievance Redress Mechanism (GRM).

I. Grievance Redress Mechanism

32. A grievance redress mechanism (GRM) has been developed in close consultation with the Haidong EPB, the PMO, the IAs and the potentially affected people, and compliance with the SPS (2009) requirement to address environmental, health, safety, and social concerns associated with project construction, operation, and leasing arrangements. The GRM also facilitates a timely and effective response to any complaints from affected persons.

33. The PMO is the lead agency responsible for overall management, implementation, and reporting of the GRM. The PMO-ES[2] coordinates the GRM and: (i) instructs the IAs and contractors on their responsibilities in the GRM; (ii) establishes a simple registry system, to document and track grievances received (including forms to record complaints and how they have been resolved); and (iii) reports on progress of the GRM in the annual environmental monitoring and progress reports (EMR) to ADB.

34. Each IA will assign a member of staff, who is responsible for implementation of the GRM and other relevant aspects of the EMP. This will be the IA-ES. Tasks include keeping a record of complaints. At least two months before construction commences, these contacts will be publicized at each construction site and forwarded to local village committees to ensure that entry points to the GRM are well known. The GRM process will involve three main grievance redress steps, (i) by the contractors/IAs directly implementing corrective actions, (ii) by the PMO coordinating a response, and (iii) by the Project Leading Group convening a stakeholder meeting to resolve more complex issues.

[2] PMO Environmental Specialist

J. Environmental Management Plan

35. **Environmental management plan (EMP).** The EMP (IEE Attachment 1) brings together all the mitigation measures for the identified impacts as well as pre-construction requirements, and construction and operational management prescriptions. The EMP will be implemented in all phases of the project—design, pre-construction, construction, and operation. The EMP defines: (i) objectives; (ii) roles and responsibilities; (iii) mitigation measures; (iv) inspection, monitoring, and reporting arrangements; (v) training and institutional strengthening; (vi) GRM; and (vii) future public consultation. The EMP will be updated at the end of the detailed design, and included as a separate annex in all bidding and contract documents. The contractors will be made aware (through the PMO and the tendering agency) of their obligations to implement the EMP and to budget EMP implementation costs in their proposals.

36. HMG (through the PMO) will have main EMP coordination responsibility. A full time environmental specialist will be assigned in the PMO to coordinate implementation of the EMP. Each IA will assign one environment specialist to coordinate EMP at local level i.e. total of five officers. These officers will implement the EMP at a day-to-day site level. The environmental monitoring station (EMS) of the Haidong City Environment Protection Bureau (EPB) will be contracted by the IAs to implement the external environmental monitoring program of the EMP. The PMO-ES will supervise this monitoring. The EMS will report to the EPB and the PMO.

37. Loan implementation environment consultants (LIEC) will advise the PMO, IAs, contractors, and construction supervision companies on all aspects of environmental management and monitoring for the project. The loan implementation consultancy services will also include water and wastewater specialists, a wetland specialist and river ecology/hydrology specialists, and ecology experts. In addition, separate contracts will be awarded to consulting firms specialized in municipal waste management (including landfill O&M); wetland O&M; forest management (including irrigation); water resources management and climate adaptation.

38. Environment safeguards monitoring and reporting obligations are defined in the EMP and include (i) project readiness monitoring, to be conducted by the PMO-ES and LIEC; (ii) internal monitoring, to be conducted by the CSCs and contractors; (iii) external environment monitoring, to be conducted by the Haidong EMS (contracted by the IAs); (iv) EMP compliance monitoring during project implementation (up to the date of the project completion report), to be conducted by the PMO-ES and LIEC; and (iv) regular monitoring by O&M units during operation of the project facilities under their responsibility.

K. Risks and Assurances

39. The diverse range of project activities will require full and effective implementation of the EMP to mitigate potential impacts, especially to the river environment. Project loan assurances have been developed which strengthen the implementation of pre-construction readiness procedures, inclusion of the EMP in tenders and bids, compliance with laws and regulations, monitoring and reporting, and GRM implementation. Key assurances also cover ADB requirements in environmental safeguards during project implementation. The EMP contains a section on environmental contract clauses listing all required mitigation measures that shall be undertaken by contractors during construction (EMP Attachment 2). These clauses will be included in all tender documents and works contracts and will therefore be legally binding.

L. Conclusion

40. It is concluded that full and effective implementation of the safeguard measures described in the IEE and its EMP will combine to minimize adverse environmental impacts of the project, and contribute to the project achieving its goal of enhanced flood management and riverside

environment, erosion control along mountain edges, water security for communities in the Qijiachuan valley and environmentally sound solid waste disposal. The EMP and loan assurances ensure that these measures are implemented in an appropriate institutional framework and are supported through comprehensive training, monitoring and reporting arrangements.

II. POLICY, REGULARY AND ADMINISTRATIVE FRAMEWORK

A. Legislative Framework for Environment Impact Assessment in the PRC

42. The PRC has established a comprehensive regulatory framework for environment safeguards, composed of laws and administrative legislation promulgated by the State Council; departmental regulations issued by Ministry of Environment Protection (MEP); and provincial legislation and regulations, environmental standards; and international agreements. The amended Environmental Protection Law of the PRC (2014) further strengthens the requirement of public participation and information disclosure. The suit of laws, regulations, guidelines and standards relevant to this project is show in the tables below.

Table II.1: Applicable Environmental Laws

Title	Year
Environmental Protection Law	2014
Environmental Impact Assessment Law	2003
Water Law	2002
Water Pollution Prevention and Control Law	2008
Air Pollution Prevention and Control Law	2000
Noise Pollution Control Law	1997
Solid Waste Pollution Prevention and Control Law	2005
Water and Soil Conservation Law	2011
Forest Law	1998
Wild Fauna Protection Law	2004
Cleaner Production Promotion Law	2002
Urban and Rural Planning Law	2008
Land Administration Law	2004
Circular Economy Promotion Law	2009
Fishery Law	2000
Flood Control Law	1998
Protection of Cultural Relics Law	2013

Table II.2: Applicable Administrative Regulations

Regulation	Year
National	
Regulation on EIA of Plans and Programs	2009
Regulation on Environmental Protection Management for Construction Projects	1998
Directive on Wetland Protection and Management	2013
Environmental Protection Supervision Rules for Construction Projects	1998
Regulation on Culture Heritage Protection	2003
Regulation on River Course Management	1988
Requirements for the EIA Summary of Construction Project	2010
Classification of Construction Project Environmental Protection Management (MEP)	2009
National Biodiversity Strategy and Action Plan (2011-2030)	2010
Requirement for Social Risk Assessment of Large Investment Projects	2012
National Biodiversity Strategy and Action Plan (2011-2030)	2010
National regulation for public disclosure of EIAs (NDRC)	2012
Regulations on Scenic and Historic Areas	2006
Regulation on Hazardous Chemicals Safety Management	2011
Regulation on Wild Flora Protection	1996

Regulation on Wild Fauna Protection	1992
Regulation on Aquatic Wildlife Protection	1993
Regulation on Urban Water Supply	1994
Management of National Wetland Park (trial)	2010

43. Implementation of the environmental laws and regulations is supported by a series of associated management and technical guidelines (Table II.-3).

Table II.3: Applicable Environmental Impact Assessment Guidelines

Guideline	Year/Code
Jurisdictional Division of Review and Approval of EIAs for Construction Projects	2009
Guideline on EIA Categories of Construction Projects	2015
Interim Guideline on Public Consultation for EIA	2006
Technical Guideline on EIA: Outline	HJ2.1-2011
Technical Guideline on EIA Regarding Surface Water	HJ/T 2.3-1993
Technical Guideline on EIA Regarding Atmospheric Environment	HJ 2.2-2008
Technical Guideline on EIA Regarding Acoustic Environment	HJ 2.4-2009
Technical Guideline on EIA Regarding Ecological Impact	HJ 19-2011
Technical Specification on Water and Soil Conservation Plan	GB50433-2008
Technical Guideline on Environmental Risk Assessment for Construction Project	HJ/T 169-2004
Industrial Restructuring Directory (2011)	Revised in 2013

44. The PRC environmental quality standard system that supports the environmental laws and regulations is classified into two categories by function: pollutant emission/discharge standards; and, ambient environmental standards (Table II.4).

Table II.4: Applicable Environmental Standards

Standard	Code
Environmental Quality Standards for Surface Water	GB 3838-2002
Urban Ambient Acoustic Quality Standard	GB 3096-2008
Ambient Air Quality Standard	GB 3095-1996/2012
Integrated Emission Standard of Air Pollutants	GB 16297-1996
Integrated Wastewater Discharge Standard	GB 8978-1996
Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant	GB 18918-2002
Underground Water Quality Standard	GB/T 14848-93
Domestic Drinking Water Quality Standard	GB 5749-2006
Emission Standard of Environmental Noise for Boundary of Construction Site	GB 12523-2011
Noise Limit of Industrial Enterprises	GB 12348-2008
Standard for pollution control on hazardous waste storage	GB 18597-2001
Pollution control for storage and disposal site for industrial solid wastes	GB18599-2001
Emission Standards for Odor Pollutants	GB 14554-93

B. International Agreements

45. The PRC is a signatory to a number of international agreements relevant to environment protection. Those relevant to the project, along with the date of signing by the PRC, are listed in Table II.5.

Table II.5: International Agreements with the PRC as a Signatory

No.	Name of Agreement	PRC Signing Date	Agreement Objective
1	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	December 21, 1975	To stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the wetlands' ecological functions and their economic, cultural, scientific, and recreational values
2	Montreal Protocol on Substances That Deplete the Ozone Layer	January 1, 1989	To protect the ozone layer by controlling emissions of substances that deplete it
3	Convention on Biological Diversity	December 29, 1993	To develop national strategies for the conservation and sustainable use of biological diversity
4	United Nations Framework Convention on Climate Change	March 21, 1994	To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system
5	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification	December 26, 1996	To combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements
6	Kyoto Protocol to the United Nations Framework Convention on Climate Change	February 23, 2005	To further reduce greenhouse gas emissions by enhancing the national programs of developed countries aimed at this goal and by establishing percentage reduction targets for the developed countries
7	UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage	1985	This convention integrates the practice of heritage conservation in the PRC with that being done around the world.

C. Policy and Planning Context

46. **Flood risk management, water pollution control, wetland conservation.** In 1997, the PRC passed the *Flood Control Law*, reinforcing that a combination of structural and nonstructural measures would be pursued to address the problem of flooding in the country. The Ministry of Water Resources (MWR) initiated a program action that proposed non-structural measures including the return of polder lands to lake storage, resettlement of people from high-risk flood-prone land, and protection of mountainous areas to plant trees. In 2008, the State Council approved the *Flood Control Plan of Yellow River Basin*, targeting that a complete flood prevention system should be established for the river basin by 2025. Proposed key measures include, strengthening flood protection infrastructure, improving the management of water and soil erosion, and enhancing flood risk management capacities.

47. The *Country's 13th Five-Year Plan (2016-2020)* includes the PRC's toughest-ever water resource management program aimed at controlling consumption and preventing pollution. The Plan includes key environmental areas such as nationwide groundwater monitoring, increasing water-recycling programs, water price adjustments to encourage conservation, water supply safety, and market-oriented mechanisms for pollution control. Key environmental targets are included in the Plan such as, by 2020, forest coverage rate should reach 23%. In addition, the *13th Five-Year Plan of National Environmental Protection* (to be published in June 2016) is expected to be consistent with recent high-level guidelines; improving environmental conditions including through afforestation and wetland rehabilitation is expected to be a key recommendation. With regards to wetlands, *Comments on speeding up the eco-civilization development* issued by State Council clearly proposes that the total area of wetlands in the PRC must be maintained at over 800 million mu. Further, the *Planning Framework for 13th Five-Year Water Pollution Prevention Plan of Major Basins* released by MEP in January 2016 lists the upper and middle reaches of Yellow River as a key protection basin.

48. Key "sponge city" practices in urban development are provided in the *Technical Guideline*

to Sponge City Construction – Construction of low-impact development stormwater system prepared by the Ministry of Housing, Urban-Rural Development (October 2014). Sponge city measures include aspects such as the protection of original urban ecosystems, ecological restoration, and low-impact development. Applying a landscape approach where urban green areas and wetlands provide stormwater storage functions is an important recommendation in the guideline.

49. In the *12th Five-Year Plan of Water Resource Development of Qinghai Province*, three key focus areas were included: (1) establishing the flood control projects for major rivers and cities/counties that were still lagging behind; (2) improving the reinforcement of risky dams and reservoirs; and (3) strengthening the management of mountain flooding through combination of structural and nonstructural measures such as application of monitoring and early-warning systems. While the 13th FYP on water resources has not been released yet, the Qinghai Provincial Government has indicated key targets on flood prevention standards, with major cities reaching to 50-100 years return period and major counties to 20-30 years.

50. In line with the national and provincial guidelines, Haidong City developed *Haidong City Drainage (Rainfall) Integrated Flood Prevention Plan (2012-2030),* emphasizing that the comprehensive flood management for Haidong should include both Huangshui River main stream projects and mountain rivers projects. The Plan also focused on the flood plain development such as vegetation restoration and rehabilitation of wetlands along the rivers, which not only maintain flood detention areas, but also provide waterfront areas for the residents. In addition, in terms of water usage and quality control, the Plan also promotes the separation of rainwater and wastewater, and increasing the amount of water reclamation.

51. The *13th Five-Year Plan on Water Resource Development of Haidong City* recently issued defines further directions to complement the current strategies on flood control, requiring that the monitoring and early-warning systems for mountainous areas and reservoirs should be soon established, and additional water resources should be identified to improve the local drought-resilience capability.

52. **Soil Erosion Control.** In 2015, the State Council approved the *PRC Water and Soil Erosion Control Plan (2015-2030)*, the first national-level soil erosion plan that includes key targets in erosion control and rehabilitation. This Plan is regarded as a key milestone for the soil erosion control in the PRC and will serve as a blueprint and major guideline for a long term.

53. Qinghai Province has prioritized management of small river basins and protection of mountainous areas to address severe soil erosion through an *Integrated Management of Small Watershed Soil and Water Conservation Program.* By the end of 2012, about 329 tributary river basins were rehabilitated - the total area for soil erosion management was up to 7,794 km^2, and approximately 14,700 km^2 for total ecological restoration was achieved.

54. Realizing the importance of this issue towards sustainable development, Haidong City prepared the *Haidong City South-North Mountains Greening Master Plan (2013-2030).* Under this plan, Haidong City had completed the total forestation area of 7,887 mu (5.26 km^2) and land preparation area of an additional 12,913 mu (8.6 km^2) by the end of 2015.

55. The *13th Five-Year Plan on Water* Resource *Development of Haidong City* also emphasizes the importance of strengthening integrated management for water and soil erosion and ecological restoration, aiming to complete 3,787 km^2 of soil erosion management area, 544 km^2 of water environment rehabilitation and 2,248 km^2 of water source areas protection within the five year plan period.

56. **Water Supply.** With rapid development of the water supply systems for cities and counties

in the PRC, the water supply coverage for cities and counties is almost complete (~98% and ~90% respectively). However, the overall rural water supply coverage is still relatively low at 76%. More efforts from central government will be put towards increasing water supply coverage in rural areas and improving the quality of potable water. In February 2016, six PRC Ministries jointly issued the *Notice on Strengthening Rural Water Supply Safety and Planning Preparation during 13th Five-Year Period,* setting the target of increasing rural water supply coverage rate to above 85% and guaranteeing a rate not lower than 90% for small projects. In addition, extending urban water supply network to rural areas with overall improvement on the water quality standards was recommended.

57. The *13th Five-Year Plan on Water Resource Development of Haidong Cit*y issued recently also gave specific targets for the water supply improvements. For example, by 2018, additional 1.37 million of rural population should have safe water access – 13 new projects will be initiated with water supply amount increased by 28,960 m^3/d and beneficiaries of 0.26 million; and 504 projects need to be upgraded with total amount of 100,767 m^3/d and beneficiaries of 1.11 million.

58. **Solid Waste Management.** Development of municipal solid waste management is a major part of improving the PRC's environmental governance. The *12th Five-Year Plan of Environmental Protection* set a target that the harmless treatment rate of municipal solid waste should reach 80% by 2015 and all counties should have capacity to treat waste. This directive is expected to continue in the *13th FYP on Environmental Protection* which has yet to be released. Meanwhile, other targets focusing on recycling and waste reduction should also be established.

59. In the *13th Five-Year Plan of Economic and Social Development in Qinghai Province*, the overall targets for urban-rural environmental management include: wastewater and solid waste treatment facilities should be significantly increased along Huangshui River, Yellow River main stream, and around Qinghai Lake; and, all townships and more than 90% of villages should have effective and sufficient sanitary treatment capacities. The *Qinghai Haidong City Core Areas Municipal Infrastructures Special Plan (2014-2030)* lacks a detailed section on solid waste treatment. However, it targets the municipal solid waste treatment rate to reach 95% by 2020 and 100% by 2030. For Ledu District, the targets are stricter, requiring the solid waste treatment rate of 100% by the end of 2020, and the number of communities with waste collection to reach 80% of all communities in the District. The *Ledu District City Management 13th Five Year Plan* also planned specific facilities and infrastructures to meet the goal, including: additional 20,000 collection points, 14 transfer stations, and an integrated treatment park including classification and recycling, kitchen waste treatment, landfill, and construction waste treatment, during the period of 2015 – 2020.

60. **Strategic fit.** ADB's strategy and operations in the PRC are closely aligned with the government's priorities. The 13th Five-Year Plan of the PRC for the period 2016-2020 sets a goal of pursuing "ecological civilization" and places great emphasis on balancing economic pursuits with environmental protection. The ADB's Country Strategy for the PRC for 2016-2020 supports the PRC's strategic priorities including in managing climate change and pursuing environmental sustainability. Key thematic areas that coincide with the proposed project include strengthening climate resilience in urban and rural areas, improving sustainable use of land and natural resources, strengthening water security, enhancing green infrastructure, promoting integrated water resource management, wetland protection, and reforestation. In particular, the project will support the achievement of the following CPS outcomes that the ADB will contribute to in the PRC: Improved urban-rural environmental protection and expanded green infrastructure; improved quality and management of water and natural resources including reduced water pollution; integrated, expanded, and improved city-cluster, urban, and urban-rural infrastructure; and expanded and improved access to municipal and social services.

D. Applicable PRC and ADB Safeguards Policies and Assessment Categories

61. In accordance with the PRC Guideline on EIA Classification for Construction Projects (MOEP, 2015), the domestic environmental impact assessment reports (EIAs) were prepared on the basis of individual components. The most stringent requirement was for the land fill ("Urban-Rural Environment Rehabilitation") component which required a full EIA Report. The assessments of other components required EIA Table and EIA Registration Form respectively. The list of subcomponents and their corresponding level of PRC environmental impact assessment are shown in Table II.6. They will be approved by the Haidong City EPB.

Table II.6: DEIA Status under the Guideline on EIA Classification for Construction Projects (MOEP, 2015)

Subproject	Level of EIA	IA
Huangshui River Channel Ping'an Segment	EIA Table	PWB
Huangshui River Channel Ledu Urban Area Segment	EIA Table	LHURDB
Huangshui River Channel Ledu Rural Area Segment		LWB
Ping'an District Huangshui River Riverside Green Belt	EIA Registration Form	PFB
Ping'an District Mountain Edge Green Belt		PFB
Yizhou Wetland Ecological Conservation Area	EIA Table	PHCEPB
Huangshui River Ledu Segment Ecological Restoration	EIA registration form	LHURDB
Ping'an WWTP Water Reclamation for South Mountain landscape irrigation	EIA Table	PHCEPB
Ledu Sanitary Landfill Expansion	EIA Report	LHURDB
Wenzukou Reservoir and Fatai Reservoir Water Supply	EIA Table	PWB

LWB=Ledu Water Resources Bureau; LHURDB=Ledu Housing and Urban-rural Development Bureau; PHCEPB=Ping'an Housing Construction and Environmental Protection Bureau; PFB=Ping'an Forestry Bureau; PWB=Ping'an Water Resources Bureau

62. ADB's Safeguard Policy Statement (SPS, 2009) provides the basis for this project IEE. Projects funded by ADB must comply with the SPS. The purpose of the SPS is to establish an environmental review process to ensure that projects funded under ADB loans are environmentally sound, comply with domestic laws, and are not likely to cause significant environment, health, or safety hazards. The ADB classified the Qinghai Haidong Urban-Rural Eco Development Project as Category B and accordingly the PPTA team was required to assist the Haidong City Government to prepare a consolidated initial environmental examination (IEE) and an Environmental Management Plan (EMP) which complies with the safeguard guidelines set out in SPS (2009). This consolidated IEE has been prepared based on information in the individual Feasibility Study Reports (FSRs) and PRC environmental impact assessment documents for each component, as well as site visits to the components by the PPTA environment team.

E. Assessment Standards

63. The environmental standard system that supports the implementation of the environmental protection laws and regulations in the PRC can be classified by function-ambient environmental quality standards, and by pollutant emission and/or discharge standards. ADB's SPS requires projects to apply pollution prevention and control technologies and practices consistent with international good practices such as the World Bank Group's Environmental, Health and Safety

Guidelines (EHS).[3] For this assessment, where EHS standards exist for parameters and are relevant, they are used in parallel with PRC standards in this assessment.

1. Evaluation against Ambient Standards

64. The Haidong Municipal Environmental Protection Bureau has designated the environmental quality classes that apply to each component of the proposed Project (Table II.7).

Table II.7: Environmental Quality Classes in the Project Area

Variable	Function Classes
Air quality	Class II of GB3095-1996 before 1st January 2016; Class II of GB3095-2012 after 1st January 2016.
Acoustic environment	Class II of GB3096-2008
Surface water quality	Mainstream of Huangshui River in Haidong boundary: Class IV of GB3096-2008.
Groundwater quality	Class III of GB/T 14848-93
Soil quality	Class II of GB15618-1995

65. **Air quality.** The PRC ranks air quality into three classes according to *Ambient Air Quality Standard* (GB3095-1996; amended in 2000). Class I is highest air quality and Class III the worst. A new standard was issued in 2012 (GB 3095-2012), replacing GB3095-1996, and will become effective in all municipal level city in 2015 and nation-wide on 1 January 2016. The new standard combines Classes II and III, introduces $PM_{2.5}$ standards, and makes more stringent NO_2 standards. Currently, the applicable standard is GB3095-1996. The World Health Organization (WHO) has set up air quality guideline (AQG) standards for various air quality parameters for the protection of public health. Recognizing that progressive actions are needed to achieve these standards and the financial and technological limitations of some countries or localities especially in developing countries, the WHO also established interim targets as intermediate milestones towards achieving the AQG (Table II.8).

Table II.8: Comparison of PRC and WBG Ambient Air Quality Standards. n/a=not applicable

Variable	Averaging period	PRC Class I (μg/m³)		PRC Class II (μg/m³)		World Bank Group EHS[1] (μg/m³)	
		GB3095-1996	GB3095-2012	GB3095-1996	GB3095-2012	Interim target	AQG
SO_2	1-year	20	20	60	60	n/a	n/a
	24-hour	50	50	150	150	50-125	20
	1-hour	150	150	500	500	n/a	n/a
NO_2	1-year	40	40	80	40	n/a	40
	24-hour	80	80	120	80	n/a	n/a
	1-hour	120	120	240	200	n/a	200
CO	24-hour	4,000	4,000	4,000	4,000	n/a	n/a
	1-hour	10,000	10,000	10,000	10,000	n/a	n/a
TSP	1-year	80	80	200	200	n/a	n/a
	24-hour	120	120	300	300	n/a	n/a
PM_{10}	1-year	40	40	100	70	30-70	20
	24-hour	50	50	150	150	75-150	50
$PM_{2.5}$	1-year		15	N/A	35	15-35	10
	24-hour		35	150	75	37.5-75	25

[3] World Bank Group. 2007. *Environmental, Health and Safety Guidelines General EHS Guidelines.* Washington: World Bank.

66. **Acoustic quality**. Noise environment for the project's settings will be evaluated against Class II standards of the Ambient Acoustic Quality Standard (GB3096-2008) GB 3096-2008 categorizes five functional areas based on their tolerance to noise pollution: from Category 0 to Category 4. Category 0 is for areas with convalescent facilities that are the least tolerant to noisy environment and therefore has the most stringent day and night time noise standards. Category 1 is for areas predominated by residential areas, hospitals and clinics, educational institutions and research centers. Category 2 is for areas with mixed residential and commercial functions. Category 3 is for areas with industrial production and storage and logistics functions. Category 4 is for regions adjacent to traffic noise sources such as major roads and highways, and is subdivided into 4a and 4b with the former applicable to major road and marine traffic noise and the latter applicable to rail noise. Standards for various functional area categories are compared with the WBG's EHS guidelines in Table II.9 showing that the EHS guidelines have lower noise limits for residential, commercial and industrial mixed areas but higher noise limits for industrial areas. The EHS guidelines do not have separate noise limits for trunk roads but apply the same noise limits based on whether the areas are for residential or industrial uses.

Table II.9: Environmental Quality Standards for Noise (equivalent sound level L_{Aeq}: dB)

Noise Functional Area Category	Applicable Area	GB 3096-2008 Standard		WBG EHS[4] Standards	
		Day 06:00-22:00	Night 22:00-06:00	Day 07:00-22:00	Night 22:00-07:00
0	Areas needing extreme quiet, such as convalescence areas	50	40	55	45
1	Areas mainly for residence, hospitals, cultural and educational institutions, administration offices	55	45		
2	Residential, commercial and industrial mixed areas	60	50		
3	Industrial areas, warehouses and logistic parks	65	55	70	70
4a	Area within 35 m from both sides of expressway, and Class 1 and Class 2 roads	70	55	55	45

67. **Surface water quality**. The ambient environmental standard applied in this EIA is Surface Water Ambient Quality Standard (GB3838—2002) Class IV for mainstream of Huangshui River and Class II for the existing water supply reservoirs (Table II.10). Category II is suitable for drinking water sources. Category IV is suitable for general industrial use and non-contact recreational activities. Category V is the worst which is only suitable for agricultural and scenic water uses. The WBG has guidelines on effluent quality standards but not ambient water quality, and recognizes the use of local ambient water quality criteria for EHS purpose.

Table II-10: Surface Water Ambient Quality Standards (Unit: mg/L)

Standard	DO	BOD	COD	NH_3-N	pH	TP	TN
(GB3838-2002) – Class II	6	3	15	0.5	6-9	≤0.1	≤0.5
(GB3838-2002) – Class III	≥5	≤4	≤20	≤1.0	6-9	≤0.2	≤1.0
(GB3838-2002) – Class V	≥5	≤10	≤40	≤2.0	6-9	≤0.4	≤2.0

68. **Groundwater quality**. Groundwater quality will be assessed against Class III standards according to Quality Standards for Groundwater (GB/T14848-1993) (Table II.11). There are no equivalent EHS targets.

[4] World Bank Group 2007, Ibid.

Table II.11: Quality Standards for Groundwater

Item	pH	Permanganate Index	Total Hardness	Nitrate Nitrogen	Fluoride	Total E.coli
Class III	6.5-8.5	≤3.0 mg/L	≤450 mg/L	≤20 mg/L	≤1.0 mg/L	≤3.0x10^3/L

69. **Soil.** Soil quality in the PRC is divided into three classes according to the Environmental Quality Standard for Soils (GB 15618-1995). Class I represents the best and Class III the worst. Class II is applicable for the proposed project area (Table II.12).

Table II.12: Environmental Quality Standard for Soils (Class II)

Parameter	Maximum Allowable Concentration (mg/kg dry weight)		
pH	<6.5	6.5-7.5	>7.5
Cadmium (Cd)	0.30	0.30	0.60
Mercury (Hg)	0.30	0.50	1.0
Arsenic (As) paddy / dry land	30 / 40	25 / 30	20 / 25
Copper (Cu) farmland / orchard	50 / 150	100 / 200	100 / 200
Lead (Pb)	250	300	350
Chromium (Cr) paddy / Dry land	250 / 150	300 / 200	350 / 250
Zinc (Zn)	200	250	300
Nickel (Ni)	40	50	60

2. Emission Standards for Construction and Operation Activities

70. **Air quality.** Fugitive emission of particulate matter (such as dust from construction sites) is regulated under PRC's Air Pollutant Integrated Emission Standard (GB 16297-1996), which sets 120 mg/m^3 as the maximum allowable emission concentration and ≤1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particle diameter. Odor from the wastewater treatment stations and solid waste transfer stations should follow the Malodorous Pollutant Emission Standard (GB 14554-93). The maximum allowable concentrations at the boundary of the sites for NH_3, H_2S and odor are 1.5 mg/m^3, 0.06 mg/m^3, and "20" (dimensionless). There are no equivalent EHS targets.

71. **Wastewater.** Discharge of wastewater from construction sites is regulated under PRC's Integrated Wastewater Discharge Standard (GB 8978-1996). Class I standards apply to discharges into Category III water bodies under GB 3838-2002. Class II standards apply to discharges into Categories IV and V water bodies. Class III standards apply to discharges into municipal sewers going to municipal WWTPs with secondary treatment. Wastewater generated during construction will be discharged into Category III and V water body. Class I and Class II of GB 8978-1996 applies for construction sites under this project (Table II.13).

Table II.13: Integrated Wastewater Discharge

Parameter	Class I	Class II	Class III
	For discharge into Category III water body	For discharge into Category IV and V water bodies	For discharge into municipal sewer
pH	6–9	6–9	6–9
SS mg/L	70	150	400
BOD_5 mg/L	20	30	300
COD mg/L	100	150	500
TPH mg/L	5	10	20
Volatile phenol mg/L	0.5	0.5	2.0
NH_3-N mg/L	15	25	---
PO_4^{2-} (as P) mg/L	0.5	1.0	---
LAS (= anionic surfactant) mg/L	5.0	10	20

72. The proposed WWTP in Ping'an District designed based on Class 1A of Urban Sewage Treatment Plant Pollutant Discharge Standards (GB18918-2002) (Table II.14). The reuse of treated effluent shall satisfy *The Reuse of Urban Recycling Water: Water Quality Standard for Urban Miscellaneous Water Consumption (GB/T 18920-2002)* for urban landscaping irrigation. *The Reuse of Urban Recycling Water: Water Quality Standard for Green Space Irrigation (GN/T-25499-2010)*.

Table II.14: Comparison of Urban Sewage Treatment Plant Pollutant Discharge Standards and Reuse Standard

Parameter	Unit	GB18918-2002 Class 1A	GB/T 18920-2002	GB/T 25499-2010
COD	mg/L	50	-	-
BOD_5	mg/L	10	10	20
SS	mg/L	10	-	-
Turbidity	NTU	-	-	≤5 (not restricted green space; ≤10 (restricted green space)
Ammonia	mg/L	5(8)	10	20
TN	mg/L	15	-	-
TP	mg/L	0.5	-	-
Petroleum	mg/L	1	-	-
Total Chlorine Residue	v	-	-	0,2≤end of pipe network≤20
LAS	mg/L	-	-	1.0
Fecal coliform	CFU/L	-	-	≤ 200 (not restricted green space; ≤1,000(restricted green space)
Ascaris eggs	Eggs/L	-	-	≤1 (Non-restricted green space), ≤2 (restricted green space)

73. Most of the parameters that meet Class 1A effluent wastewater quality will also meet the quality standard for reclaimed water for green space irrigation, except for levels of total coliform and *Ascaris* eggs. Therefore, the FSR proposed chlorination disinfection of the effluent before its use for irrigation. ClO_2 (chlorine dioxide) has been designed for disinfection with a capacity of 10,000 m^3/d in the Ping'an Wastewater Treatment Plant (WWTP) Water Reclamation Project[5], and is planned to be implemented in Phase I work. No additional disinfection is needed for Phase II.

74. **Sludge disposal.** The quality of sludge going to landfill disposal should meet the Standard for Pollution Control on the Landfill Site of Municipal Solid Waste (GB 16889-2008). This requires the water content of sludge not to exceed 60%, and meet standards for reuse including as soil conditioner (GB15618-1995), afforestation in gardens and windbreak plantation (GB23468-2009), fertilizer for agricultural use (GB4284-84), land improvement (CJ/T 291-2008), brick building (CJ/T 289-2008) and other land applications. There are no equivalent EHS targets (each country having its own sludge disposal and reuse quality standard).

75. **Noise.** Construction noise will be assessed against the PRC Emission Standards of Ambient Noise for Boundary of Site Noise (GB 12523-2011) and Class II of Emission Standard for Industrial Enterprises Noise at Boundary (GB 12348-2008) (Table II.15).

[5] Ping'an County Water Reclamation Project Feasibility Study Report

Table II.15: Construction Site Noise Limits. Unit: Leq [dB (A)]

Period	Major Noise Source	Noise Limit	
		Day	Night
Construction	Bulldozer, excavators and loader; pile driving machines; concrete mixer, vibrator and electric saw; hoist and lifter	70	55
Operation	Pumps	60	50

76. **Vibration.** Construction activities will cause vibration impact, and should comply with the Standard for Urban Area Environmental Vibration (GB10070-88) (Table II.16).

Table II.16: Vertical Vibration Standard Value for Various Urban Areas (Unit: dB)

Scope of applicable area	Day	Night
Special residential area	65	65
Residential, cultural and educational area	70	67
Mixed area and commercial center	75	72
Industrial centralized area	75	72
Both sides of traffic trunk line	75	72
Both sides of railway main line	80	80

F. Area of Influence

77. For the assessment of environmental impacts, the project's direct area of influence extends along the length of the Huangshui River from the Gaolong Hydropower Station diversion channel in the west (upstream) to the end of the Ledu rural section at Laoya Gorge in the east (downstream). This is a distance of 100 km and includes the riverbed, wetlands and both banks inland to an average distance of 60 m where embankments and greenbelts will be constructed (along 74 km).. Construction will mainly occur in non-urban areas along the river which are vegetated or support agriculture, since these lands are flood prone. However, in the Ledu city area, riverside works will be in an urban setting.

78. Further areas of direct influence of about 800 ha occur along the southern edge of the Haidong urban area and on South Mountain where shelterbelt forests will mark a limit to urban expansion and protect the fragile landscape. The area of direct influence also covers the Qijiachuan valley up to and including the Fatai and Wenzukou reservoirs, and the site of the landfill located in the first line of foothills 2km southwest of the village of Qilidian.

79. Cutting across these areas is the network of pipe-laying to deliver irrigation water to the greenbelts and shelterbelts, and linking the water supply components in the Qijiachuan valley. The communities near these areas will be potentially affected during construction. All the areas of direct influence of the project are depicted in Figure III.2 in the next chapter.

80. The indirect area of influence extends a further 17 km downstream on the Huangshui River to where the first floodplain settlement potentially affected by changed floods occurs. Indirect areas of influence also occur in the watersheds which feed the reservoirs and determine their raw water quantity and quality. The service areas of the water treatment plants and water distribution and the buffer zone around the landfill will also be indirectly affected.

81. Because of the multitude of activities and large areas over which they will occur, it is not meaningful to compile a long list of individual sensitive receivers. Instead, in the assessment of impacts, distances over which impacts will be experienced are identified (e.g for noise, dust) and sensitive receivers within these distances are identified. For the loss of land and habitats

along the river and pipeline alignments, the actual footprint of disturbance has been calculated from field survey.

III. DESCRIPTION OF THE PROJECT

A. Project Rationale

82. The PRC has experienced high urbanization in the past three decades, with urban population increasing from 191 million to 731 million, and the proportion of urban residents rising to 53.7% from 19.4%. By 2045, the urban population is expected to reach 70% of the total population or approximately one billion people. The large-scale urbanization has required considerable investments in urban infrastructure. While municipal services, such as water supply and wastewater coverage and treatment, have reached more people, urbanization has also brought considerable environmental and social challenges. Recognizing this, the national government has proposed a new model of urban development in their *National Plan for New Urbanization* published in 2014. The new model proposes urban development that is "people-centric, environment-oriented, and market-led." The new model for urbanization builds upon more than two decades of emphasis on sustainable development, which was first raised in the PRC's National *Agenda 21* in 1994. Since then, national level policies have continued to promote sustainable development. The *13th Five-Year* Plan (2016-2020) continues this emphasis and has identified green development as one of the five key development concepts (innovative, coordinated, green, opening and inclusive development). Green development includes: (1) reasonably utilizing the natural resources and promote the harmonious coexistence between humans and nature; (2) strengthening management efforts to improve environment quality; and (3) prioritizing the ecological protection and restoration and strengthening water environment management.

83. Qinghai Province is located in the western portion of the PRC, mostly on the northeastern part of Qinghai-Tibetan plateau. The province has long been a melting pot for a number of ethnic groups including the Han, Tibetans, Hui, Tu, Mongols, and Salars. Haidong City is the second largest city in the province and located adjacent to Xining, the provincial capital. In line with national policies to promote development in the western provinces, and to protect fragile mountainous landscapes and the headwaters of key rivers of national and international importance (including the Yellow River, Yangtze River, and Mekong River) further to the west, Qinghai has made a decision to limit urbanization and industrialization within the Xining-Haidong urban cluster. Haidong was recently upgraded to a prefecture-level city, a designation that recognizes the city's importance towards regional development.

84. Haidong is a city of 1.72 million residents. Urban development is concentrated in two districts – Ping'an and Ledu. Both districts are located along the Huangshui River, a nationally important tributary of the Yellow River. Urban development in Ping'an and Ledu is concentrated within the narrow valley of the Huanghsui River, and confined between steep mountainous areas. Buildable land is limited and the fertile valley has been experiencing a high rate of conversion from farmland to urban development. According to the *Master Planning of Haidong Urban Area (2013-2030)*, the two districts are expected to add more than half million residents by 2030. Ledu District is projected to increase from 109,800 residents to 502,000 between 2012 and 2030, while Ping'an is expected to see its population grow from 68,100 to 190,000 during the same period. This will put pressure on an already fragile landscape that is prone to flooding[6] and considerable amount of soil erosion, as well as on existing municipal services including water supply and solid waste disposal.

[6] According to Haidong's historical records, flood events of different levels occurred every year since 1949, with large-scale floods occurring every 6-7 years. In 2010, flooding in Haidong City caused direct economic loss of CNY 89.7 million in Ping'an, Ledu and Huangyuan Counties.

85. To address these concerns, the Government of the PRC proposed the *Qinghai Haidong Urban-Rural Eco Development Project* to Asian Development Bank (ADB) in 2013. The Government requested lending support to improve environmental sustainability in Haidong, mainly through the protection and better management of the Huangshui River and its watershed, and to help the city achieve its key goal to become "a plateau ecological livable city" as identified in the *Haidong City Master Plan 2013-2030*. Key aspects of the Project include: (i) reducing vulnerabilities to flooding and climate change; (ii) rehabilitating the riverine wetlands and riparian areas; (iii) controlling soil erosion by increasing forest coverage along the fragile mountainous landscape that will also serve as an urban growth boundary; (iv) addressing water insecurity through water reclamation for irrigation of the mountainous landscape and increased water supply coverage for rural residents; (v) expanding solid waste disposal capacities; and (vi) enhancing recreational opportunities along the river for Haidong residents.

86. Innovative **and special features.** The project design incorporates lessons from previous ADB-financed projects and policy-oriented studies on IWRM, environmental and ecosystem improvement, wetland management and restoration, reforestation, urban–rural integration and climate adaptation in the PRC, as reflected in several innovative and special features including the following: (i) Climate risk and vulnerability assessment (CRVA) to raise awareness and identify risks related to climate change in Haidong City, and incorporation of risk modeling data in the design of flood protection infrastructure; (ii) Landscape approach to reduce soil erosion and to facilitate temporary storage of flood waters; (iii) Use of reclaimed water for mountainside irrigation that showcases an integrated approach to address water supply and soil erosion challenges; (iv) Development of a constructed wetland on the Huangshui floodplain to meet multiple objectives of storm/river water quality remediation, increasing ecological function, recreational and educational opportunities; (v) Water balance study and non-revenue water (NRW) assessment intended to address potable water security concerns in Ping'an District; and (vi) Institutional strengthening to support better coordination and project implementation with regards to water resource management.

87. In addition to the specific climate change adaptation measures incorporated in component designs (or to be included during the detailed design phase), the whole of the project in conjunction with Qinghai's planning policies for the Huangshui basin contributes to climate adaptation on a regional scale. This is through six major initiatives: (i) limiting urban development along the Haidong corridor to protect the fragile landscapes of the hills and slopes for erosion and enhance watershed values; (ii) urban greening will mitigate the effects of urban "heat islands", increase amenity and reduce power consumption for domestic climate control; (iii) wastewater reuse will take pressure off potable water services and the exploitation of limited natural water resources for irrigation; (iv) water conservation saving and water conservation techniques in the design of irrigation systems; and (v) the diversification of water sources for more conservation-oriented management of regional water resources;

B. Project Impact, Outcome, Outputs

88. The expected impact of the project will be improved quality of life and environmental sustainability in Haidong City. The outcome of the project will be improved water resources management in the Huangshui River watershed through the four outputs that reflect an integrated and multidisciplinary approach towards enhancing flood protection, controlling soil erosion, improving water quality, expanding drinking water treatment and supply, reducing water insecurity, improving solid waste disposal capacity, increasing climate change resilience and strengthening institutional capacities. All of these provide public safety and/or health benefits and thus improve the quality of life and provide long-term economic benefits in Haidong City.

89. The proposed project has four outputs which are summarized below (Table III.1a). The O&M arrangements for each of the subprojects are defined in Table III.1b.

Table III.1a: Project Outputs and Components

Name	Description	Cost (CNY million)
Output 1: Integrated flood plain management infrastructure for Huangshui River provided		
1.1 Huangshui River Channel Ping'an Segment	Embankment and blockage removal along the Huangshui River Channel: a) Xiaoxia Segment: (1) from Gaolong Hydropower Station Diversion Channel to the Haidong Industrial Park New Retaining Wall, on the south bank, total length 3980 m embankment; (2) 2 km of embankment at tributary mouth and construction of 3 water culverts. b) Shangtan Segment: (1) 2,300 m embankment on the north bank Shangtan Bridge to the Xidao; (2) 2,980 m embankment from downstream Shangtan bridge to Xidao on the south bank; (3) Blockage removal of 100,000 m3; (4) 1 km of embankment at tributary mouth and construction of 3 water culverts. c) Zhangjiazhai Segment: (1) 2,070 m embankment on the north bank from the Dongtou Village to the Shuimogou Channel; (2) 2,350 m embankment on the south bank from the Dongzhuang Village to the Bazanggou Channel; (3) 3 km of embankment at tributary mouth and construction of 4 water culverts.	159.75
1.2 Huangshui River Channel Ledu Urban Area Segment	Embankments along the Huangshui River Channel: 15 km embankment on both sides of the Huangshui River Channel (7.5 km on each side) from Haidong Avenue Number One Bridge to the Shuimoying Bridge. Enhancement of riverside park areas comprising recreation areas, parklands and wetlands. 116 ha.	290.00
1.3 Huangshui River Channel Ledu Rural Area Segment	Embankment and blockage removal along the Huangshui River Channel: a) Hetanzhai to Haidong Avenue No.1 Bridge Segment: (1) 5,970 m embankment on the north bank from Shuimogou Channel to Haidong Avenue No.1 Bridge; (2) 5,300 m embankment on the south bank from the Bazanggou Channel to Haidong Avenue No.1 Bridge; (3) 5 km of embankment at tributary mouth and construction of 8 water culverts. b) Shuimoying Bridge to Lubanting Bridge Segment: (1) 11,780 m embankment on the north side; and (2) 16,300 m embankment on the south side; (3) 5 km of embankment at tributary mouth and construction of 20 water culverts; (4) total blockage removal volume of 30,000 m3.	372.88
1.4 Ping'an District Huangshui River Riverside Green Belt	Construction of Ping'an District Huangshui River Riverside Green Belt a) New Urban Area Segment: Starting from east of Pinganxin Park in the west and ending at Qijiachuan River, on the south side of Huangshui River Channel. Total area 13.5 ha of green belt. b) Main Urban Area Segment: Starting from Qijiachuan River in the west, and ending at Yizhou Wetland in the east, on the south side of Huangshui River Channel. Total area 8.5 ha of green belt. c) Eastern Segment: Starting from Zhangjiazhai Bridge in the west, and ending at Shuimogou Channel, on the north side of the Huangshui River Channel; and starting from Yizhou Wetland in the west and ending at Bazhanggou, on the south side of the Huangshui River Channel. Total area 49.2 ha of green belt.	106.15
1.5 Yizhou Wetland Area	A wetland park with a total area of 20 ha (constructed wetlands (10.88 ha), wetland recreational area (4.43 ha) and a science-education area (4.69 ha). West side from the intersection of Lan-Xi highway and Huangshui River opposite Baima temple, and east side to intersection of Lan-Xi highway and Huangshui River near Xidao.	115.84
Output 2: Haidong urban catchment soil erosion control measures implemented		
2.1 Ping'an District Mountain Edge	Construction of Ping'an District Mountain Edge Shelterbelt. a) Haidong New Urban Area segment: starting from the Sanshilipu in the west, and	154.49

Shelterbelt	ending at Sanhe Avenue in the east, total area of 62.2 ha of shelterbelt. b) Ping'an Urban Area and Eastern Area Segment: Starting from the Qixingtai Park in the west and ending at Bazanggou in the east, total area of 42.5 ha of shelterbelt.	
2.2 Ping'an WWTP Water Reclamation	Expansion of pipeline network from Ping'an WWTP for South Mountain Landscaping Water Irrigation System with total reclamation capacity of 9,500 m3/d, including 3 pump stations, 76.4 km of pipes and 15 water storage tanks.	101.78
Output 3: Rural Water Supply and urban solid waste infrastructure constructed		
3.1 Wenzukou Reservoir and Fatai Reservoir Water Supply	Construction of Fatai Reservoir WTP (1,500 m3/day); Wenzukou Reservoir WTP (1,500 m3/day), Sanhe Township WTP (20,000 m3/day), raw water conveyance pipelines, and distribution pipelines.	119.25
3.2 Ledu Sanitary Landfill Expansion	Construction of the Phase 3 and Phase 4 of the landfill, with capacity of 850,000 m3.	72.80

Output 4: Project management capacity strengthened		
4.1 Capacity building and institutional strengthening of EA/IAs	Consulting service, training and equipment upgrade aimed at strengthening EA and IA's capacity in project implementation and operational management to ensure smooth project implementation and sustainability in future operation.	22.24

Table III.1b: Detailed Arrangement for Components (Operational Phase)

	Component	**O&M Unit**
1	***Output 1: Integrated flood plain management infrastructure for Huangshui River provided***	
1.1	Huangshui River Channel Ping'an Segment	Ping'an Water Course Management Station
1.2	Huangshui River Channel Ledu Urban Area Segment	Ledu River Course Management Center
1.3	Huangshui River Channel Ledu Rural Area Segment	Ledu River Course Management Center
1.4	Ping'an District Huangshui River Riverside Green belt	Ping'an Forestry Bureau
1.5	Yizhou Wetland Ecological Conservation Area	Conservation Station set up by the Ping'an Housing Construction & Environmental Protection Bureau
2	***Output 2: Haidong Urban Catchment Soil Erosion Control Measures Implemented***	
2.1	Ping'an District Mountain Edge Green belt	Ping'an Forestry Bureau
2.2	Ping'an WWTP Water Reclamation Phase II	Ping'an Housing Construction & Environmental Protection Bureau
3	***Output 3: Rural Water Supply and urban solid waste infrastructure constructed***	
3.1	Wenzhukou Reservoir and Fatai Reservoir Water Supply	Ping'an Water Affairs Bureau
3.2	Ledu Sanitary Landfill Expansion	Ledu City Management Bureau

Figure III.2: Overall project location map, project components

C. Output 1: Integrated Flood Management Infrastructure for Huangshui River

90. Project components under Output 1 will include the following:

a) Provide flood protection infrastructure (embankments, comprising levees or dykes), and/or rehabilitate existing infrastructure to 20/30 year return period flood event in accordance with the State and local flood control standards to enhance the main Huangshui River flood control capacity (in Ledu urban area, the standard will be 50 year return period flood event);
b) Undertake remediation works along the erosion susceptible areas and pursue stabilization works to reduce riverbank erosion and collapse. About 117km of riverbank protection revetment works have previously been built, however due to poor design and construction methods most of these works are in disrepair and require urgent improvement;
c) Improve Huangshui River channel water flow by clearing blockages caused by failed banks;
d) Establish a 71.2 ha riverside green belt along the south and north banks of the Huangshui River mainstream in Ping'an District;
e) Construct the Yizhou Wetland Park along the southern bank of Huangshui River from the conjunction of Bamasi in the west to Xidao in the east.

Components 1.1 and 1.3: Embankment works in Ping'an and Ledu Rural Segment

91. The design criteria for the Huangshui River flood and river embankment protection works follows the National and State design standards and codes and is based on the number of affected population in the area, protected cultivated land areas and protected infrastructure. The river protection works for the study area will follow a flood control standard of 20 year or 30 year return period design flood event, depending on the location of the structures. A free board of 0.7 m above modeled flood levels[7] has been incorporated into the embankment designs in accordance with the PRC embankment design code (GB50286-2013) for the flood protection levee embankments.

92. Flood maps for the existing situation of the Huangshui River from Xiaoxia Bridge to Lubanting Bridge have been prepared from 5 year to 100 year return period flood (Figures III.2a-c). These flood maps show that the Huangshui River is well confined in reaches where the constraints of terrain and existing flood control works maintain a bounded channel, while in other reaches the 5 year flood event overflows the river banks onto floodplain of low-lying areas.

93. The Huangshui River floodplain is under the 30 year flood level in most of the river segments. With the increase in flood protection embankments along the main river channel under the project, the flood storage area will be reduced in these areas. To avoid the exacerbation of flooding in the remaining flood storage parts of the floodplain as a consequence, a series of riverside greenbelts will also be constructed by the project to maintain flood storage functions within the natural floodplain.

[7] This design flood includes the 8% increase in flows recommended by the project climate change vulnerability assessment (CRVA).

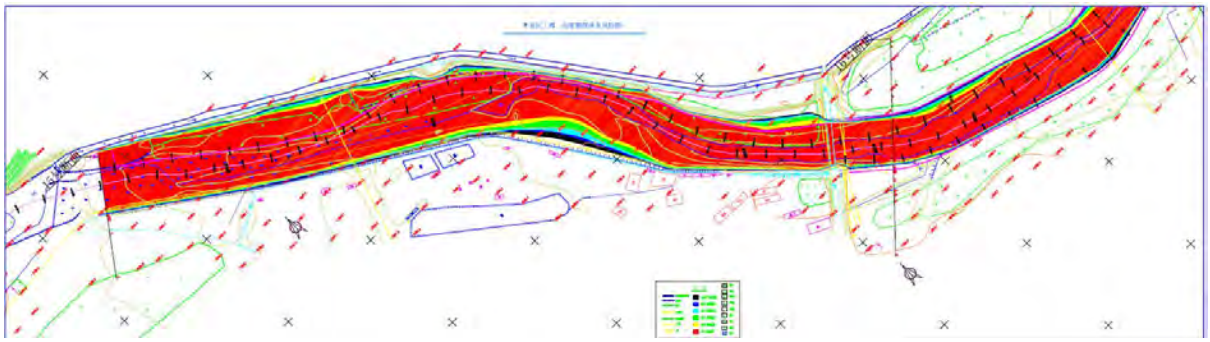


Figure III.3a: Huangshui River Flood Map at confined channel area (Red is the 5 year flood extent and Black is 100 year flood extent)

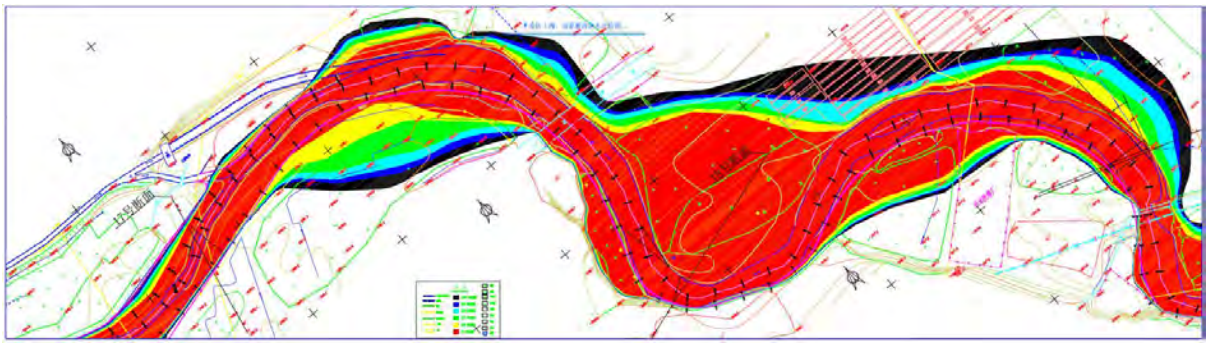


Figure III.2b: Huangshui River flood map in Ping'an area (Light Blue is the 30 year flood extent)

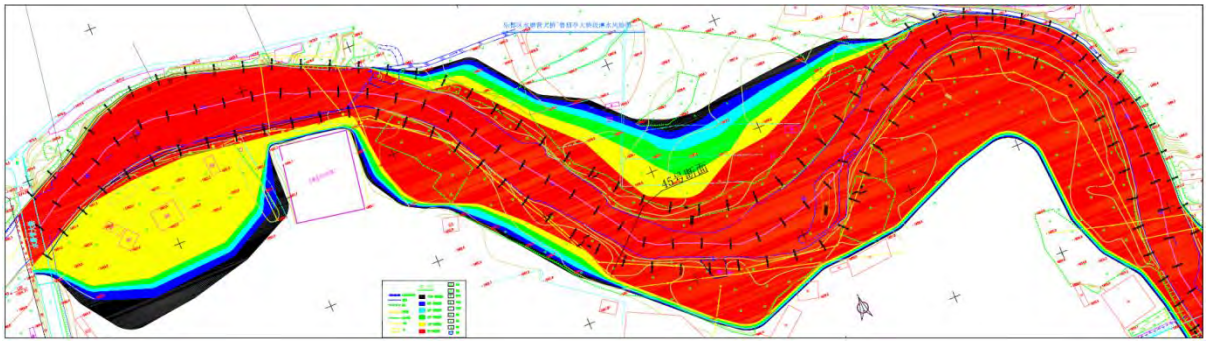


Figure III.2c: Huangshui River flood map in Ledu urban area (Yellow is the 10 year flood extent)

94. The proposed works include a total of six design concepts of embankment structures that combine riverbank scour protection works, flood protection levees and riverside habitat niches. The design best suited to the riverbank conditions will be used. These alternative designs and their application are discussed in Chapter VI (Analysis of Alternatives). The construction period for riverbank works and embankments is from the beginning of the second quarter 2017 to mid 2019. This long construction period is to allow for periods of high river flows when work will on riverbanks will be interrupted. The main engineering works involved are listed in Table III.2.

Table III.2: Engineering works of Components 1.1 and 1.3

Location	Segment	Embankment (km)			Crest access track (km)			Culvert	Protection level
		Left	Right	Total	Left	Right	Total		
Ping'an	Xiaoxia	0	3.98	3.98	0	3.98	3.98		1/30
	Shangtan	2.3	2.98	5.28	2.3	2.98	5.28		1/30

Location	Segment	Embankment (km)			Crest access track (km)			Culvert	Protection level
		Left	Right	Total	Left	Right	Total		
	Zhangjiazhai	2.07	2.35	4.42	2.07	2.35	4.42		1/30
	Gully mouth training	2	1	3					
Ledu (Rural)	Hetanzhai bridge-Daxia bridge	5.97	5.3	11.27	5.97	5.3	11.27	8	1/20
	Shuimoying bridge-Lubanting bridge	11.78	16.3	28.08	11.78	16.3	28.08	30	1/30
	Gully mouth training	2	2	4					
	Total	31.62	39.41	71.03	22.12	30.91	53.03	38	

95. **Blockage removal.** To meet the minimum Huangshui River channel hydraulic conveyance and to accommodate major flood events within the riverbanks a blockage removal of localized in-fall material such as rocks, gravel and sand is required. The amount of blockage removal required was calculated in the FSR for the Ping'an river section of 100,000m^3 and for the Ledu river section 30,000 m^3 of river rubble and sand materials.

96. To minimize the temporary impact on water quality and on the riverine environment this work will be undertaken in stages during the dry season, whereby the river will be diverted from left bank to right bank and from right bank to left bank and then removing the blockage when the there is no water in the area of works. This activity will only occur at selected spots on the river and work during the low flow period will avoid hydrological or river geomorphological changes. Removal of blockages will return the river to its normal configuration.

Component 1.2 Embankment protection and riverside park in the Ledu Urban area

97. The works in the Ledu urban segment will consist of two elements – consolidation of flood protection for Ledu Urban area, and enhancement of riverside parkland. The project area will be divided into four riverfront functional areas: (i) metro riverfront landscape business district, (ii) vibrant riverside recreation and leisure area, (iii) Old Town portal riverside landscape areas, and (iv) riparian wetland ecological experience zone (see Figure III.3). Several design concept variations are proposed for each functional area (see Figures III.4 and III.5) including off channel wetlands within the flood embankments.[8] The riverside parkland areas along the 7.5 km reach of the Huangshui will total 116 ha. The conceptual designs in the figures illustrate the following elements:

a) Metro Riverfront Landscape Business District – This area is adjacent to the new business district in Ledu, in which green corridors will be strengthened on both sides of the river and amenity facilities such as pedestrian walkways will be provided to enhance connectivity along the riverside and quality of waterfront landscape.
b) Riverside Recreation and Leisure Area - There are two separated parts on both sides of the Urban Riverfront Business Landscape Area, in which leisure, sport and entertainment facilities will be provided and embankments will be renovated.
c) Old Town Portal Riverside Landscape Areas - This area is gateway to the old Ledu downtown area. Embankments and riverfront landscape on the north bank will be improved and waterfront platforms on the south bank will be built for better view to the north.

[8] These landscape designs are still at a conceptual level; landscape design during the detailed design stage will ensure that ecological principles are followed in the design of the wetlands.

d) Riparian Wetland Ecology Experience Zone - Farmland and wetland landscape will be provided in this area to form a diversified ecological riparian zone. It will also provide flood storage to offset the loss of floodplains that will result from embankment construction. Pedestrian routes and walkways will be built along the river.

Figure III.3a: Concept design for riverfront parkland within the embankment in Ledu urban area

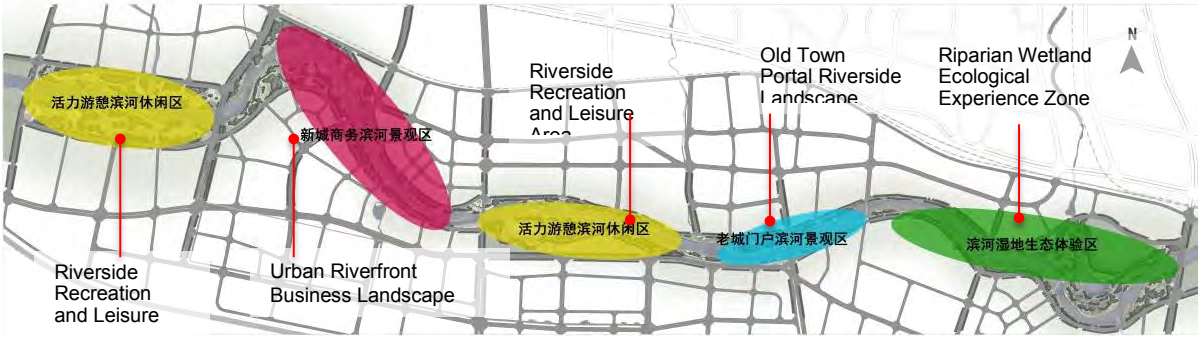


Figure III.3b: Functional areas for riverfront parkland within the embankment in Ledu urban area

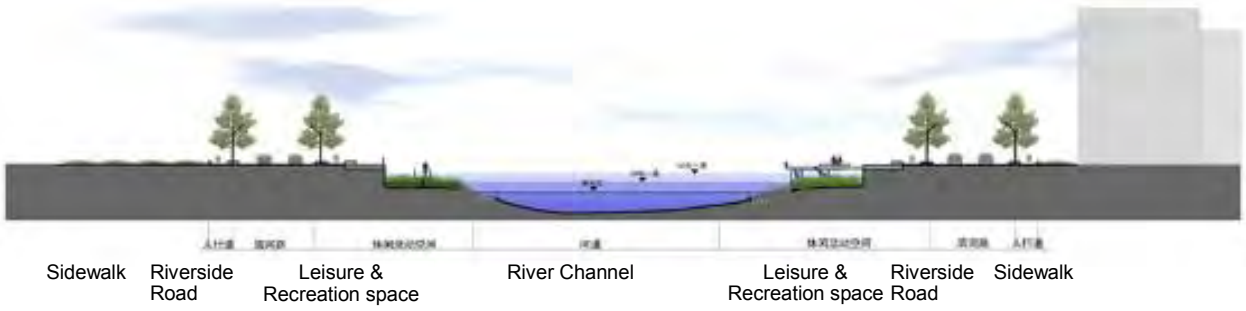


Figure III.4: Proposed river section in Ledu urban area (Metro Riverfront Business)

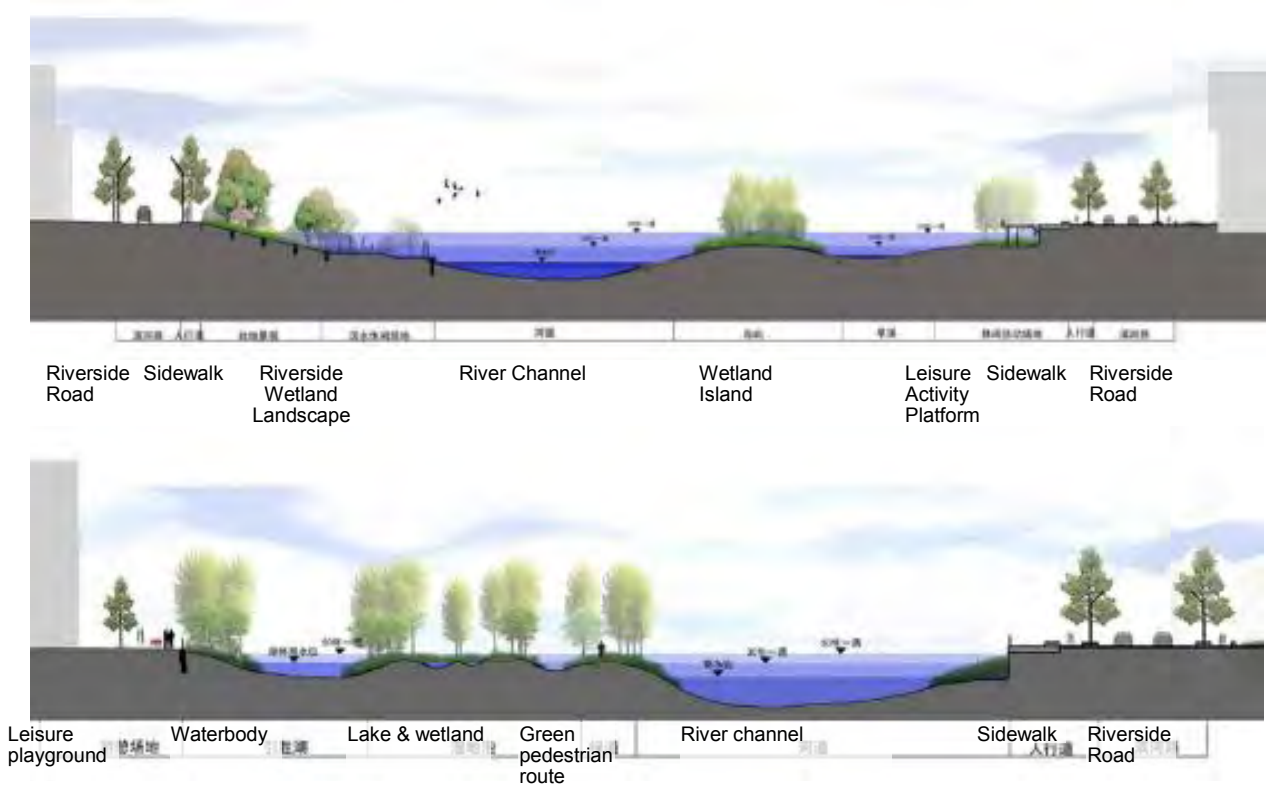


Figure III.5a and b: Proposed river sections in Ledu urban area (channel and parkland)

Component 1.4 Ping'an Riverside greenbelt landscaping

98. Three segments of riverside greenbelts will be developed in Ping'an district: (i) a section along the new urban area of Haidong extending for 3.1 km and covering an area of 19.5 hectares (Figure III.6a); a section along the existing urban area extending for 2.3 km and covering an area of 16 ha (Figure III.6b); and an eastern section that will extend for 12.3 km (divided on both sides) and cover 42.4 ha (Figure III.6c).

Figure III.6a: Proposed riverfront greenbelt in Ping'an District east

Figure III.6b: Proposed riverfront greenbelt in Ping'an District center

Figure III.6c: Proposed riverfront greenbelt in Ping'an District west

99. Different design layouts are proposed for the different sections. These will be further developed during the detailed design stage. The planned layouts illustrate the configuration of planting areas for new trees, and recreational trails for walking and bicycle access (see Figure III.7 and III.8).

100. The riverside greenbelt will serve as a recreational amenity that will improve public access along the riverfront. The forested area is also expected to increase biodiversity, stabilize the riverbanks and provide a visual amenity along the river.

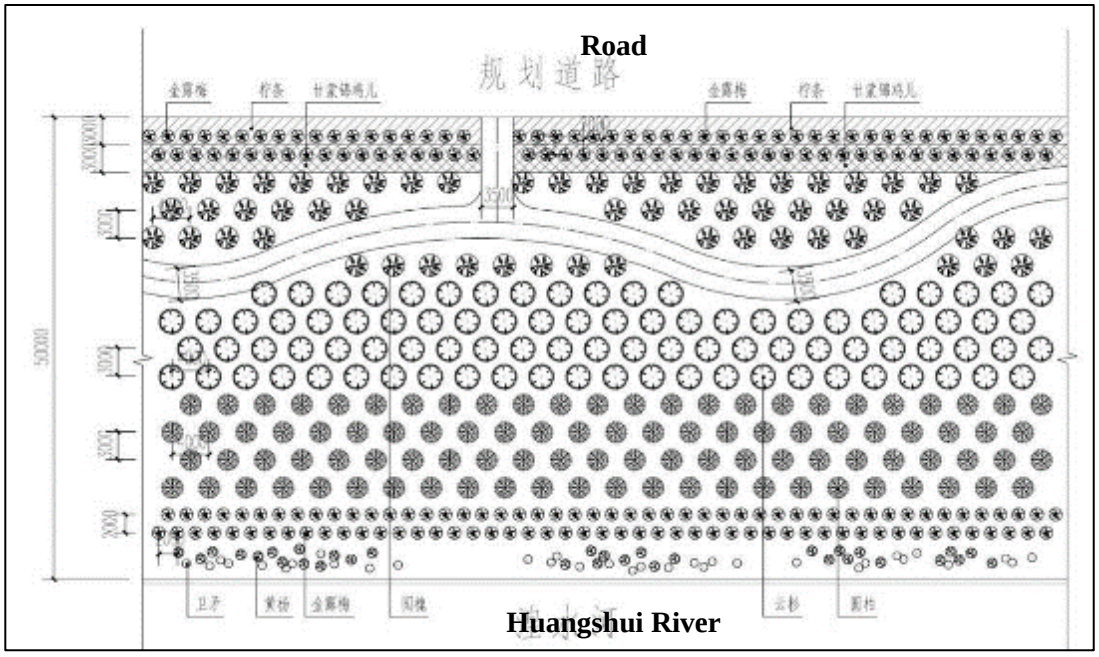


Figure III.7: Standard dense planting layout for the riverside greenbelt (50m depth)

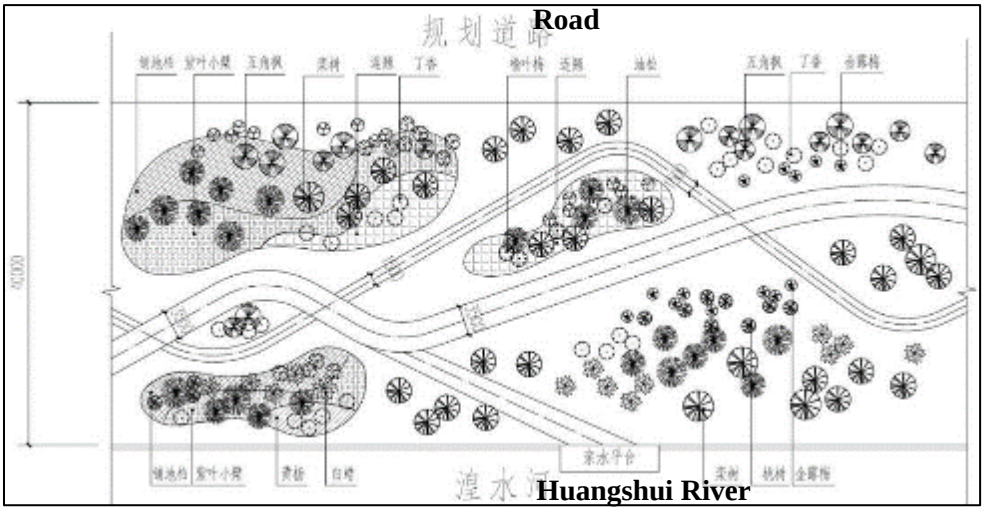


Figure III:8: Standard open parkland layout for the riverside greenbelt (40m depth)

101. The specifications for major works under this component are summarized in Table III.3.

Table III.3 Major works for Ping'an District Huangshui River Riverside Green Belt

Item		Scale
Earthwork	Excavation	15,000 m^3
	Filling	25,000 m^3
Landscape	Big tree (6-8 cm)	32,300
	Small tree (4-6 cm)	15,672
	Shrub	64,736 m^2 (Plant density: 16/m^2)
Roads and square	Asphalt road	88,410 m^2
	Concrete road	47,740 m^2

	Gravel road	20,460 m^2
	Waterside pavilion	200 m^2
Bank protection	Embankment	1010 m
	Revetment	252 m
Affiliated facilities	Boundary marker	392
	Boards	6
	Bins	126
	Benches	126

Component 1.5: Yizhou Wetland Park

102. The Yizhou Wetland Park will be developed as a 20 ha park (see Figure III.9). This was modified from an earlier proposal to develop an 86 ha park. The proposed park will include three functional areas – constructed wetlands (10.88 ha), wetland recreational area (4.43 ha) and a science-education area (4.69 ha).

103. **Wetland services.** A key objective of the wetland park within the context of the whole river management is the provision of flood storage areas to offset the lost floodplains to be protected by embankments. Other important services provided by the wetland park will include enhancement of biodiversity values along the river, showcasing an example of using wetlands for water quality improvement, promoting environmental education and awareness activities and providing recreational opportunities along the riverfront for urban residents.

Figure III.9: Concept design for the proposed Yizhou Wetland Park

104. **Wetland design.** The constructed wetland, designed as a linear wetland corridor, will be the primary landscape feature of the park. It will run from the northwest to the southeast of the site (Figure III.10). The wetland design also includes one island (6 ha) in the northeast of the site and two in the southeast (3.2 ha and 2 ha).

105. **Wetland hydrology.** The orientation of the linear wetland corridor provides a fall of 14 m (or 0.5%) across the site. A flow of water through the wetlands is important, especially in summer, to control eutrophication and algae blooms. The water level within the wetlands will be regulated by sluices. This will enable different habitats to be created and maintained. A wetland

design flow rate, drawn from the US EPA Wetland Manual, is proposed at 0.084 m^3/sec. The groundwater investigation results conducted as part of the FSR, showed the ground water level at 1.6 m and an aquifer thickness of 5.1 m. The pebble layer of the aquifer had a high permeability (K= 42.55 m/d). The height of the ground water table was anticipated to have an annual range of 1 m. Given the proposed design depth of the wetland, there will be limited flow of groundwater into the water in the wetland.

106. Design of the wetland is based upon a yearly water retention volume of 232,000 m^3 and a through flow of 2.6 million m^3 per year, flowing out of the constructed wetland back into the Huangshui River. This will require pumping 2.2125 million m^3 from the Huangshui River (78%) at the upstream inlet, 201,800 m^3 inflow from ground water (7%) and 420,000 m^3 from rainfall (15%). The wetland has a water flow retention time of 8 days for the 5.4 ha wetland and thus a water treatment design capacity of 7,257 m^3/day.

107. Ping'an Housing Construction and Environment Bureau will lead the implementation of this component. It plans to set up an on-site conservation station to strengthen the daily management and monitoring, and additional staffing for wetlands O&M is planned.

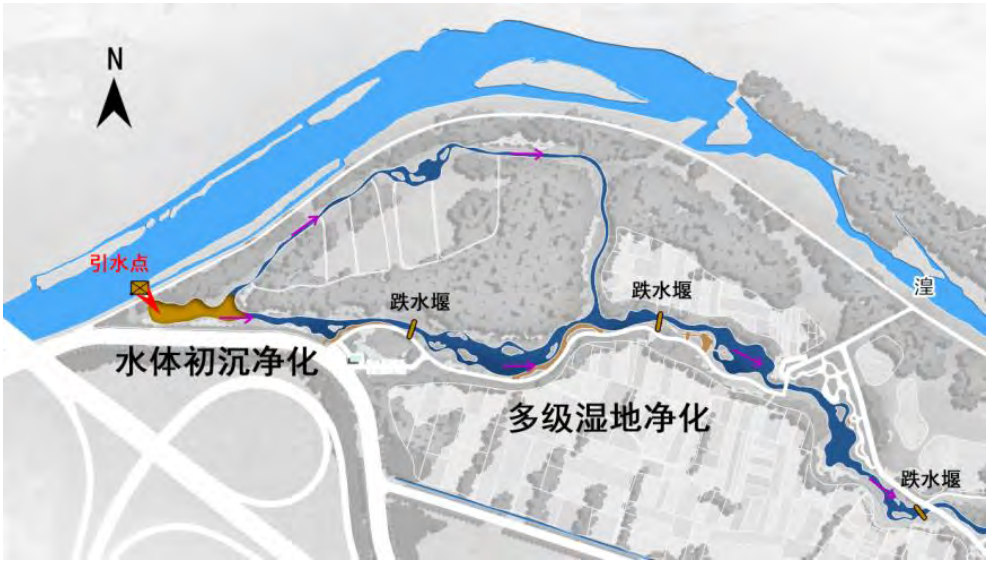


Figure III.10: Huangshui River water intake point for Yizhou Wetland Park

D. Output 2: Haidong Urban Catchment Soil Erosion Control Measure Implemented

Component 2.1 Ping'an District Mountain Edge Shelterbelt

108. The objectives of the Mountain Edge Shelterbelt are to increase the effectiveness of existing soil stabilization works, limit future urban sprawl into the fragile mountainous landscape, increase local biodiversity, and enhance the visual quality of the mountain edge along the Ping'an District urban area. Works will involve increasing the vegetative cover (especially the establishment of trees) over a 104.7 ha area. The estimated length of the greenbelt is 21 km with an average width of 50 m (see Figures III.11 and III.12).

109. The soils of the area are classified as Hilly Loess soils. These soils have the highest water-induced soil erosion rate in Haidong. The FSR lists rainfall intensities of up to 0.514

mm/minute resulting in average erosion rates of 10,000 t/km^2/yr and maximum rates of up to 19,000 t/km^2/yr. Terracing of slopes has already greatly reduced the amount of erosion. Increasing the vegetative cover will make a further major contribution to lowering soil erosion by lessening the impact on the soil of heavy rainfall intensities, which are predicted to increase.

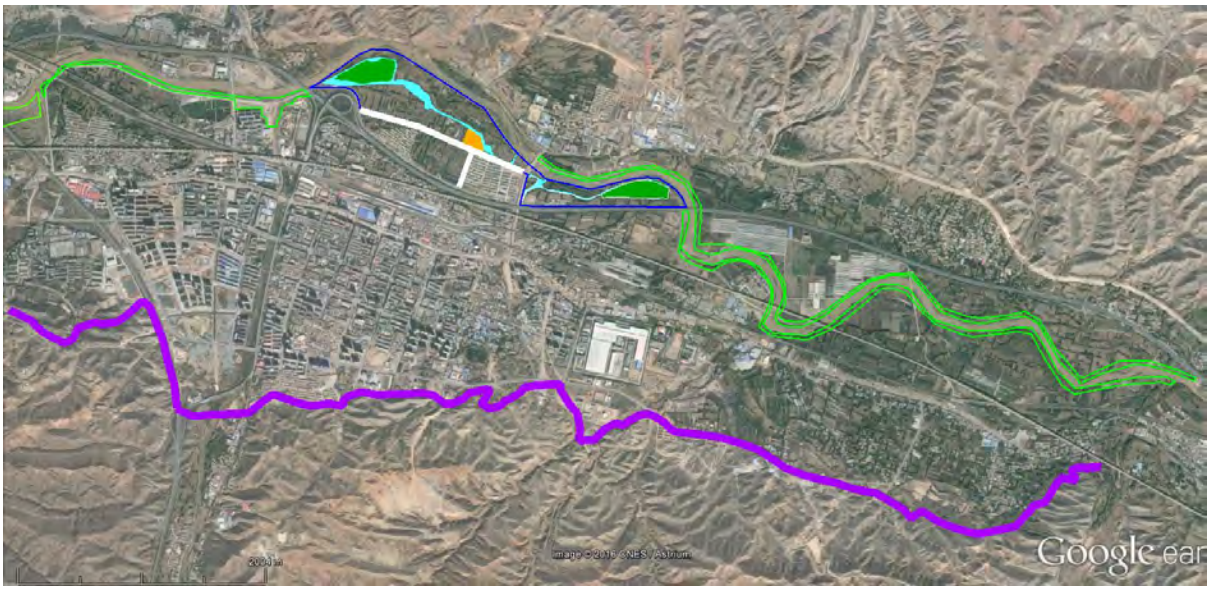


Figure III.11: Proposed Western Mountain Edge Shelterbelt (in purple)

Figure III.12: Proposed Eastern Mountain Edge Shelterbelt (in purple)

110. The component will build on the existing slope stabilization work implemented by the Ping'an Forestry Bureau. The mountain edge adjacent to Ping'an District's urban area has already been terraced and planted with shrubs. In a small area, to the south of Haidong Industrial Park, a trial has been conducted involving the supplementary planting of large tree seedlings into existing stabilization works. It was found that a major limitation on the establishment of vegetation on the terraces is low soil moisture. A small irrigation trial was

successfully conducted to test the supplementary addition of the tree seedlings to the plantings.

111. Building on these trials, a key assumption made in planning future tree plantings is that, using drought tolerant local species, irrigation will only be needed to establish the tree seedlings. Hence, it is proposed to irrigate the seedlings on eight occasions during the year: 3 times during spring, 4-5 times during dry May to July, and once during late autumn. The water requirements for the tree plantings has been estimated in the FSR at 1,200 m^3/ha/yr, with a total water demand of 125,640 m^3/yr. Drip irrigation will be used to maximize the efficiency of water use and deliver it direct to the root zone of the tree seedlings.

112. The Xiaoxia canal and Ping'an canal will be used for greenbelt irrigation. Xiaoxia canal has a flow of 2.6 m^3/s, with 80 million cubic meters available annually; Ping'an canal has a flow of 0.8 m^3/s, with 24 million cubic meters available annually. With increasing urban development, the farmland historically served by Xiaoxia canal and Ping'an canal has been rezoned as construction land, releasing this water resource for alternative uses. Water from Xiaoxia canal and Ping'an canal will be extracted from an existing irrigation delivery channel at the base of the mountain edge bordering Haidong Industrial Park and pumped to water storage tanks. It will then flow into irrigation canals and pipes by gravity into the drip irrigation system. A total of eight pump stations and eight water storage tanks will be built. Drip irrigation is adopted to save water. The forest will be irrigated 8 times each year, of which 3 times during spring, 4-5 times during dry May to July, and once during late autumn. In the eastern part of the shelterbelt, the irrigation system will be linked with the irrigation system of the South Mountain irrigation area which will receive reclaimed water from the Ping'an Wastewater Treatment Plant.

Component 2.2: Ping'an WWTP Water Reclamation

113. The objective of the component is to supplement limited water resources in Haidong to alleviate severe water scarcity in the area. The project will finance the construction of pipeline networks and associated facilities of WWTP in Ping'an District that will transport recycled wastewater effluent for use in the mountain landscaping water irrigation system.

114. The total irrigated area of South Mountain is 663 ha. According to Qinghai Provincial Water Norm (2009) the annual quota for forest irrigation is 300 L/m^2. The annual quota is based upon an average frost free period of 280 days per year when irrigation is possible. Taking 0.5% pipe network leakage and allowing a safety margin, the total demand for irrigation has been calculated at 9,500 m^3/d.

115. Two separate irrigation systems will use discharge from the WWTP. The first, not financed by this project, will provide 500 m^3/d for the irrigation of green space in the Ping'an urban area. This is shown as the blue area in Figure III.13.The development financed by the project will support construction of irrigation infrastructure with a total capacity of 9,500 m^3/d to service South Mountain forest. This is shown as the yellow area in Figure III.13.

116. Ping'an WWTP is designed to meet Class 1A of Discharge Standards of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002). The effluent used for forest irrigation shall comply with the Reuse of Urban Recycling Water-Water Quality Standard for Green Space Irrigation GB/T 25499-2010. Disinfection facilities using chlorine dioxide (ClO_2) is designed is to ensure the effluent satisfies the requirement of water reuse.

117. The design in the FSR divides the South Mountain irrigation area into 15 districts for irrigation; a covered water reservoir will be constructed at the highest point in each district. Figure III.14 shows the proposed locations and areas for the 15 districts; the proposed locations and elevations of pump stations and reservoirs are also shown.

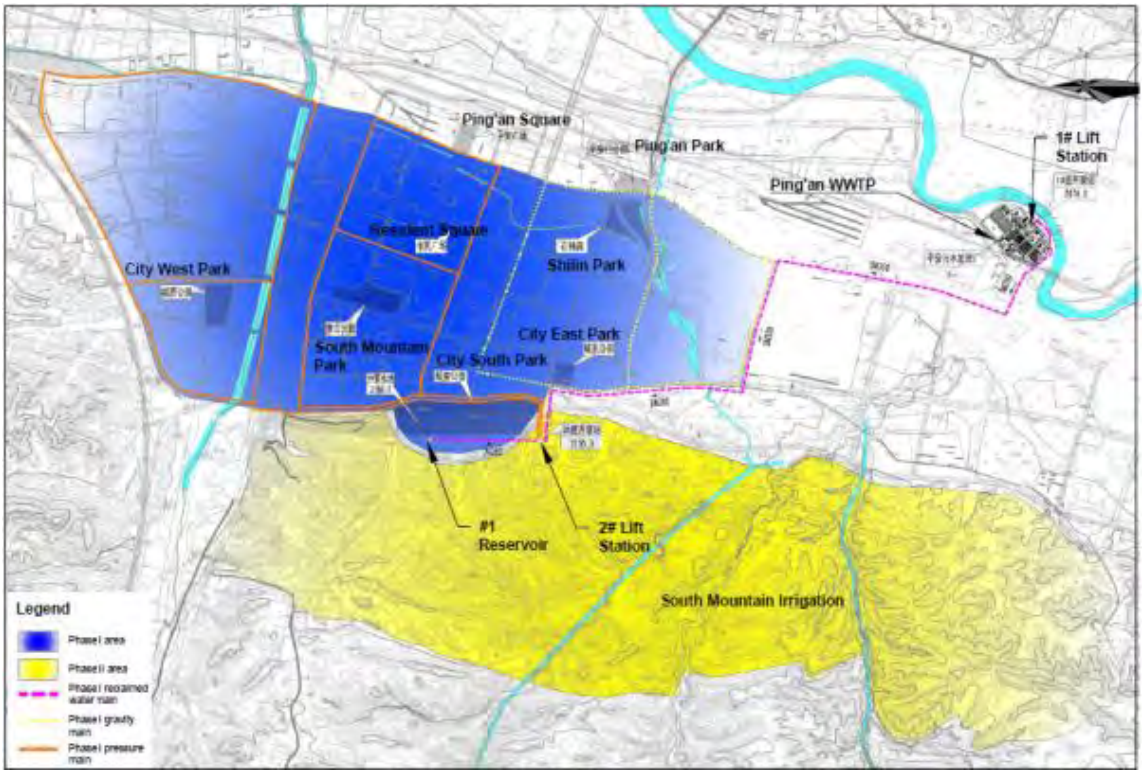


Figure III.13: Irrigation scheme for South Mountain (yellow area)

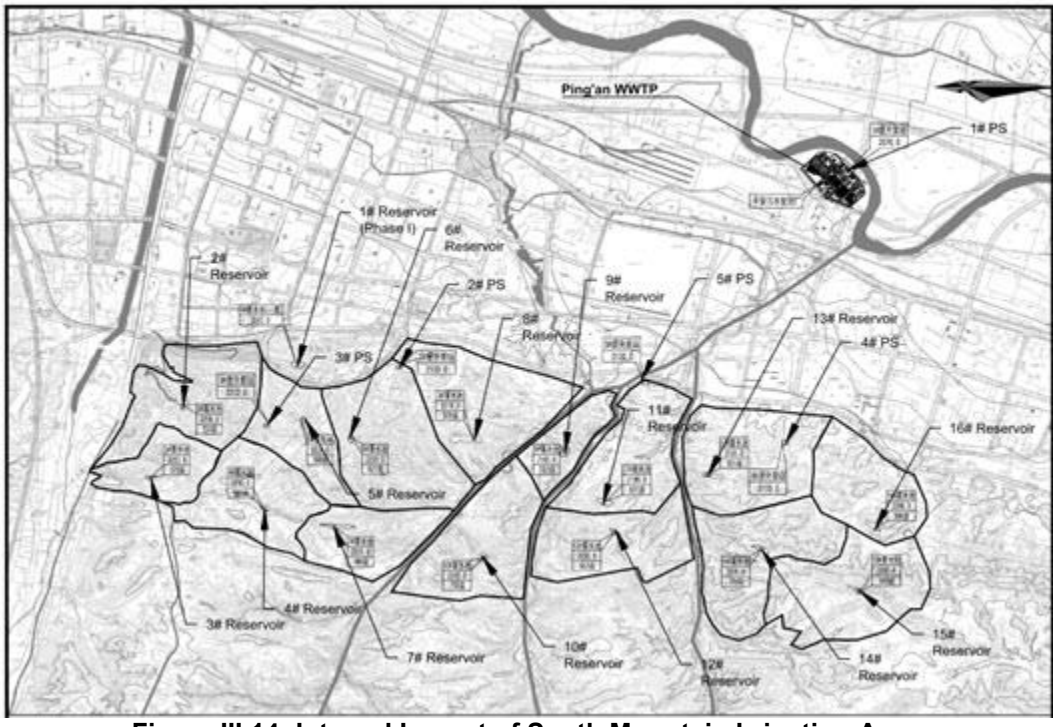


Figure III.14: Internal Layout of South Mountain Irrigation Area

Species Selection for Greenbelt, Shelterbelt and Wetland Plantings

118. To satisfy the landscape objectives of the different planting areas, a range of tree, shrub and herb species has been developed. They are all species growing locally, either in Qinghai or in northwest PRC, and include shrubs and trees which are drought resistant for use in shelterbelt plantations. The mix of evergreen and deciduous, gymnosperms (conifers) and angiosperms is aimed at achieving an aesthetically pleasing effect and seasonal variation. The mix of wetland plants combine those that will contribute to water polishing and those that provide habitat areas. The list of species is at Table III.4. The highest drought-tolerant species will form the core of mountain edge shelterbelt plantations. Wetland species for the Yizhou Wetland, including fringing forest trees, and smaller wetlands associated with riverside greenbelt plantings are at Table III.5.

Table III.4: Species List for Greenbelt and Shelterbelt Plantations

Form	Scientific name	Chinese name	Drought Tolerance
Evergreen trees	*Picea crassifolia*	云杉	+
	Picea wilsanii	青杆	
	Cedrus deodara	雪松	
	Pinus tabulaeformis	油松	++
	Juniperus chinensis	圆柏	++
Deciduous trees	*Robinia pseudoacacia*	刺槐	
	Sophora japonica	国槐	++
	Sophora japonica	龙爪槐	
	Populus × hopeiensis Hu & Chow	河北杨	+
	Populus alba L. var. pyramidalis Bunge	新疆杨	+
	Populus cathayana	青杨	++
	Ulmus pumila	白榆	++
	Juglans regia	核桃	
	Pirus, i, f.	梨树	
	Prunus davidiana	杏树	
	Armeniaca sibirica	桃树	
	Prunus cerasifera Ehrhart f. atropurpurea (Jacq.) Rehd.	紫叶李	
	Acer mono	五角枫	++
	Salix matsudana	旱柳	++
	Tamarix chinensis	柽柳	+
	Malus pumila Mill.	苹果树	
	Prunus L	李树	
Evergreen shrub	*Buxus sinica*	黄杨	
	Euonymus alatus	卫矛	
	Rhodiola crenulate	景天	
	Juniperus procumbens	铺地柏	+
Deciduous shrub	*Caragana opulens*	甘蒙锦鸡儿	++
	Syringa oblata Lindl.	丁香	
	Hypericum perforatum	连翘	
	Jasminum nudiflorum	迎春	
	Syringa reticulata subamurensis	暴马丁香	
	Fraxinus chinensis Roxb	白蜡	
	Koelreuteria Paniculata	栾树	
	Elaeagnus angustifolia	沙枣	
	Hippophae rhamnoides Linn	沙棘	
	Berberis thunbergii DC	小檗	++
	Berberis thunbergii var. atropurpurea Chenault	红叶小檗	++
	Cerasus pseudocerasus	樱桃树	

Form	Scientific name	Chinese name	Drought Tolerance
	Rosa xanthina Lindl	黄刺玫	+
	Potentilla fruticosa	金露梅	++
	Dasiphora davurica	银露梅	
	Sorbaria sorbifolia	珍珠梅	
	Prunus triloba	榆叶梅	
	Robinia hispida L.	红花槐	
	Parthenocissus quinquefolia	五叶地锦	

Figure III.5: Species List for Wetlands

Form	Scientific name	Chinese name
	Salix babylonica	垂柳
	Juniperus przewalskii	祁连圆柏
	Populus × hopeiensis Hu & Chow	河北杨
	Picea crassifolia Kom.	青海云杉
	Populus alba L. var. pyramidalis Bunge	新疆杨
	Ulmus pumila	白榆
	Fraxinus chinensis	白蜡
	Sophora japonica	国槐
	Robinia pseudoacacia	刺槐
	Koelreuteria paniculata	栾树
	Sophora japonica	龙爪槐
	Robinia hispida	红花槐
	Acer mono	五角枫
	Prunus davidiana	山桃
	Armeniaca sibirica	山杏
Shrub	*Syringa oblata*	丁香
	Dasiphora davurica	银露梅
	Sorbaria sorbifolia	珍珠梅
	Prunus triloba	榆叶梅
	Rosa xanthina Lindl	黄刺玫
	Euonymus alatus	卫矛
	Forsythia suspensa	连翘
	Rhodiola crenulate	景天
	Buxus sinica	黄杨
	Jasminum nudiflorum	迎春
	Hippophae rhamnoides	沙棘
	Tamarix chinensis	柽柳
Aquatic plants	*Nelumbo nucifera*	荷花
	Lythrum salicaria	千屈菜
	Schoenoplectus tabernaemontani	水葱
	Pontederia cordata	梭鱼草
	Typha orientalis	香蒲
	Phragmites australis	芦苇
	Nymphoides peltata	荇菜
	Euryale ferox	芡实

E. Output 3: Rural WaterSupply and Urban Solid Waste Infrastructure Constructed

Component 3.1: Wenzukou Reservoir and Fatai Reservoir Water Supply

119. The component includes the construction of three Water Treatment Plants (WTP), raw water conveyance pipelines and clean water pipelines (potable water distribution pipelines): (i) Fatai WTP (1,500 m^3/d); (ii) Wenzukou WTP (1,500 m^3/d); and (iii) Sanhe Township WTP

(20,000 m^3/d); (iv) raw water conveyance pipelines and (v) potable water distribution pipelines. The location of the scheme is shown in Figure III.15 below.

120. **Water Demand Forecast.** The population of Ping'an district is projected at 122,000 for mid-term planning year, 2020 and 190,000 for long-term planning year, 2030. Based on the population projection, the water demand in Ping'an urban area at 2020 and 2030 is predicted at 36,600m^3/d and 76,000m^3/d, respectively. The rural area included in this project component is Qijiachuan watershed, its water use includes domestic and livestock use, farmland and forest irrigation. This project will address the water demand in the Qijiachuan watershed for domestic and livestock use primarily. The water demand analysis for these uses was based on an economic trends projection and summarized in Table III.6.

Table III.6: Qijiachuan Watershed Economic Index Projection and Water Demand (m^3/day)

District	Domestic			Livestock	Total
	Town	Village	Total		
Shitai Creek	41.76	462.91	504.67	280.98	785.65
Shihuiyao Creek	40.32	564.97	605.29	198.42	803.71
Downstream of Sanhe Town	56.88	520.31	577.19	417.77	994.96
Total	138.96	1548.19	1687.15	897.17	2,584.32

121. The total for potable water demand (i.e. to supply the urban and rural population within the Qijiachuan watershed) is 2,584 m^3/day (953,276 m^3/y). The delivery of this water from the reservoirs has high seasonal variance and the full capacity of the three WTPs combined of 23,000 m^3/day is designed to cope with periods of high water flow and to provide back-up potable water for the Ping'an urban area.

122. Water will be supplied from two reservoirs (see below). These reservoirs will also supply irrigation water in Shitai Creek, Shihuiyao Creek and donwstram of Sanhe Town. The irrigation water demand estimate is mainly based on the existing use and irrigation water use coefficient and farmland use coefficient. For 2010, the gross irrigation water use is 668 m^3/mu for farmland and 514 m^3/mu for forest. According to the water-saving goals set out in *Technical Specification for Water-saving Irrigation Engineering* (GB/T 50363-2006) and *Building Water-Saving Society* 12th Five-year Plan, the water use of farmland irrigation for 2025 is 389 m^3/mu, and the forestry irrigation water use is 300 m^3/mu, both of which are significantly lower than current water uses in 2010.

123. **Fatai Reservoir.** This reservoir is located in the Qijiachuan Fatai Gorge. It was constructed and commissioned in 1983, with a total capacity of 1.26 million m^3, within which the active capacity is 1.13 million m^3 and inactive storage is 75,000m^3. The normal water level of Fatai Reservoir is 2,675.7 m, with inactive storage level at 2,655m and full flood stage at 2,676m. The original purpose of the reservoir was for irrigation. Automated reservoir level monitoring is connected to the Ping'an District's water resources monitoring system (including flashflood monitoring and early warning system).

124. **Wenzukou Reservoir**. Wenzukou Reservoir is currently under construction. It is located upstream of the Qijiachuan Tianchong River. The purpose of the Wenzukou Reservoir is to provide water supply for downstream towns/townships and villages as well as Ping'an District. Wenzukou Reservoir will have a total storage capacity of 3.57 million m^3, with an active storage of 2.38 million m^3 and inactive storage of 1.03 million m^3. The normal water level will be 2,771.59 m, inactive level 2,757.7 m, the design flood stage is at 2,772.06 m and full flood stage is at 2,772.23 m. Automated reservoir level monitoring will be connected to the Ping'an District's water resources monitoring system (including flashflood monitoring and early warning system).

125. **Water Intake at the Reservoirs.** The specifications of the water intakes at Wenzukou Reservoir and Fatai Reservoir proposed by the FSR are listed in Table III.7 below. The design for pressure release valves and major appurtenances for the pipelines are listed in FSR.

Table III.7: Water Intake Volumes at the Reservoirs

	Wenzukou Reservoir	Fatai Reservoir
Annual Water Supply	5,257,800 m^3/y	1,547,000 m^3/y
Average Daily Water Supply	14,404 m^3/d	4,238 m^3/d
Water Intake Pipe Size	DN500	DN400
Velocity	0.79m/s	0.31m/s
	1.7‰	0.4‰
Length of Raw Water Pipe to Sanhe Town WTP	11.9km	8.6km
Pipe Material	DIP	DIP

126. The FSR indicates that the source waters in this component are both low temperature and low turbidity water and proposes several design alternatives for the water treatment processes. Based on the comparisons of various design alternatives, the treatment processes proposed in the FSR are shown in Figure III.16 and Figure III.17.

Figure III.15: Scheme of the proposed urban-rural water supply component

127. **Water Treatment Process.** The Sanhe Town WTP will include the following treatment process: mixer–sedimentation tank– valve-less filtration basin – UV & bleach (chlorine)

combined disinfection. Filtration basin backwash will be returned to the sedimentation basin, sludge will be collected in the sludge tank and pumped into sludge treatment system. Figure III.16 below shows the proposed treatment process for Sanhe Town WTP. The process for the Wenzukou Reservoir and Fatai Reservoir WTPs is slightly different, employing tube mixing followed by grid flocculation inclined-tube sedimentation basin, valve-less filtration basin and UV & bleach (chlorine) combined disinfection (Figure III.17).

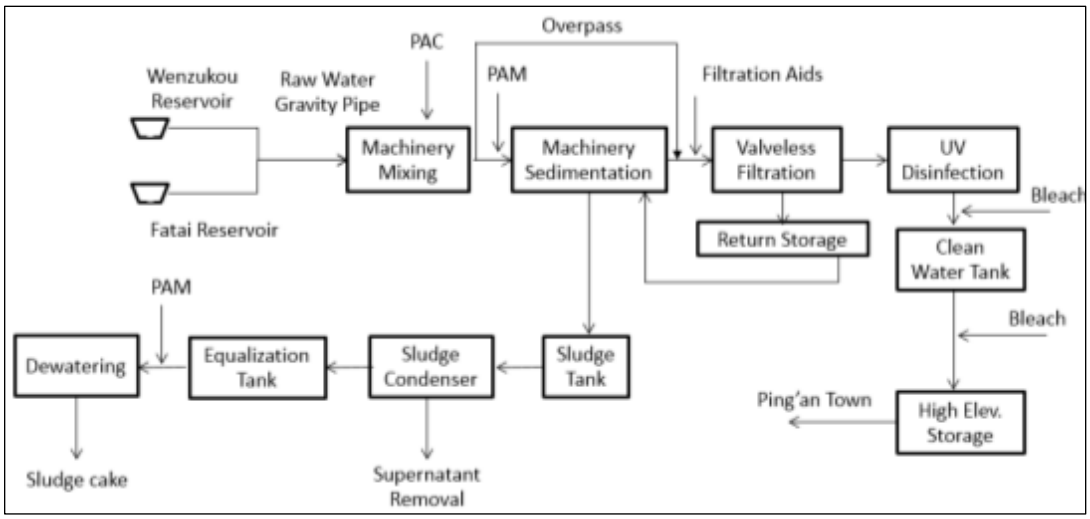


Figure III.16: Sanhe Town WTP Treatment Process Schematic

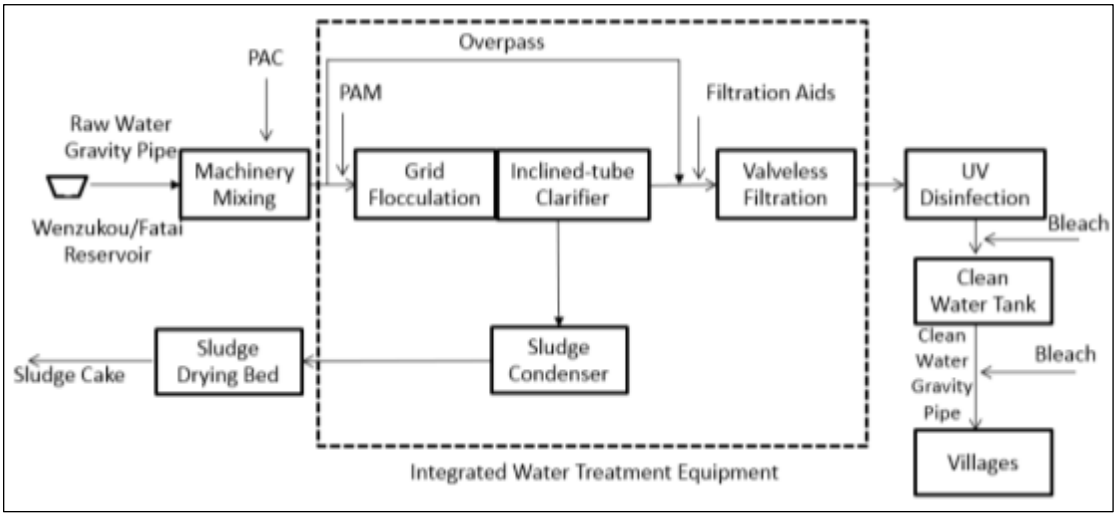


Figure III.17: Wenzukou WTP and Fatai WTP Treatment Process Schematics

128. Sludge production is estimated at 0.3 t/d for Sanhe Town WTP and 0.023 t/d for both Wenzukou and Fatai Reservoir WTPs. Sludge from sedimentation and filtration basins backwash will be collected in a sludge tank and pumped into sludge treatment system. Dewatered sludge will be transported to brick factories to be reused.

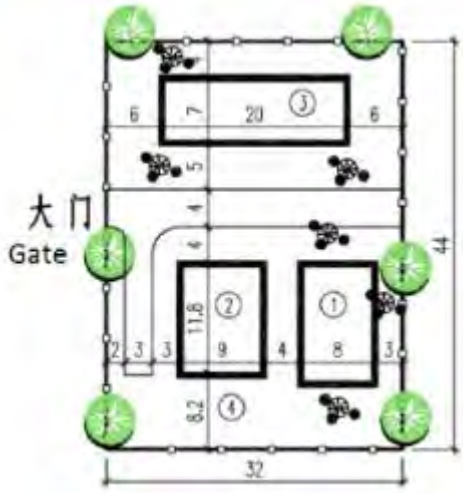
129. **WTP Layouts.** The site layout of Sanhe Town WTP is shown in Figure III.18 below, the whole site is divided into preliminary treatment area, major water treatment process building area and sludge treatment area. The planned footprint for Sanhe Town WTP is approximately 0.89 ha.

No.	Buildings	Capacity	No. of Buildings
1	Mixing Tank	20,000m3/d	1
2	Sedimentation Tank	10,000m3/d	2
3	Valveless Filtration Basin	20,000m3/d	1
4	Clean Water Tank	3,000m2	1
5	Dosing Room	20,000m3/d	1
6	Chlorination Room	20,000m3/d	1
7	Recycling Tank	20,000m3/d	1
8	Sludge Tank	20,000m3/d	1
9	Sludge Condenser	20,000m3/d	1
10	Sludge Dewatering Room	20,000m3/d	1
11	Transformer Room		1
12	Management Room		1
13	Guard Room		1

Sanhe Town WTP Site Layout

Footprint: 0.89ha

Figure III.18: Sanhe Town WTP Site Layout



No.	Buildings	Capacity	No. of Buildings
1	Integrated Water Treatment Equipment	1,500m3/d	1
2	Clean Water Tank	450m3/d	1
3	Dosing and Chlorination Room	1,500m3/d	1
4	Sludge Drying Bed	150m2	1

Site Layout of
Wenzukou Reservoir WTP
Fatai Reservoir WTP

Footprint: 0.14ha

Figure III.19: Wenzukou and Fatai WTP Site Layouts

130. The main specifications of the component are listed in Table III.8.

Table III.8: Design Specifications of WTPs

Proposed Design	Detailed Proposed Design	Proposed Capacity/Size
Water Treatment Plant	Wenzukou Reservoir WTP	1,500m3/d
	Fatai Reservoir WTP	1,500m3/d
	Sanhe Town WTP	20,000m3/d
Water Transmission Pipeline	Raw water pipeline from Wenzukou Reservoir to Sanhe Town WTP	DN500, 11.9km
	Raw water pipeline from Fatai Reservoir to Sanhe Town WTP	DN400, 8.6km
	Clean water pipeline from Sanhe Town WTP to Ping'an urban area Guchengya	DN600, 15.9km
High Elevated Water Storage	1 high elevated water storage which divided into 2 tanks	3,000m3 storage volume
	1 chlorination room	20,000m3/d

Component 3.2: Ledu Sanitary Landfill Expansion

131. Both Ping'an and Ledu Districts rely on landfills to dispose of waste. There is one landfill in Ping'an District with a capacity of 2,720,000 m^3 and service period of 31 years. It has been operational since 2002. Currently the solid waste collection rate in Ping'an District is approximately 95% covering the whole urban area and 144 villages, and there appears to be adequate capacity in the landfill to meet future needs. Ledu District faces a more immediate challenge. The garbage collected in the urban area of the Ledu District is sent to the Queertan Donggou Sanitary Landfill, and there are 4 other small landfills for rural solid waste disposal. The Queertan Donggou Sanitary Landfill is expected to reach capacity shortly. With increased solid waste quantities projected due to increasing urban population, there is an immediate need to provide additional landfill space in the District.

132. The objective of the component is to improve solid waste treatment capacity for Ledu District through expansion of the Donggou Sanitary Landfill to a design capacity of 1.24 million m^3 and an operational life of 16 years. The landfill is located in the southwest of Ledu District, about 7 km to the urban area, as shown in the Figure III.20.

Figure III.20: Location of the landfill

133. Based on existing statistics of Ledu District, the current population in Ledu District is approximately 100,000, and the garbage production was 4×10^4 t/y in 2014 with average daily production of 110 t/d. Using garbage production trends in other cities and consideration of actual conditions in Ledu District, it is assumed that the garbage production will be increasing at a rate of 5% in 2015-2025, 3% in 2025-2030 and 2% after 2030. Therefore, the cumulative garbage production will be about 1.15 million m^3 by 2030, and 2.93 million m^3 by 2046.

134. The existing eastern rammed earth retaining wall for the landfill has a top elevation of 2057m. The FSR proposed to increase the top elevation of the retaining wall to 2063m. The maximum height will become 20 m. The classification of retaining dam is a Class III hydraulic structure with anti-slide stability safety coefficient of 1.3 (under normal condition, otherwise 1.15). Dam type is reinforced earth and stone dam. Total dam top width is at least 3m and dam body slope is between 1:1 and 1:1.5.

135. The proposed ADB loan project would include (i) the development of cells No. 3 and 4; and (ii) the construction of a leachate treatment facility, along with the necessary leachate storage tank. The new cells will add additional 850,000 m3 capacity (or 740,000 m^3 effective capacity) to the landfill which will be able to serve for 10 years for the district. The layout of the landfill is illustrated in Figure III.21 below.

136. The storm event standard for the landfill site is designed for 50 years return period storm with a safety margin which complies with the standard for a 100 years return period storm, as recommended in the CRVA. The system consists of runoff interception trenches around the site, water-collecting well, discharge pipe and sedimentation tanks. The intercepting trench cross-section is rectangular (width of 0.5-0.8m and depth of 0.6-1.0m).

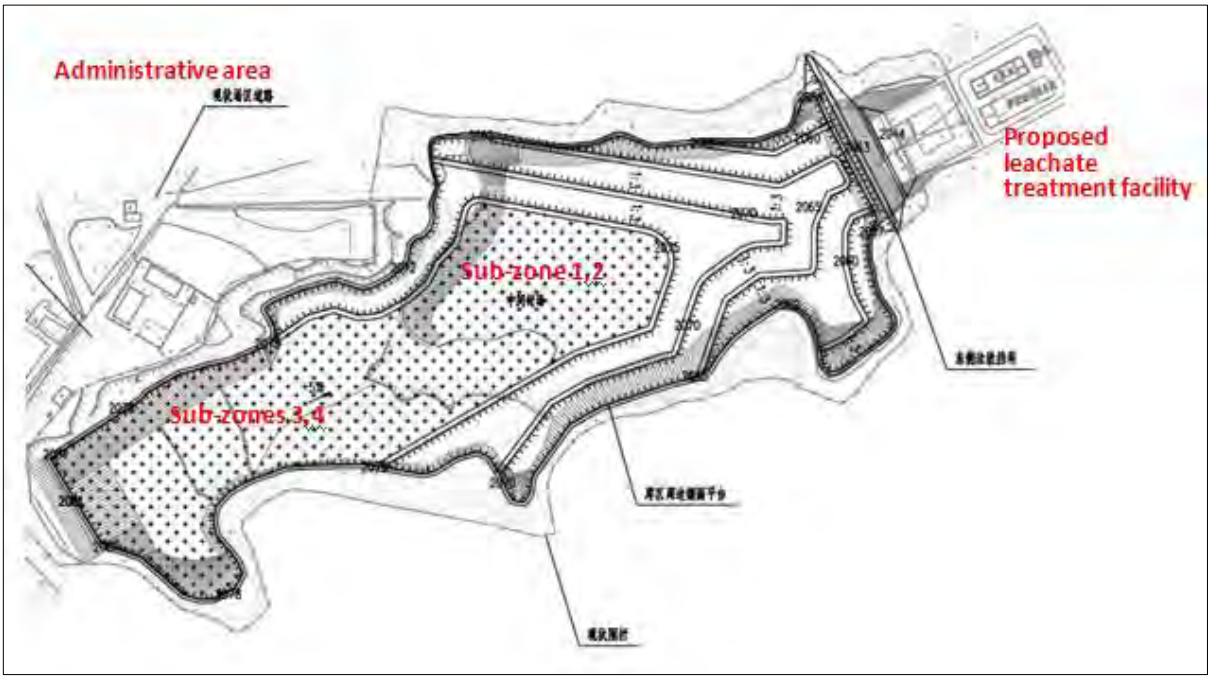


Figure III.21: Proposed layout of the landfill

137. **Leachate collection and treatment.** A composite liner system is proposed. The structure of the liner system for both landfill base and side slope are as below (from top down),

respectively:

a) The bottom lining system structure: 200g/m2 light filament geotextile layer; 500mm gravel leachate conduit layer; 2×600g/m^2 nonwoven geotextile protective layer; 2.0mm liner of smooth HDPE geomembrane; GCL geomembrane composite liner; 1.0mm liner of smooth HDPE geomembrane; 300mm protective layer of clay;
b) The slope lining system: 800g/m2 nonwoven geotextile top protective layer; 2.0mm liner of hair side HDPE geomembrane; GCL geomembrane composite liner; 1.0mm liner of hair side HDPE geomembrane; 600g/m^2 nonwoven geotextile bottom protective layer of compacted soil.

138. The leachate collection system is at the base of the landfill, consisting of 500 mm of rubble, leachate trenches and HDPE perforated collection tubing. The main pipe diameter is 315 mm and the branch pipe diameter is 250 mm. A leachate treatment facility with a design capacity of 50 m^3/d is also proposed. Leachate quality assumptions are shown in Table III.9. The effluent quality from the leachate treatment facility will be in accordance with the requirements set out in the Standard for Pollution Control on the Landfill Site (GB16889-2008).

Table III.9: Leachate characteristics (design assumptions)

Item	COD_{cr} (mg/L)	BOD_5 (mg/L)	Total N (mg/L)	SS (mg/L)	TDS (mg/L)	PH
Influent quality	10-000 - 30,000	7,500 - 20,000	350 - 1,000	900- 1,800	15,000 - 20,000	6 - 10

139. Preliminary treatment followed by a two-stage double tube reverse osmosis (DTRO) process is selected for leachate treatment. The treatment process and water balance are illustrated in Figure III.22 below.

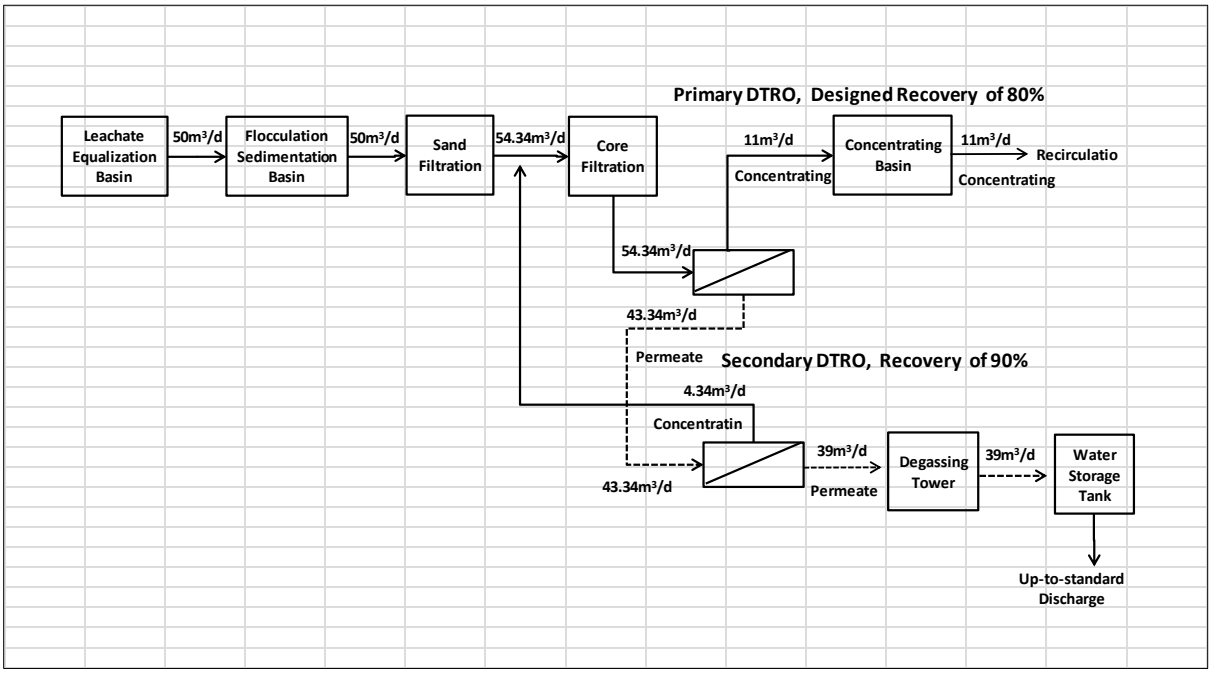


Figure III.22: Schematic diagram of treatment process and water balance for landfill leachate treatment

140. A leachate holding tank of 1,000 m^3 (sufficient to store 20 days leachate production) will

collect the leachate before it enters the treatment plant. Inside the plant, a second over-sized holding tank of 125 m^3 will be provided for condensed liquid (membrane refuse) which will be re-injected into the landfill. The layout of the leachate treatment facility is illustrated in Figure III.23 below.

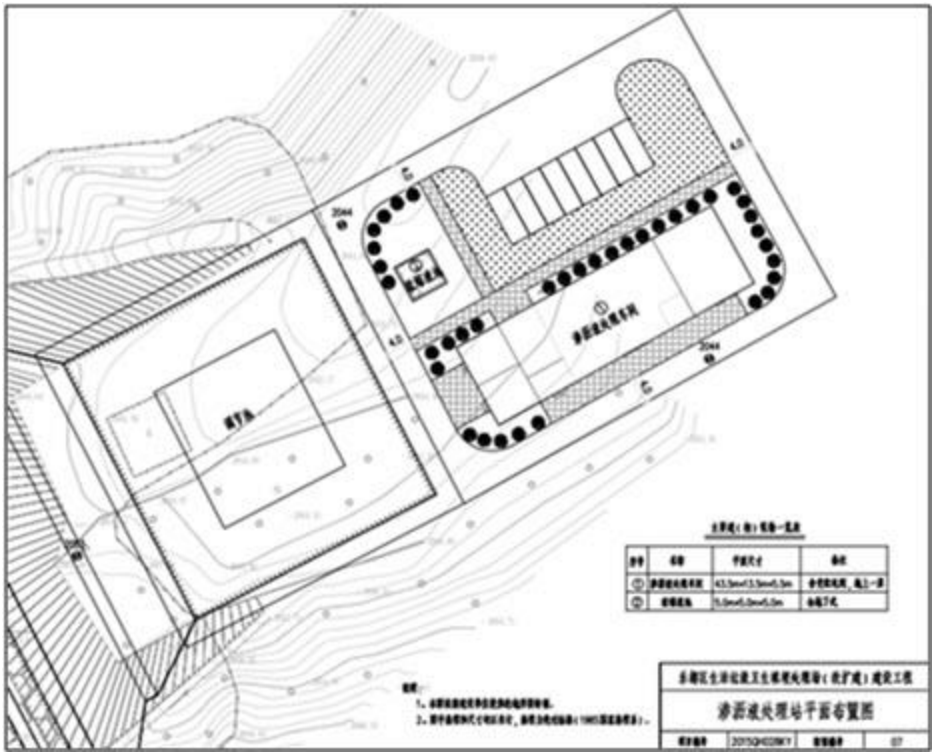


Figure III.23: Proposed layout of the leachate treatment facility

141. **Methane collection.** The methane gas will be collected and flared. The collecting system for landfill gas includes silo, pipes and air-extractor. The silo employs air guide gabion structures with diameters of 800mm and interval of 50-60m. Air guide gabions will be built by segments and each section is 0.5m higher than the corresponding covering surface. The total gas production is estimated at $4.7*10^7$ m^3 of mixed gas emission (assuming methane 50%) over a 20 years lifespan, calculated using a Scholl Canyon model. The gas emission rate will increase from 2016-2026 and peak at approximately 359 m^3/h, then reduce gradually.

F. Output 4: Capacity Building

142. The Project also provides for institutional development and capacity building for the EA, IAs and facility operating units. The capacity building will include project management consulting services and training during loan implementation. This will help the implementing agencies (IAs) to (i) become operationally efficient and financially sustainable entities; (ii) comply with relevant national policies for cost recovery, tariff and enterprise reforms; (iii) develop sound O&M plans for future service provisions; (iv) develop a public awareness training program on environmental protection and social impact monitoring and (v) improve the efficiency of management.

143. The project management services and training during loan implementation are detailed in the Project Administration Manual (PAM). Capacity building and training directly related to the implementation of the environmental management plan; the technical strengthening of IAs and O&M Units for the management of green belts, shelterbelts and wetlands; and the climate

proofing of development plans; are described in Chapter V (Anticipated Impacts and Mitigation Measures) and included in the EMP.

G. Associated and/or Linked Facilities

144. There will be several associated and/or linked facilities in the project, including: (i) the reservoirs for the water supply component and the management of their watersheds; (ii) the existing landfill (sub-zones 1 and 2) and its current management; (iii) the existing Ping'an WWTP for the reuse of treated wastewater discharge. For all, the minimum requirement for due diligence is the appropriate environmental approvals and advice (from the relevant EPB) of environmental compliance record of operating facilities. This data is set out in Table III.11.

Table III.11: Approval of Associated Facilities

District	Associated Facility	EIA approval	Approval date	Approval agency	Remarks
Ping'an	Ping'an WWTP	Yes	2008	Qinghai Provincial EPB	
	Fatai Reservoir	No	-	-	Facility built in 1979. No EIA required at that time
	Fatai Water Source Protection Area	-	-	-	Facility built for irrigation water supply. No requirement for water source protection zones
	Wenzukou Reservoir	Yes	2011	Qinghai Provincial EPB	
	Wenzukou Water Source Protection Area	-	2011	Ping'an WRB	
Ledu	Ledu Landfill stages 1 and 2	Yes	2005	Qinghai Provincial EPB	

Source: PPTA team and Haidong EPB

145. Chapter V (Anticipated Impacts and Mitigation Measures) examines the current functional status and environmental performance of these facilities, based upon advice from the EPB and PPTA team inspections. Additionally, for the reservoirs, the appropriateness of existing and planned water source protection arrangements are considered. The due diligence carried out for the facilities has concluded that their operations are in compliance with environmental regulations and are sustainable.

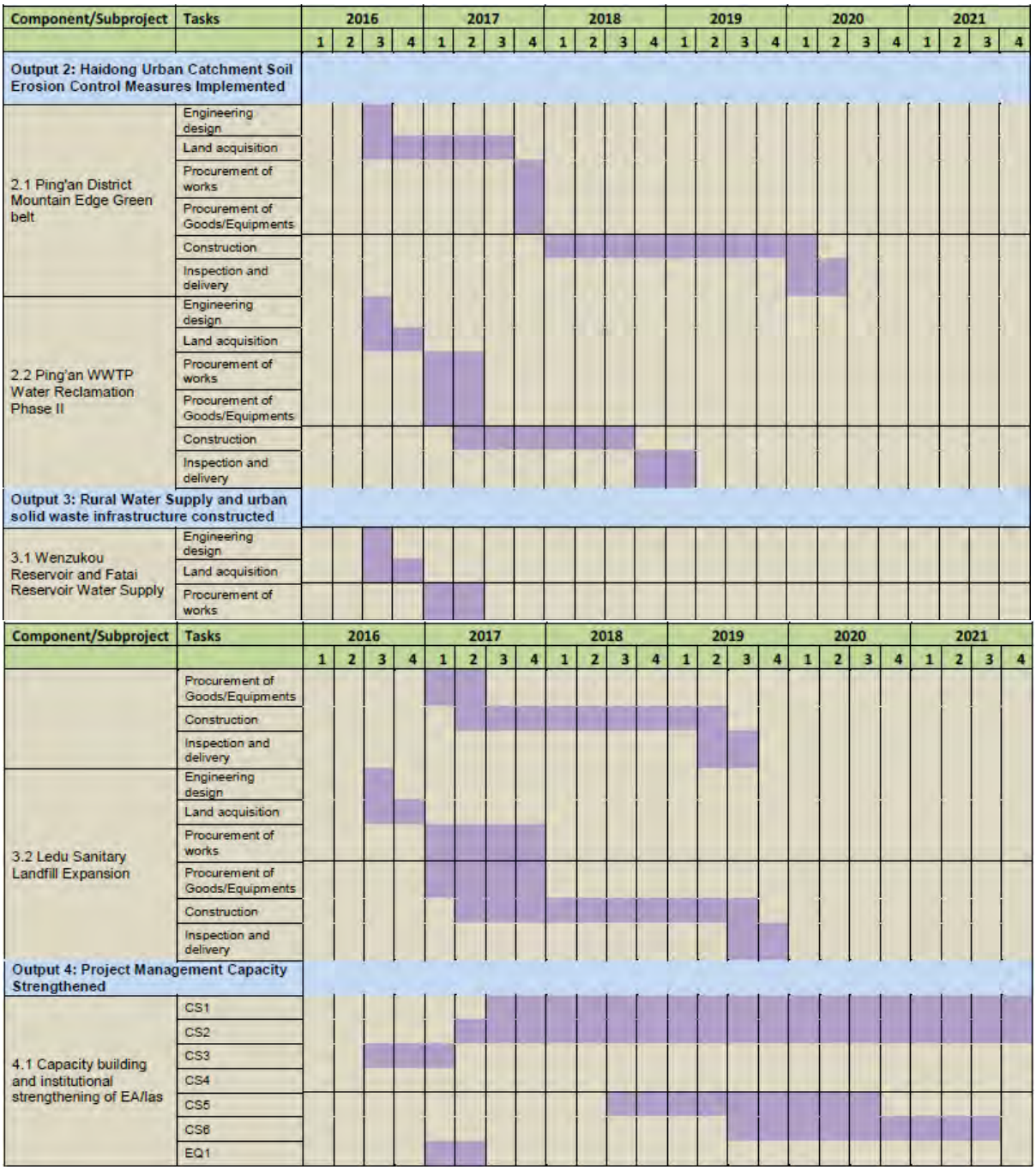
H. Project Implementation Schedule

146. The project is expected to be implemented from middle of 2016 to the end of 2021. Main construction activities will take place over a period of 3 years, from April 2017 to April 2020. The project implementation schedule is presented in Table III.12 below (this table will be updated annually and disclosed in the Project Administration Manual).

Table III.11: Project Implementation Schedule

Component/Subproject	Tasks	2016				2017				2018				2019				2020				2021			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Output 1: Integrated flood plain management infrastructure for Huangshui River provided																									
1.1 Huangshui River Channel Ping'an Segment	Engineering design																								
	Land acquisition																								
	Procurement of works																								
	Procurement of Goods/Equipments																								
	Construction																								
	Inspection and delivery																								
1.2 Huangshui River Channel Ledu Urban Area Segment	Engineering design																								
	Land acquisition																								
	Procurement of works																								
	Procurement of Goods/Equipments																								
	Construction																								
	Inspection and delivery																								
1.3 Huangshui River Channel Ledu Rural Area Segment	Engineering design																								
	Land acquisition																								

Component/Subproject	Tasks	2016				2017				2018				2019				2020				2021			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	Procurement of works																								
	Procurement of Goods/Equipments																								
	Construction																								
	Inspection and delivery																								
1.4 Ping'an District Huangshui River Riverside Green belt	Engineering design																								
	Land acquisition																								
	Procurement of works																								
	Procurement of Goods/Equipments																								
	Construction																								
	Inspection and delivery																								
1.5 Yizhou Wetland Area	Engineering design																								
	Land acquisition																								
	Procurement of works																								
	Procurement of Goods/Equipments																								
	Construction																								
	Inspection and delivery																								



Source: Project Administration Manual (PAM), April 2016.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Sub-regional Environmental Setting

146. **Geographical location**. Haidong is a prefecture level city of Qinghai Province in Western PRC. Its name literally means “east of the Qinghai Lake”. It is at longitudes 100°41.5′ E to 103°04′ E and latitudes 35°25.9′ N to 37°05′ E bounded by Xining, the provincial capital, to the west, and Gansu Province to the east. The project components are located in two districts (Ping’an District and Ledu District) within the municipality. Ledu District, with the land area of 3050 km^2, is situated at the south of the middle reaches of Huangshui River. Ping’an District, with the land area of 769 km^2, is situated at the east of Ledu District and adjacent to Xining City (see map in Figure IV.1).

Source: Haidong Core Area Master Plan (2013-2030)

Figure IV.4: Project Location

147. **Geology and topography.** Haidong is located in the middle Qilian uplift belt of Caledonian geosynclinals fold in the transition zone between Loess Plateau and Qinghai-Tibet Plateau, with elevation range from 1,650 m to 2,835 m. The terrain is high in the west and low in the east. In the framework of the climate risk and vulnerability assessment (CRVA) conducted for the project, a 30 meter resolution digital elevation data was collected for the project area from ASTER Global Digital Elevation Model (DEM).[9]

[9] A comprehensive climate risk and vulnerability assessment (CRVA) was conducted by climate modeling experts. A summary of the CRVA report is attached as Attachment 3 of this IEE.

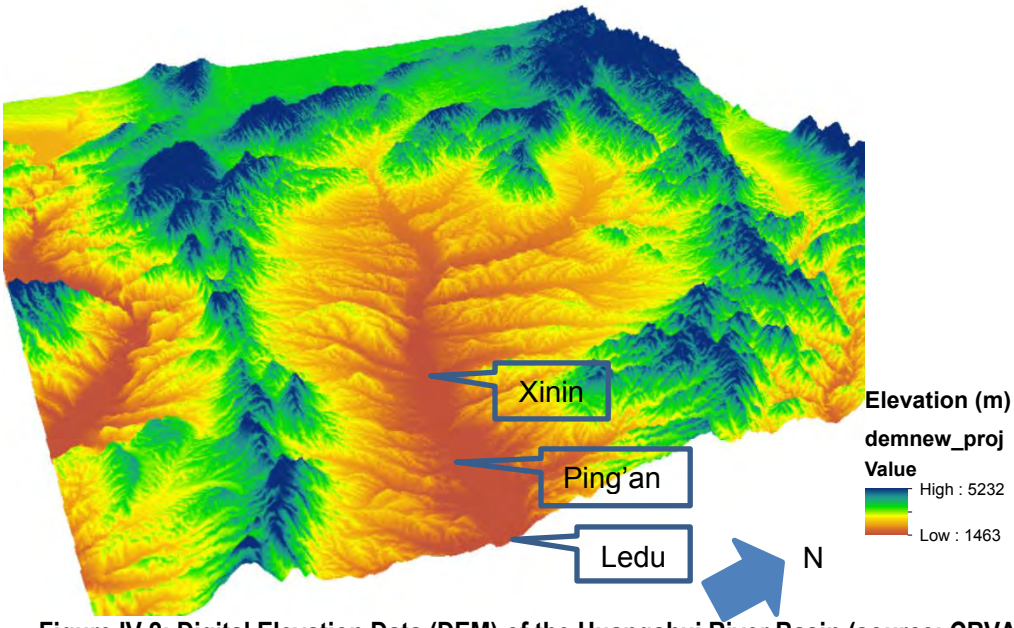


Figure IV.2: Digital Elevation Data (DEM) of the Huangshui River Basin (source: CRVA, December 2015)

148. **Soil data.** Soil data was collected for the project area from field survey by Yang (2012). The top soil (0-30cm) of the project area is dominated by loam and loam sandy type, while sandy loam and silt loam are also common at the upper reach area (Figure IV.3). In the framework of the Feasibility Study, detailed field topographic surveys and geotechnical investigations were undertaken, covering the entire Huangshui River section that is included in the project scope. The geotechnical investigations focused on riverbed and riverbank material samples. The engineering geology and geotechnical investigation results are reported in Section 3 of the FSR. The river bed material samples have a d10=0.150mm, d30=5.761mm, d50=22.439mm, d60=36.356mm and d95=147.837mm.

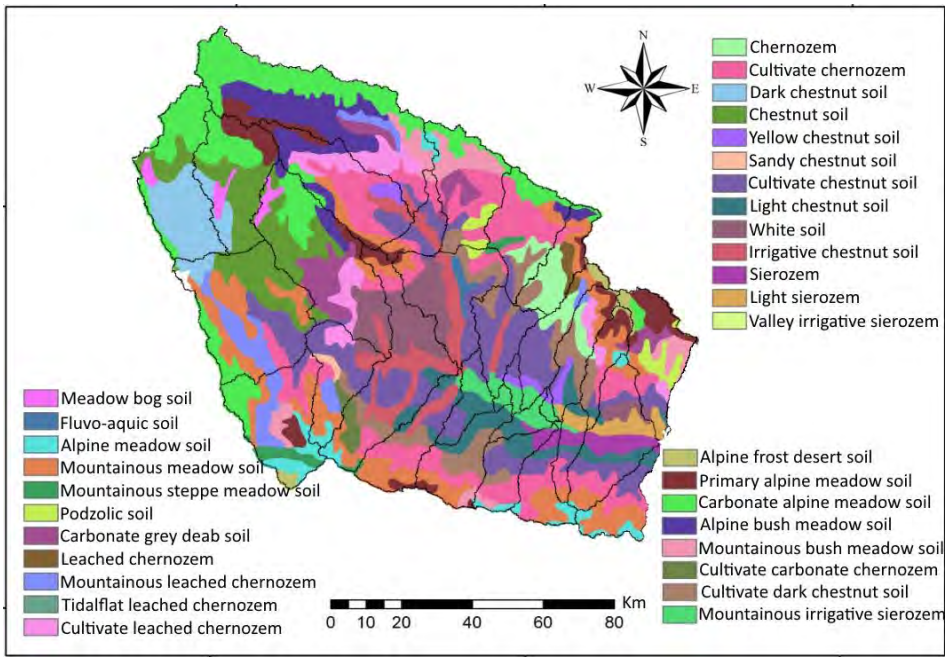


Figure IV.3: Soil type data of Huangshui River basin (Yang, 2012).

149. **Seismicity**. According to Chinese Ground Motion Parameter Zoning Map (GB18306-2001), the seismic peak ground acceleration of the project area is 0.1 g and the ground motion response spectrum characteristic period is 0.45 s, indicating low seismic risk.

150. **Climate.** Lying in the Arid Plateau Continental Climate Zone and due to its high altitude and low air pressure, Haidong's climate is characterized by low precipitation, high evaporation, long freezing period, short frost-free period, and large temperature differences between day and night with strong UV radiation. Table IV.1: summarizes the climate characteristics of Haidong Municipality.

Table IV.1: Haidong's Climate Characteristics

Annual average temperature	3.2°C-8.6°C
Lowest temperature	-18.8°C-25.1°C
Highest temperature	25.1°C-33.5°C
Annual average precipitation	319.2-531.9 mm
Relative humidity	57%-63.66%
Annual average frost free days	90 days
Average wind speed	1.9-2.5 m/s
Dominate wind direction	East
Annual average sunshine hours	2,708-3,636 hours
Evaporation	1,275.6-1,861 mm

151. **Predicted Changes in Temperature and Precipitation.** Climate change scenarios have been constructed by the project CRVA from climate projections of AR5 global climate models. Because the timeframe of those plans are up to 2030 only, the climate change scenarios were finalized with GCM projections from 2020 to 2040. Hydrological models, including ArcSWAT and HEC-HMS, were used in simulating climate change impact on the river flow volumes and flood levels of the Huangshui River. Likely impact of climate change on regional water resources are also assessed based on the modeling outcomes for the Huangshui River in combination with spatial water balance analysis.

152. The annual mean temperature in the Huangshui River basin is projected to increase approximately 0.7°C, 0.9°C, and 1.8°C in 2030 under the low, medium, and high emission scenarios, respectively. The projected temperature increases for the Huangshui River basin is approximately the average increases of the whole province. The lower Huangshui valley is still one of the warmest areas in the province.

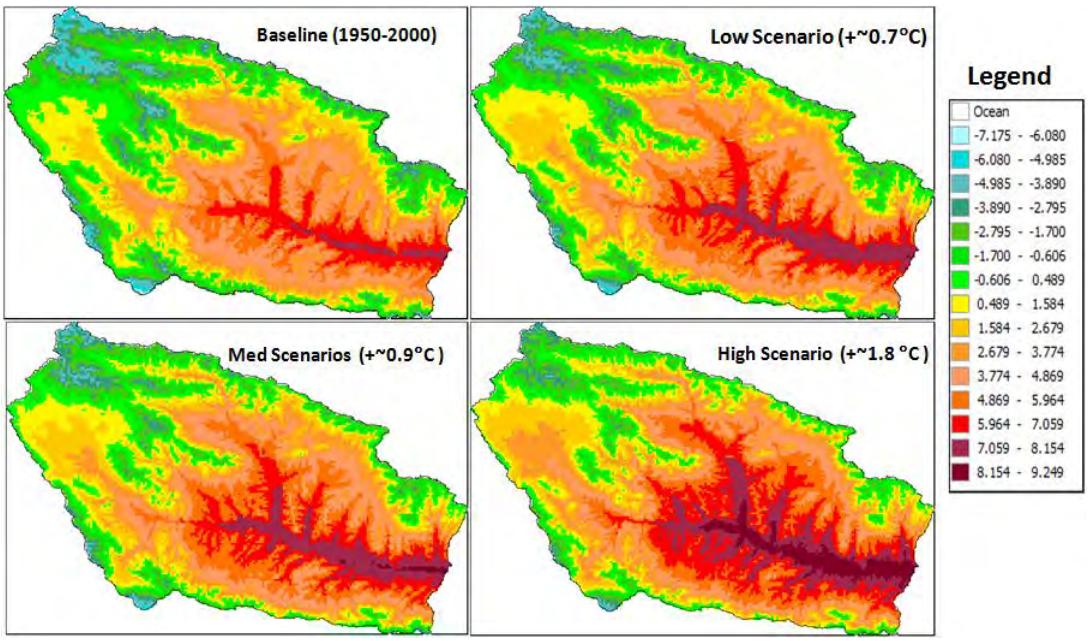


Figure IV.4: Baseline and projected annual mean temperature in 2030 for the Huangshui River basin (Source: CRVA, December 2015)

153. Annual mean precipitation is projected to increase approximately 2%, 3.5%, and 8.5% in 2030 under low, medium, and high climate change scenarios. Similar to temperature, the projected precipitation increases in the Huangshui basin is also close to the provincial average.

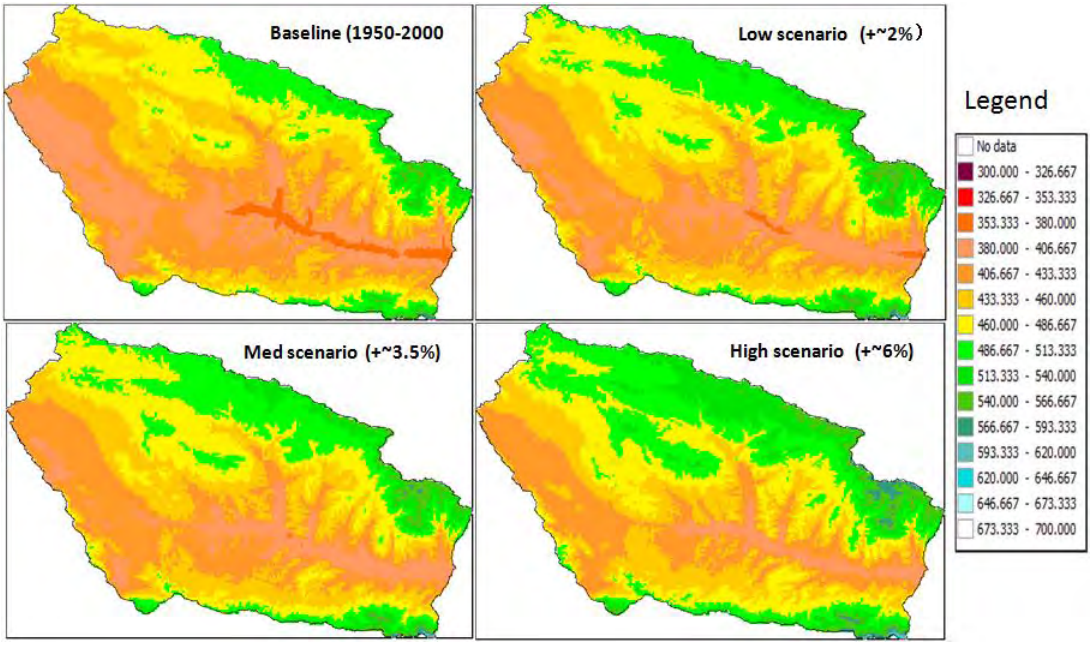


Figure IV.5: Baseline and projected annual mean precipitation in 2030 for the Huangshui River basin (Source CRVA, December 2015)

154. **Water resources in Qinghai Province.** In terms of area, water resources of Qinghai are 88,200 m^3/km^2, which is less than 1/3 of the PRC's average. However, Qinghai is much less populated than the rest of the country and is less developed economically. The per capita water resource is 1,200 m^3, which is 4 times the national average, but its spatial distribution is greatly

unbalanced. While the less settled south Qinghai Plateau has relative abundant water resources (and includes headwater areas of several main rivers of national and international importance, including the Yellow River, the Yangtze River, and the Mekong River), the densely populated industrial areas in the east of the Province are faced by water shortage.

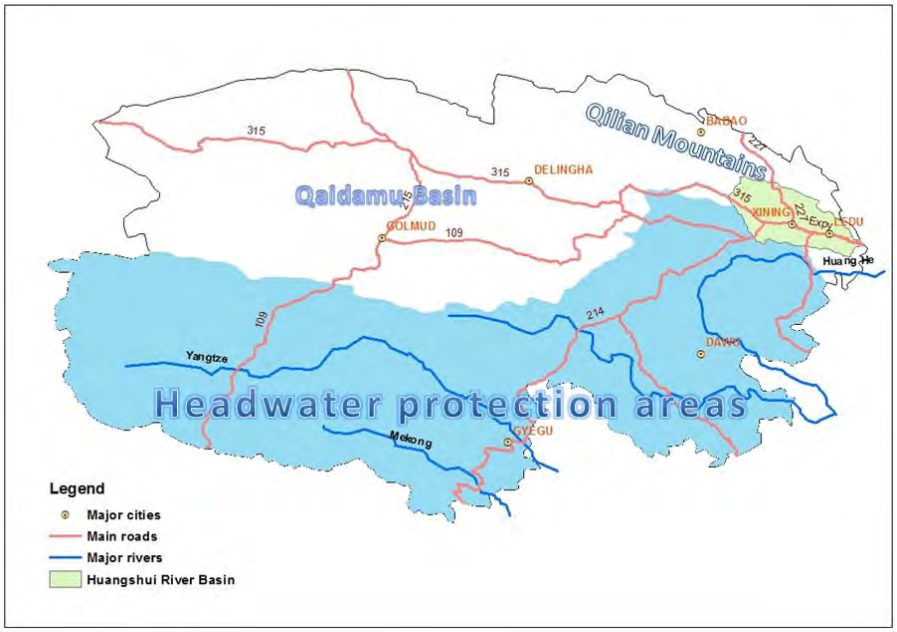


Figure IV.6: Qinghai River Basins (Source: CRVA, December 2015)

155. Qinghai Province's contribution to flow volumes of the Yangtze and the PRC section of the Mekong are 26% and 16% respectively. The water use in those headwater areas is minimal. These headwater areas are located in the southwest of the Qinghai Province where the altitude is mostly around 5,000m.

156. The CRVA reviewed the effects of climate change on provincial water resources using the water balance method (i.e. precipitation minus potential evaporation). It concluded that regional water resources in Qinghai Province will not change significantly in total volumes in 2030, but seasonal and annual variability will increase. Hydrological modeling results show that river flow volumes will decline slightly under the low climate change scenario but will increase under medium and high scenarios. The mixed change signals are interaction results between projected rising temperature and increased precipitation across regional Qinghai Province. However, there are will increased climate risks due to increased seasonal and annual variability in precipitation and hence river flow volumes. Shrinking glacier areas caused by rising temperature is also posing risks to the river headwaters.

157. **Huangshui River** is the largest tributary of the upper stream of the Yellow River (see Figure IV..8). The Huangshui River basin, where the proposed project is located, accounts only 3.25% of the province's water resources, but it has more than 60% of the province's population, about half of the cultivated agriculture land and generates more than 60% of the province's GDP. It has a total length of 374 kilometers, of which 226 km is within the boundary of Qinghai Province, and a total watershed area of 16,120 km^2. The long term (1950 onwards) average annual flow at Ledu station is 61.68 m^3/s and the annual runoff is 2.15 billion m^3. The width of the river varies from 50 m to 200 m, and the average gradient is 13.3 to 1.6. The dry season is from December to March, and wet season is from July to October.

158. The runoff during wet season accounts for >40% of the whole year. It is sourced from both

rainfall and snow melt from the southern slope of the Qilian Mountains in Haiyan County, Qinghai Province. Huangshui River flows through six towns of Haiyan, Huangyuan, Pingan, Ledu, Minhe and Honggu and Xining then directly discharges into the Yellow River. The total length in Haidong is 139.2 km, of which 30.2 km is in Ping'an District, 64 km in Ledu District, and 45 km in Minhe County.

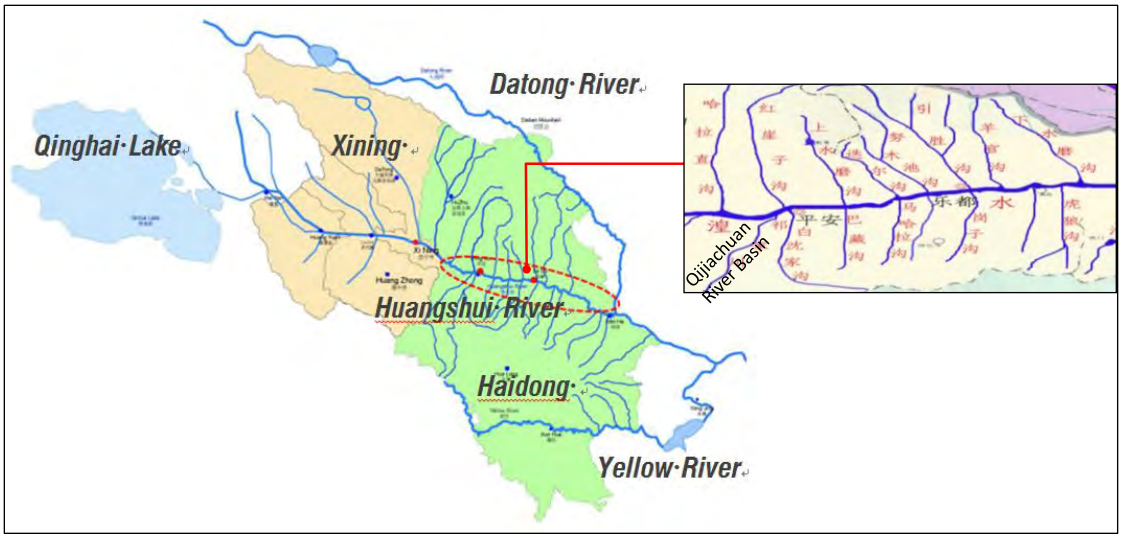


Figure IV.7: Huangshui River system

159. The average (1955-2012) annual flow at Ledu gauging station is 1,330 x10^6 m^3 within a range of 637.1 million m^3 – 2,679 million m^3. The maximum flow occurs in September and minimum is in January. As shown in Figure IV.8 below, the flow volume of the river did not show any significant change from the 1970s although a slight declining trend is found from 1950s to the present.

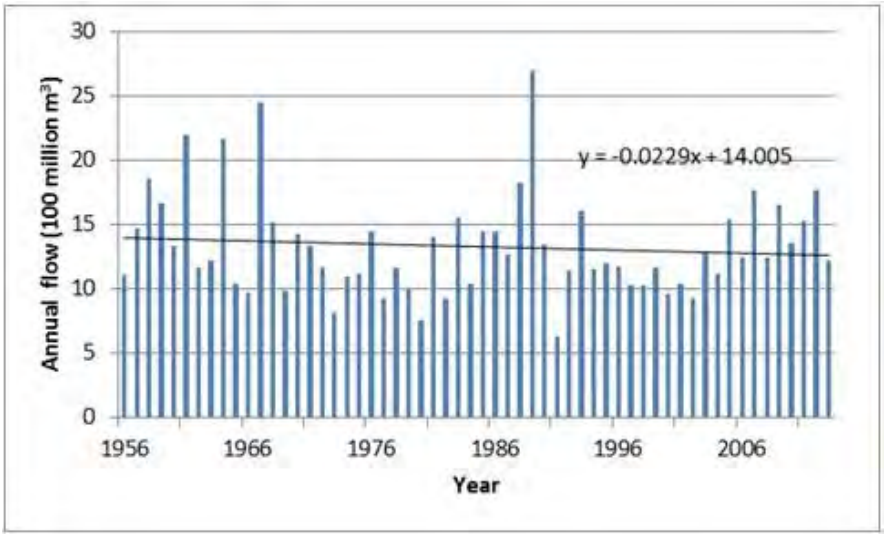


Figure IV.8: Annual Huangshui River flow volume measured at Ledu station from 1952 to 2012

160. In the Huangshui River Basin, 70-80% of the annual precipitation falls within three months, i.e. July, August, and September, when there are often storms that result in localized flash floods. Those storms may become more severe in the future as results of increased summer temperature and rainfalls, due to climate change. The low and mid scenario projections pointed

to little change in high flow to a likely 6% increase in flow intensity by 2030, while the high scenario indicated up to 12.5% flow intensity increase by 2030.

Table IV.2: Projected Huangshui River annual maximum daily high flow change under different climate change scenarios.

Flood event time	Modelled river flow (m3/s)	Climate change scenario at 2030					
		Low		Mid		High	
		Flow (m3/s)	Change (%)	Flow (m3/s)	Change (%)	Flow (m3/s)	Change (%)
Aug. 2, 1967	512	537	4.9	545	6.4	576	12.5
Aug. 18, 1970	399	413	3.5	417	4.5	442	10.8
Aug. 17, 1983	326	327	0.3	327	0.3	336	3.1
Jul. 23, 1989	234	240	2.5	243	3.8	250	6.8
Four Event Average	367.75	379.25	2.8	383	3.75	401	8.3

Source: CRVA, 2015

161. **Qijachuan River.** The Qijiachuan Watershed (Figure IV.9), which has a total area of 269.3 km^2. Qijiachuan River is one of the main tributaries of Huangshui River, and is located to the south of Huangshui River; its main stream has a total length of 16.2 km. It originates from the mountainous area to the south of Shihuiyao Township and Sanhe Town and feeds into Huangshui River at Guchengya in Sanhe Town. Based on water resource utilization development and planned water supply projects in the watershed, it is divided into three valleys: (i) Shitai Creek basin (with a total area of 85 km^2 and administered by Shitai Township); (ii) Shihuiyao Creek basin (with a total area of 77.6 km^2 and administered by Shihuiyao Township); and the watershed downstream of Sanhe Town (with a total area of 106.7 km^2 and administered by Sanhe Town).

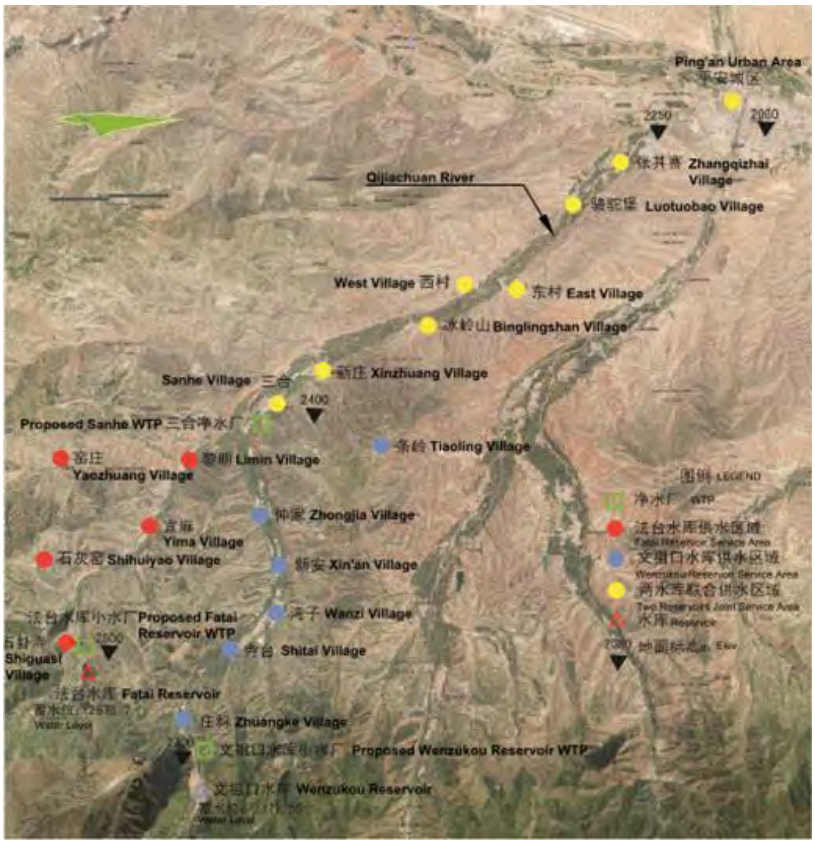


Figure IV.9: Qijiachuan Watershed

B. Physical Environment at the Project sites

162. **Ambient air quality**. According to the new air quality standard (GB 3095-2012), the ambient air quality in the assessment area of the project has been assigned to meet Class II standard. Automated air quality monitoring is conducted by the Haidong Environmental Monitoring Station (HEMS). From the daily average monitoring results for Ping'an District during the first quarter in 2015, the average 24-hr concentrations for SO_2, NO_2 and PM_{10} are 36 μg/m^3, 34.6 μg/m^3 and 131 μg/m^3 respectively, indicating generally the air quality conforms to Class II (GB 3095-2012) and WBG's EHS interim targets.

163. The air quality monitoring results at Ledu from August 2015 to March 2016 was cited in the domestic TEIA. The monitoring results also showed compliance with Class II (GB 3095-2012) levels (Table IV.3).

Table IV.3: Air Quality Monitoring Results

	Ping'an			Ledu		
Date	Comprehensive Index	Primary pollutant	Days of good air quality	Comprehensive Index	Primary pollutant	Days of good air quality
2015/08	4.69	$PM_{2.5}$	31	4.19	O_3, NO_2	25
2015/09	4.69	$PM_{2.5}$	30	4.19	O_3, NO_2	29
2015/10	4.23	$PM_{2.5}$	31	4.98	NO_2	27
2015/11	6.4	$PM_{2.5}$, PM_{10}	18	4.33	$PM_{2.5}$	26
2015/12	6.96	$PM_{2.5}$	13	10.14	$PM_{2.5}$	9
2016/02	4.55	$PM_{2.5}$	25	4.09	$PM_{2.5}$, PM_{10}	29
2016/03	6.07	$PM_{2.5}$, PM_{10}	19	6.88	$PM_{2.5}$, PM_{10}	15

164. Baseline ambient air quality monitoring was undertaken for the Ledu landfill expansion subcomponent at Taomajia Village (upwind direction), the existing landfill site and Qilidian Village (downwind direction) from 5 to 11 January 2016 for seven consecutive days. The monitoring results presented in Table V.4 show non-compliance of NH_3 levels caused by excessive emissions from the existing landfill site. Non-compliance was also found for PM_{10} levels, caused by wind born dust from adjacent barren land.

Table IV.4: Baseline Ambient Air Quality for Ledu Landfill Expansion Subcomponent

Location	Date	NH3 (mg/m3)	H2S (mg/m3)	SO2 (mg/m3)		NO2 (mg/m3)		PM10 (mg/m3)
		1-hour	1-hour	1-hour	24-hour	1-hour	24-hour	24-hour
Existing landfill site	16.01.05	0.08-0.20	0.001-0.004	0.007-0.032	0.019	0.019-0.038	0.020	0.113
	16.01.06	0.11-0.27	0.002-0.005	0.007-0.029	0.016	0.021-0.036	0.021	0.147
	16.01.07	0.08-0.11	0.002-0.005	0.007-0.013	0.021	0.015-0.024	0.014	0.122
	16.01.08	0.07-0.10	0.002-0.004	0.007-0.030	0.023	0.020-0.032	0.029	0.143
	16.01.09	0.07-0.15	0.003-0.007	0.009-0.024	0.024	0.020-0.061	0.031	0.147
	16.01.10	0.08-0.17	0.002-0.004	0.010-0.017	0.017	0.017-0.031	0.018	0.147
	16.01.11	0.07-0.13	0.002-0.004	0.012-0.025	0.022	0.021-0.038	0.023	0.146
Upwind	16.01.05	0.14-0.27	0.002-0.004	0.007-0.034	0.025	0.024-0.053	0.028	0.145
	16.01.06	0.20-0.30	0.001-0.003	0.009-0.033	0.019	0.015-0.039	0.020	0.139
	16.01.07	0.07-0.13	0.002-0.005	0.016-0.032	0.017	0.014-0.030	0.020	0.142
	16.01.08	0.10-0.29	0.002-0.005	0.017-0.041	0.024	0.030-0.069	0.025	0.147
	16.01.09	0.09-0.17	0.004-0.005	0.019-0.047	0.023	0.032-0.035	0.019	0.138

	16.01.10	0.09-0.15	0.002-0.003	0.012-0.037	0.020	0.027-0.039	0.022	0.143
	16.01.11	0.11-0.17	0.002-0.004	0.011-0.039	0.020	0.025-0.034	0.020	0.137
Downwind	16.01.05	0.12-0.26	0.003-0.004	0.008-0.022	0.026	0.044-0.082	0.042	0.172
	16.01.06	0.06-0.11	0.002-0.004	0.010-0.024	0.026	0.028-0.055	0.045	0.165
	16.01.07	0.10-0.15	0.003-0.009	0.016-0.023	0.022	0.028-0.074	0.040	0.181
	16.01.08	0.12-0.16	0.001-0.005	0.012-0.034	0.020	0.046-0.075	0.049	0.178
	16.01.09	0.13-0.14	0.004-0.006	0.019-0.035	0.022	0.034-0.071	0.043	0.172
	16.01.10	0.09-0.14	0.003-0.004	0.015-0.024	0.023	0.036-0.063	0.041	0.181
	16.01.11	0.12-0.15	0.002-0.004	0.013-0.026	0.021	0.038-0.048	0.039	0.170
Applicable Standard		*0.20*	*0.01 (TJ36-79)*	*0.5 (GB3095-2012 Class II)*	*0.15 (GB3095-2012 Class II)*	*0.2 (GB3095-2012 Class II)*	*0.08 (GB3095-2012 Class II)*	*0.15 (GB3095-2012 Class II)*
Exceed applicable standard								

165. **Acoustic environment.** The project areas have been designated functional area Category 2 for ambient noise. The monitoring results conducted in the framework of the environment baseline assessment for the domestic EIAs showed compliance with the requirement of Class II (GB 3096-2008) and WBG EHS guidelines.

Table IV.5: Baseline Noise Monitoring Data

Sub component	Monitoring Date	Monitoring Location	Noise Level (dB(A))	
			Daytime	Nighttime
Huangshui River Ledu urban segment	2016/01/08	Majiatai Village	45.7	41.3
		Jiaotong Huayuan community	50.5	47.2
		Zhaojingyuan community	51.3	48.1
Huangshui River Ledu rural segment	2016/01/19	Xiaohetanzhai Village	52.1	42.8
	2016/01/20		52.5	43.3
	2016/01/19	Xiakou Village	51.4	42.5
	2016/01/20		52.6	43.6
	2016/01/19	Xinsheng Village	49.3	41.2
	2016/01/20		50.2	40.5
	2016/01/19	Shangzhai Village	51.3	42.3
	2016/01/20		50.4	41.6
Huangshui River Ping'an segment	2016/01/19	Wangjiazhuang Village	51.8	43.2
	2016/01/20		52.3	41.6
	2016/01/19	Shangtan Village	51.3	42.8
	2016/01/20		50.3	42.3
	2016/01/19	Zhangjiazhai Village	52.6	43.6
	2016/01/20		51.4	42.8
Yizhou Wetland	2015/11/09	Mayixin Village	53.2	-
	2015/11/09	Xiaoxi Village	54.8	-
Urban water reclamation	2015/11	Ping'an WWTP	57	46
	2015/11	#4 PS	53	43
	2015/11	#12 Reservoir	52	41
	2015/11	# 4 Reservoir	51	41
Ledu Landfill Expansion	2016/01/06	East boundary	45.4	36.2
	2016/01/07		46.1	37.1
	2016/01/06	West boundary	41.2	35.4
	2016/01/07		42.1	35.1
	2016/01/06	South boundary	40.3	33.6
	2016/01/07		40.5	33.2
	2016/01/06	North boundary	45.8	37.7

Sub component	Monitoring Date	Monitoring Location	Noise Level (dB(A))	
			Daytime	Nighttime
	2016/01/07		45.9	36.8
	2016/01/06	Qilidian Village	38.7	33.2
	2016/01/07		40.5	35.0
Class II (GB 3096-2008)			*60*	*50*
WBG EHS Standard			*55*	*45*

166. **Huangshui River water quality.** The targeted water quality for the Huangshui River mainstream in the Haidong area is Category IV according to the Qinghai Provincial Water Function Zoning (2004) approved by Qinghai Provincial Government. There are four national controlled cross sections along the mainstream as indicated in Figure IV.10. Monitoring results of major pollutant indicators during Jan-May 2015 were collected from Haidong Environmental Monitoring Station (HEMS). Results showed exceedance of Category IV and even Category V standards for five days biological oxygen demand (BOD_5), ammonia, total phosphorus (TP), total nitrogen (TN) and fecal coliforms at all monitoring locations on the days of monitoring. Haidong City is located at the downstream of Xining City. The river sections in Haidong receive large amounts of municipal and industrial wastewater from Xining. In addition, improper rural solid waste dumping and non-point agricultural pollution along the river in Haidong also undermine water quality (Table IV.8).

Figure IV.10: Huangshui River water quality sampling location map

167. **Qijiachuan River basin water quality.** Faitai and Wenzukou reservoirs are located within the Qijiachuan River basin and are classified as Class III water bodies. In July, 2015, Ping'an District Water Affairs Bureau conducted water quality monitoring for the water source of Wenzukou Reservoir at Yaodong (Table IV.6). Water quality monitoring for the water source of Fatai Reservoir at Limin Village was conducted in February, 2005 (Table IV.7).

Table IV.6: Wenzukou Reservoir (2015)

Parameter	Unit	Results	Parameter	Unit	Results
Total Coliform	CFU/100 ml	2,400	Turbidity	NTU	0.46
Thermotolerant Coliforms	CFU/100 ml	326	Odor		No odor
E. coli	CFU/100 ml	261	Visible particles		None
Total Bacteria	CFU/100 ml	3,400	pH		8.64

Parameter	Unit	Results	Parameter	Unit	Results
As	mg/L	<5.0x10-4	Aluminum	mg/L	<0.02
Cd	mg/L	<1.0x10-3	Iron	mg/L	<0.005
Cr6+	mg/L	<0.004	Manganese	mg/L	<0.001
Lead	mg/L	<5.0x10-4	Copper	mg/L	0.025
Hg	mg/L	<5.0x10-4	Zinc	mg/L	0.017
Selenium	mg/L	<5.0x10-4	Chloride	mg/L	19.7
Cyanide	mg/L	<0.002	Sulfate	mg/L	85.7
Fluoride	mg/L	<0.20	Total Dissolved Solids (TDS)	mg/L	297
Nitrate (counted as N)	mg/L	0.91	Total Hardness (as Calcium Carbonate)	mg/L	198
Trichloromethane	mg/L	<3.0x10-3	Oxygen Consumption (as CODMn)	mg/L	1.63
Phenixin	mg/L	<1.5x10-4	Volatile Phenol	mg/L	<0.002
Chromaticity		<5	Anionic synthetic detergents	mg/L	<0.10
Total β	Bq/L	0.11	Total α	Bq/L	0.11

Table IV.7: Surface Water Quality Monitoring Data at Fatai Reservoir (2005)

Parameter	Unit	Results	Parameter	Unit	Results
Total Bacteria	CFU/ml	86	Oxygen Consumption (as CODMn)	mg/L	0.83
Total Coliform	CFU/L	3	Sulfate	mg/L	140.0
Chromaticity		<5	Fluoride	mg/L	0.40
Turbidity	NTU	<3	Nitrate (counted as N)	mg/L	11.2
pH		6.5	Total Dissolved Solids (TDS)	mg/L	820
Odor		No odor	Iron	mg/L	<0.3
Visible particles		None	Manganese	mg/L	<0.1
Total Hardness (as Calcium Carbonate)	mg/L	120.7	Arsenic	mg/L	<0.05
Chloride	mg/L	105.7	Mercury	mg/L	<0.001
Chromium (Cr6+)	mg/L	<0.05	Cadmium	mg/L	<0.01
Lead	mg/L	<0.05			

Table IV.8: Baseline Surface Water Quality

Monitoring section	Date	Temperature	Ph	DO	COD_{Mn}	BOD5	NH_3-N	Oils	Volatile phenol	Hg	Pb	CODcr	TN	TP	Cu	Zn	F	Se	As	Cd	Cr^{6+}	Fecal coliforms
		℃		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Xiaoxia Bridge	201501	2	7.21	6.6	2.83	12	3.54	0.01	0.0052	0.00001	0.001	23	9.69	0.32	0.004	0.02	0.37	0.0003	0.0003	0.0001	0.009	≥24000
	201502	2	7.48	7.8	2.83	8	3.196	0.03	0.0070	0.00001	0.002	20	7.98	0.56	0.001	0.02	0.20	0.0003	0.0003	0.0001	0.011	≥24000
	201503	10	7.88	7.6	2.86	9	4.67	0.01	0.0032	0.00001	0.001	25	9.14	0.63	0.001	0.02	0.42	0.0003	0.0003	0.0001	0.016	≥24000
	201504	10	7.98	7.7	2.72	6	5.07	0.01	0.0018	0.00001	0.001	23	9.92	0.62	0.002	0.02	0.49	0.0003	0.0003	0.0001	0.006	≥24000
	201505	11	7.8	6.5	3.55	5	1.363	0.01	0.0031	0.00001	0.001	24	5.41	0.22	0.003	0.02	0.59	0.0003	0.0003	0.0001	0.004	≥24000
Wanzi Bridge	201501	1	7.66	6.0	2.88	13	2.649	0.01	0.0036	0.00001	0.001	24	8.61	0.28	0.002	0.02	0.45	0.0003	0.0003	0.0001	0.012	≥24000
	201502	1	7.66	6.8	3.15	11	2.905	0.01	0.03	0.00001	0.002	20	9.78	0.46	0.001	0.02	0.35	0.0003	0.0003	0.0001	0.016	≥24000
	201503	3	7.86	7.6	2.80	10	3.310	0.01	0.0029	0.00001	0.001	22	8.80	0.54	0.001	0.02	0.38	0.0003	0.0003	0.0001	0.015	2800
	201504	11	8.01	7.2	2.88	6	4.280	0.01	0.0016	0.00001	0.001	15	8.61	0.59	0.001	0.02	0.38	0.0003	0.0003	0.0001	0.008	≥24000
	201505	12	7.88	6.4	2.18	2	1.250	0.01	0.0021	0.00001	0.001	9	6.48	0.24	0.003	0.02	0.49	0.0003	0.0003	0.0001	0.011	≥24000
Laoya Xiakou	201501	1	7.59	6.6	2.96	5	2.535	0.01	0.0050	0.00001	0.001	16	8.88	0.25	0.002	0.02	0.51	0.0003	0.0003	0.0001	0.012	≥24000
	201502	1	7.57	6.4	1.60	9	2.784	0.03	0.0088	0.00001	0.001	35	9.60	0.43	0.001	0.02	0.23	0.0003	0.0003	0.0001	0.019	3500
	201503	3	8.03	6.4	2.90	6	2.95	0.01	0.0026	0.00001	0.001	19	7.87	0.48	0.001	0.02	0.42	0.0003	0.0003	0.0001	0.013	1800
	201504	13	8.16	6.9	2.72	5	3.240	0.01	0.0021	0.00001	0.001	20	8.88	0.49	0.001	0.02	0.42	0.0003	0.0003	0.0001	0.005	≥24000
	201505	13	7.91	7.2	2.37	3	1.190	0.01	0.0024	0.00001	0.001	13	6.57	0.28	0.001	0.02	0.52	0.0003	0.0003	0.0001	0.010	≥24000
Minhe Bridge	201501	1	7.54	6.7	2.53	10	1.870	0.01	0.0030	0.00001	0.001	19	9.13	0.20	0.004	0.02	0.56	0.0003	0.0003	0.0001	0.011	≥24000
	201502	1	7.57	7.5	3.20	6	1.702	0.01	0.0050	0.00001	0.003	20	10.50	0.32	0.001	0.02	0.55	0.0003	0.0003	0.0001	0.015	5400
	201503	5	7.78	6.2	2.56	5	1.490	0.01	0.0022	0.00001	0.001	20	8.73	0.23	0.001	0.02	0.57	0.0003	0.0003	0.0001	0.012	3500
	201504	10	8.20	6.5	2.48	4	1.390	0.01	0.0014	0.00001	0.001	19	8.51	0.22	0.001	0.02	0.36	0.0003	0.0003	0.0001	0.004L	≥24000
	201505	15	7.81	7.2	2.79	3	0.823	0.01	0.0014	0.00001	0.001	15	5.51	0.18	0.002	0.02	0.47	0.0003	0.0003	0.0001	0.007	≥24000
IV (GB 3838-2002)			6-9	≥3	≤10	≤6	≤1.5	≤0.5	≤0.01	≤0.001	≤0.05	≤30	≤1.5	≤0.3	≤1.0	≤2.0	≤1.5	≤0.02	≤0.1	≤0.005	≤0.05	≤20000
V (GB 3838-2002)			6-9	≥2	≤15	≤10	≤2.0	≤1.0	≤0. 1	≤0.001	≤0.1	≤40	≤2.0	≤0.4	≤1.0	≤2.0	≤1.5	≤0.02	≤0.1	≤0.01	≤0.1	≤40000

Note:
Exceed category V Exceed category IV

168. **Groundwater quality.** Groundwater was not found at the existing landfill site during the sampling that was planned during domestic EIA. Drilling stopped at 55m – so groundwater, if present, is deeper than this. Groundwater samples were taken from existing wells at three villages near the landfill site on 6 January 2016 by Qinghai Jinyun Environmental Technology Company. The results showed non-compliance with Groundwater Quality Standard (GB/T14848-93) in terms of total hardness, total coliform, chloride, sulfate and ammonia.

169. However, due to their locations these three sites at Taomajia village (2.5 km upstream), Shuimowan Village (2 km upstream) and Qilidian Village (1.5 km downstream) are more likely to be sampling local groundwater conditions than any influence from the landfill. Both Shuimowan and Qilidian are on the Huangshui River floodplain and within 200 m of the Huangshui River itself. Groundwater quality is overwhelmingly more likely to be a result of local pollution rather than leakage from the more distant landfill. Similarly, Taoajia Village is in a different local watershed than the landfill and is a small farming community on a tributary of the Huangshui. Locations are shown on Figure IV.11.

Figure IV.11: Location of Sampling Wells in relation to the Landfill Site

170. Moreover, the parameters which exceed the standard in Table IV.9 are characteristic of domestic pollution, rather than landfill leakage – where elevated levels of heavy metals might also be expected. Repeat sampling of groundwater at and adjacent to the landfill site will need to be taken following antecedent rains in order to access the local groundwater.

171. **Groundwater at Yizhou wetland.** A ground water test, conducted as part of the FSR, showed the ground water level at 1.6 m and an aquifer thickness of 5.1 m. The pebble layer of the aquifer had a high permeability (K= 42.55 m/day). The height of the ground water table is anticipated to have an annual range of 1 m. Given the proposed design depth of the wetland, there will be a strong interaction between the ground water and the water in the wetland. Groundwater samples were taken at Mayi village by HEMS on 26th February 2016. This village is on the same landform as the wetland site and is adjacent to the planned wetland construction area. It was chosen because its existing wells provided ready access to the groundwater resource without drilling. The results showed compliance with Class III of Groundwater Quality Standard (GB/T14848-93).

Table IV.9: Baseline Groundwater Quality

Item	Unit	Taomajia Village	Shuimowan Village	Qilidian Village	Mayi Village	Class III GB/T14848-93
Temp.	oC	1.5	5.2	4.8	-	-
pH		7.26	7.64	7.45	7.32	6.5-8.5
IMn	mg/L	1.1	0.6	2.2	1.05	≤3.0
Total hardness	mg/L	1.60×103	5.07×103	8.88×103	-	≤450
Bacteria	CFU/mL	7.5×102	6.1×102	7.0×102		≤100
Total coliform	CFU/L	80	50	70	3	≤3.0
Chloride	mg/L	3.86×102	1.57×102	2.10×102	158	≤1.0
Sulfate	mg/L	4.31×102	4.47×102	2.79×102	42	≤20
Ammonia	mg/L	0.775	0.225	0.148	0.093	≤0.2
Nitrate	mg/L	-	-	-	10.9	≤20
As	mg/L	3.00×10-4	3.00×10-4	3.00×10-4	3.00×10-4	≤0.5
Hg	mg/L	4.00×10-5	4.00×10-5	4.00×10-5	1.00×10-5	≤0.001
Pb	mg/L	0.001	0.001	0.001	0.001	≤0.05
Cu	mg/L	-	-	-	0.001	≤1.0
Cr6+	mg/L	-	-	-	0.004	≤0.05
	Exceeds standard					

172. **Soil Quality**. Soil samples were taken at the landfill site, including one point upstream of the landfill site, as well as one point downstream of the existing leachate collection tank (24th February 2016). The results are given in Table IV.10. The results show compliance with the Soil Quality Standard (GB15168-1995), no change between upstream and downstream sites, and no indication of contamination through lateral movement of leachate through the soil.

Table IV.10: Baseline Soil Quality at Landfill Site (February 2016)

Location	pH	Hg (mg/kg)	As (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Pb (mg/kg)
Upstream of landfill site (0-20cm)	8.2	0.011	12.6	62	0.23	15.7
Upstream of landfill site (20-40cm)	8.28	0.014	13	61	0.23	17.3
Downstream of leachate tank (0-30cm)	8.47	0.01	12.7	65	0.22	16.5
Downstream of leachate tank (30-40cm)	8.92	0.01	12.7	64	0.23	18
Class III of GB15618-1995	*>6.5*	*≤1.5*	*≤40*	*≤300*	*≤1.0*	*≤500*

C. Ecological Resources

173. **Land use/Land cover.** Land use and land cover data was collected for the Huangshui Basin from a 2007 remote sensing data by Yang (2012). The upper reach of the Huangshui River is relatively well protected. The dominant land cover is meadow, needle leaved evergreen forest or broadleaved evergreen forest; the dominant land use from the middle to the lower

reach of the basin are dominated by agriculture land, with both rain fed and irrigated crops; Xining as the biggest urban area is located in the middle of the basin (Figure IV.11).

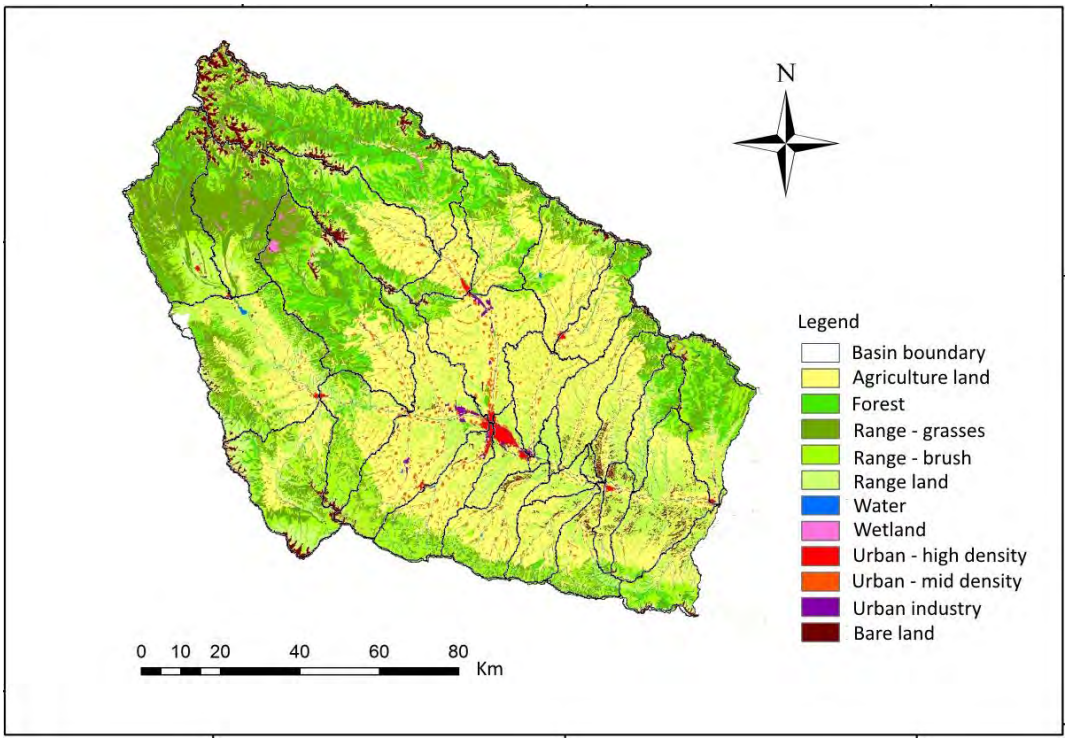
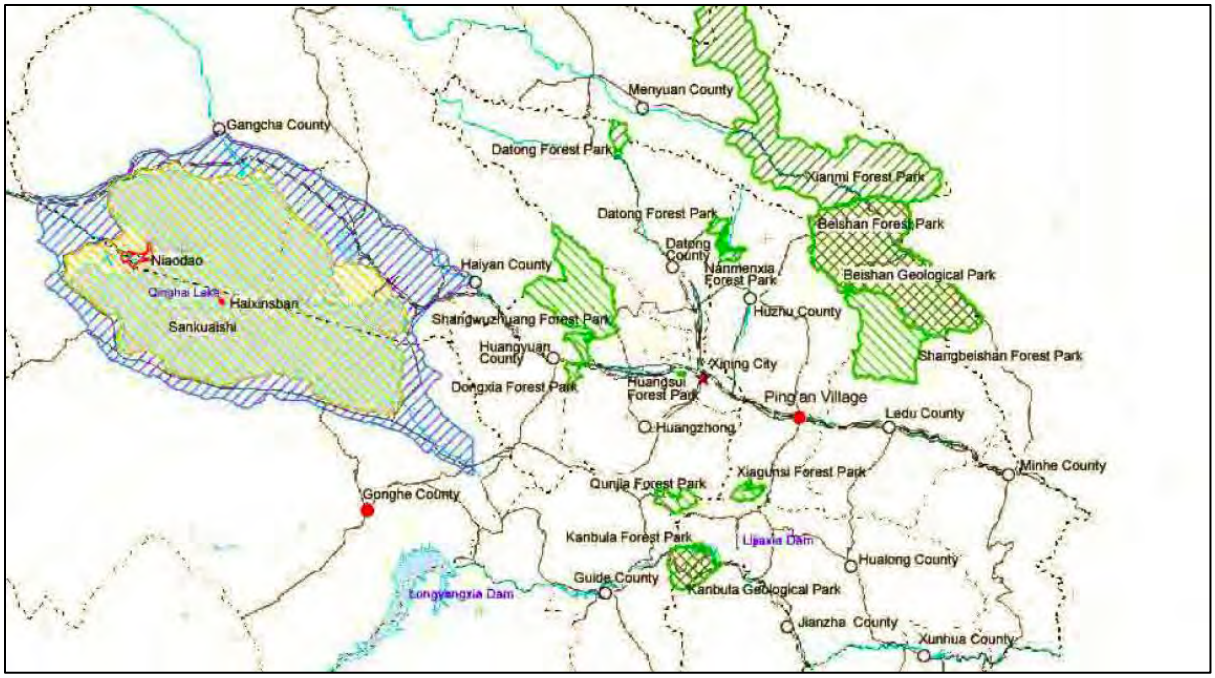


Figure IV.11: Land use and land cover data of Huangshui River basin (Yang, 2012)

174. **Protected Areas in the Huangshui Basin.** Huangshui river basin contains two national level nature reserves (Qilianshan National Natural Reserve and Liancheng National Natural Reserve in Gansu province) and two at provincial level (Qinghai Datong Beishan River Source Natural Reserve and Qinghai Qilianshan Natural reserve); five forest parks; and one national geological park (Beishan National Geological Park). The Xiagunsi Forest Park is upstream of the Fatai and Wenkuzhou reservoirs and the Shangbeishan Forest Park is in the northern reaches of Ledu District. None are near areas of project activities (Figure IV.12).



Source: PADECO 2006 for JICA

Figure IV.12: Protected Areas in the Haidong Basin

175. **Riverside Land use and Land Cover.** In the Ledu Urban Area the upstream, central and downstream sections include parklands. The other two sections have riverside walkways and some small areas of parkland. Within each section, riparian vegetation has established along parts of the shoreline and on the islands that have formed in the channel. This vegetation has increased the aquatic biodiversity and amenity of the area.

Figure IV.13: Riparian vegetation in the central section of the Ledu Urban Area

Figure IV.14: Islands of Riparian vegetation in the central section of the Ledu Urban Area

176. The vegetation on the floodplain of the Huangshui River in Ping'an District is highly degraded due to a long history of grazing and cultivation. Contemporary flood management structures, and the redevelopment of agricultural land for industrial and urban uses, have caused additional loss of vegetation. The loss of species diversity and structure in the vegetation has resulted in low diversity of flora and fauna in these areas and will also have impacted on the "corridor" functionality of the river for fauna.

177. There is very limited riparian (in-stream and river bank) vegetation along the Huangshui River in Ping'an District as the flood embankments are positioned close to the river channel. Between the two flood embankments, any vegetation that does establish, is regularly removed by channel works. Downstream of Haidong City, the floodplain is primarily used for agriculture and horticulture.

Figure IV.15: Right Bank near Haidong showing some riparian vegetation below the flood embankment and the area between the top of the wall and the adjacent road covered in weeds.

Figure IV.16: Right bank immediately south of the G6 Jingzang Expy.

Figure IV.17: Right bank 400m south of the G6 Jingzang Expy.

178. Along the river near the Haidong Industrial Park, a narrow "greenbelt" has been established on the bank. In this area the greenbelt is approximately 15m in width and has a combined pedestrian and cycle way.

Figure IV.18: Landscaped riverbanks near the Haidong Industrial Park

179. **Floodplain Wetlands.** There is a very limited area of wetlands remaining on the Huangshui floodplain in Ping'an District and these are primarily fish ponds dug into the shallow water table and recently constructed wetlands in recreational parks. Other wetland areas in, or adjacent, to project sites in Ping'an District include; (i) fish ponds and reed beds (<7 ha) adjacent to the proposed Main Urban Riverside Greenbelt; (ii) constructed wetlands in Haidong Industrial Park (24 ha); (iii) recently constructed wetlands of Pinganxin Park (<10 ha); and (iv) some small constructed wetlands in the proposed Ping'an Eastern Riverside Greenbelt.

180. **Yizhou wetland.** In the 1980's, parts of the floodplain, including large areas of the planned Yizhou Wetland site, had subsurface drainage installed to reduce summer waterlogging, and increase agricultural production. This has prevented permanent wetlands from forming on these areas of the floodplain.

181. Poplar trees have been planted along the river to protect arable land. Some irrigation water still runs onto the area and surface water can be observed in a low-lying parts of the site and there are some small patches of reeds and fish ponds. A number of aquatic plant species are growing in the drainage canals. Most of the farmland is abandoned but a limited amount of grazing by sheep and small scale cultivation still occurs.

Table V.11: Land Cover Breakdown of Yizhou Wetland Site

Land use type	Area (ha)	Percentage (%)
Building	1	1.16
Agricultural land (mostly abandoned)	42.9	48.97
Forest	28.2	32.79
Nursery	2	2.32
Road	4.2	4.88
Reed and Sedge Swamps	6.27	7.28
Open space	2.24	2.6

Tree plantation

Cultivated land

Abandoned agricultural Land

Reed and Sedge Swamp

Figure IV.19: Typical Habitats at the Yizhou Wetland Site

182. **Riverbank Habitats**. The PPTA team has undertaken a river habitat survey. This involved traversing the length of the river and recording on data sheets the dominant vegetation, landcover type, riverbank form and riverbed for both riverbanks at approximately 500m intervals during September 2015. Notes on vegetation species were also made. These data sheets were then used as "ground truthing" for the mapping of the riverbanks using Google Earth images. The maps were then imported into a GIS (ArcGIS ver. 10.1) to provide the maps below. This dataset is described below, and enables an assessment of the cumulative loss of habitat type as well as site specific impacts on habitat.

183. The following survey results show the habitat types along the riverbanks. The dominant habitat and vegetation for a distance of 20 meters from the waterline has been recorded (Table V.12 and Figure IV.20a, IV.20b and IV.20c).

Table V.12: Riverbank Habitat Categories and Abundance

Vegetation/Land Cover	Distance along Riverbank (m)	
	Left Bank	Right Bank
Urban/industrial/road	8400	4800
Trees or regrowth forest - Planted landscape	1200	400
Crops/orchard	12600	9200
Planted landscape	550	-
Weeds/waste ground	5250	5500
Weeds/waste ground - Urban/industrial/road	1200	1000
Crops/orchard with riverbank trees	11100	11650
Reclaimed land	7900	13550
Reeds/wetland	2750	900
Rocks/cliffs	2200	500
Trees or regrowth forest - Shrubs – Reeds	1000	200
Regrowth shrubs - Reeds/wetland	2100	600
Trees or regrowth forest - Crops/orchard	3100	4400
Trees or regrowth forest	5000	6700
Trees or regrowth forest - Regrowth shrubs	1950	1000
Urban/industrial/road - Planted landscape	-	250
Reeds/wetland - Weeds/waste ground	600	2150
Reeds/wetland - Reclaimed land	-	2000
Reeds/wetland - Crops/orchard with riverbank trees	-	2250
Regrowth Shrubs	-	400

Source: PPTA Team survey

184. The results show that the right (southern) bank is richer in trees and natural regrowth forest, and that the left (northern) bank is more urbanized. Wetlands are distributed along both banks, with the main occurrences on the left bank. The left bank has twice as much riverside development (urban/industrial/road) as the right bank, but the right bank has a large amount of reclaimed land indicating potential growth in this land cover category. Altogether, the left bank has 12,800m (17%) of natural regrowth and wetland, and the right bank has 9,800m (11%).

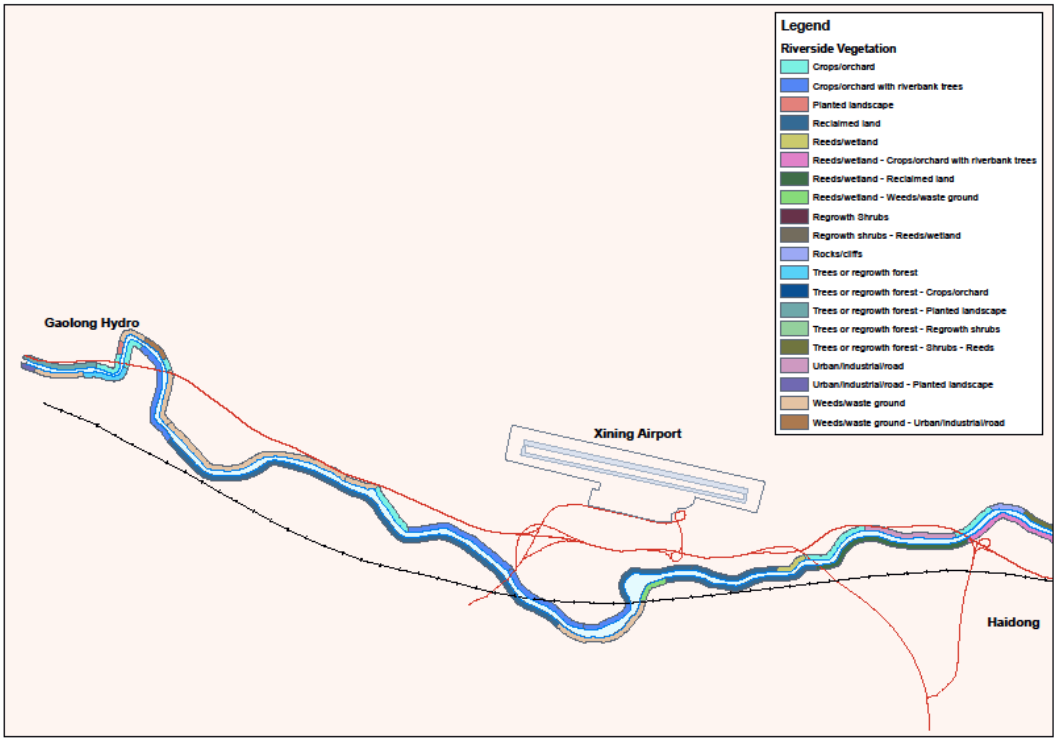


Figure IV.20a: Riverbank Habitats along Huangshui West

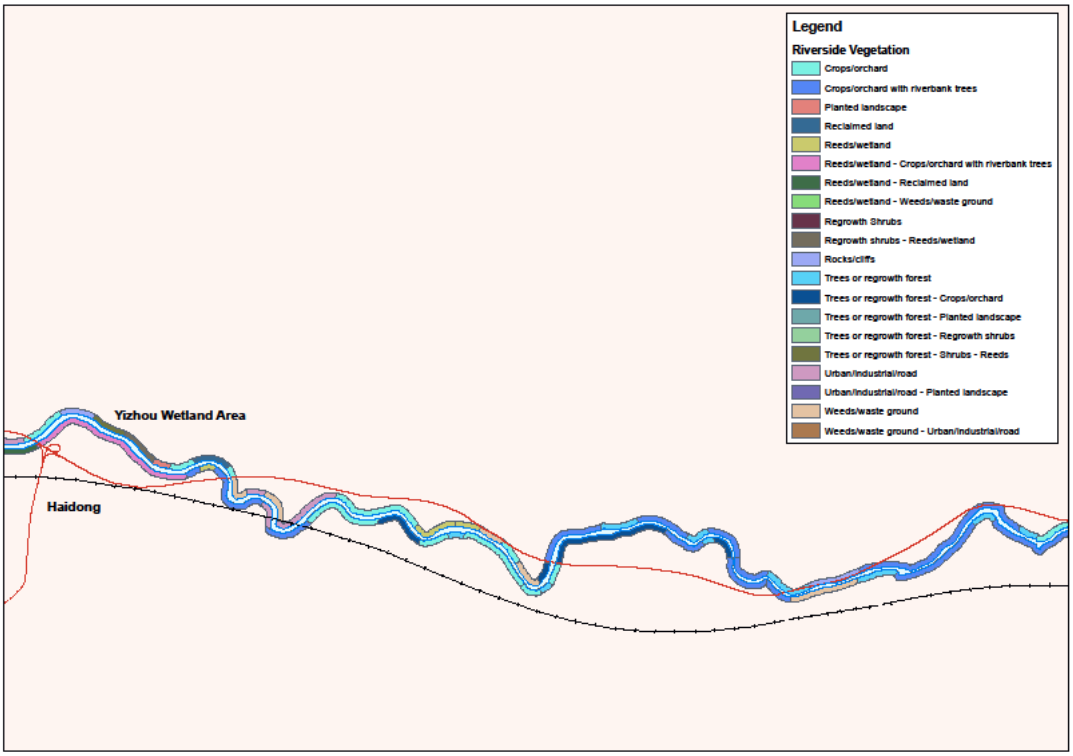


Figure IV.20b: Riverbank Habitats along Huangshui Central

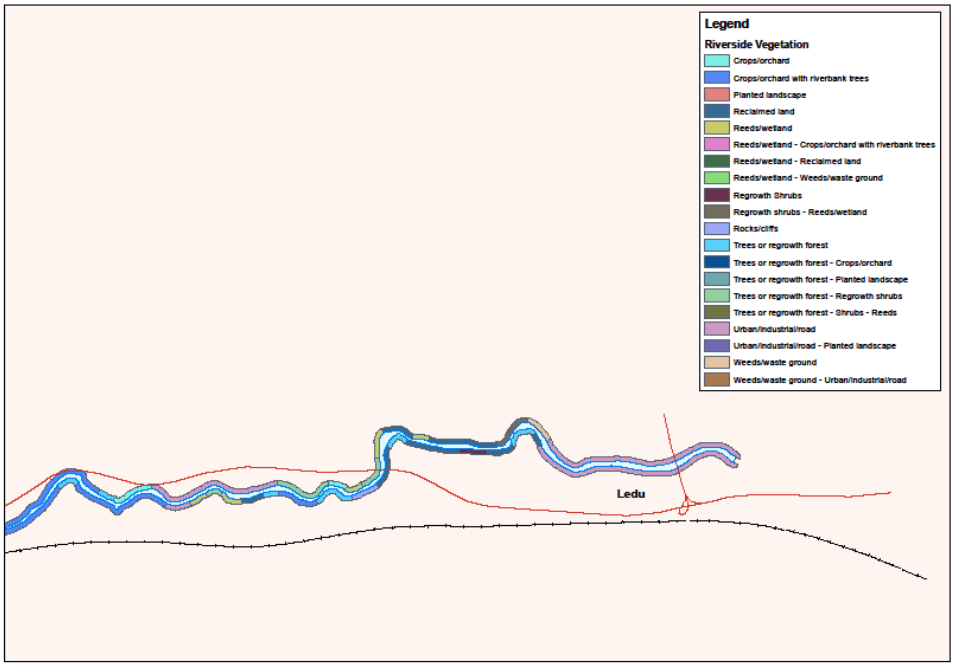


Figure IV.20c: Riverbank Habitats along Huangshui East

185. Flora species that dominate in the various habitat categories are presented in Table V.13. None of these species is on the PRC local or provincial list for protected species, nor are these species of concern on the IUCN list.

Table V.13: Riverside Vegetation Species

Vegetation/Land Cover Category	Main Species
Trees or regrowth forest 	*Populus simonii* *Betula platyphylla* *Pinus tabuliformis* *Salix matsudana* *Picea asperata* *Salix babylonica* *Juniperus przewalskii* *Betula albosinensis* *Pinus armandii* *Quercus liaotungensis*
Regrowth Shrubs 	*Spirea alpine* *Salix oritrepha* *Caragana brevifolia* *Berberis dasystachya* *Potentilla fructicosa* *Artemisia gmelinii* *Cotoneaster adpressus* *Lychium chinensis* *Hippophae thibetana*
Reeds/wetland	*Hordeum jubatum* *Miscanthus sacchariflrus*

Vegetation/Land Cover Category	Main Species
	*Stipa aliena* *Lolium temulentum* *Agrostis hugoniana* *Agrostis gigantea* *Setaria viridis* *Phragmites australis* *Schoenoplectus ehrenbergii* *Artemisia lavandulifolia* *Bidens tripartita* *Inula japonica* *Cirsium arvense var. integrifolium* *Saussure sp.* *Polygonum lapathifolium* *Rumex sp.* *Halerpests tricuspis* *Plantago major* *Plantago depressa* *Potentilla anserina* *Draba nemorosa* *Melilotus officinalis* *Medicago sativa* *Mentha canadensis* *Cerastium caespitosum*
Planted landscape and Crops/orchard with riverbank trees 	All the above species under "Trees or regrowth forest" and shrubs plus….. *Populus cathayana* *Picea asparata* *Ulmus laevis* *Juniperus chinensis* *Abies fargesia* *Sophora japonica* *Acer pictum ssp mono* *Cunninghamia sp*

Source: PPTA Team survey

186. **Riverbank Form.** The survey recorded the type of riverbank for each reach of the river, identifying three main types: Natural earth/rock; Reclaimed/fill; and Wall/concrete. The first category is the most natural, providing a water-land interface where both terrestrial and aquatic organisms can find habitat. The results of the survey are at Table IV.14 and Figures IV.21a, IV.21b and IV.21c.

Table IV.14: Riverbank Form

Bank type	Percentage Distance along Riverbank	
	Left Bank	Right Bank
Natural earth/rock	56%	50%
Reclaimed/fill	36%	38%
Wall/concrete	8%	12%

Source: PPTA Team survey

187. The results show that for approximately half the length of the river in the project area, on both sides, the banks are "soft" comprising non-built shorelines.

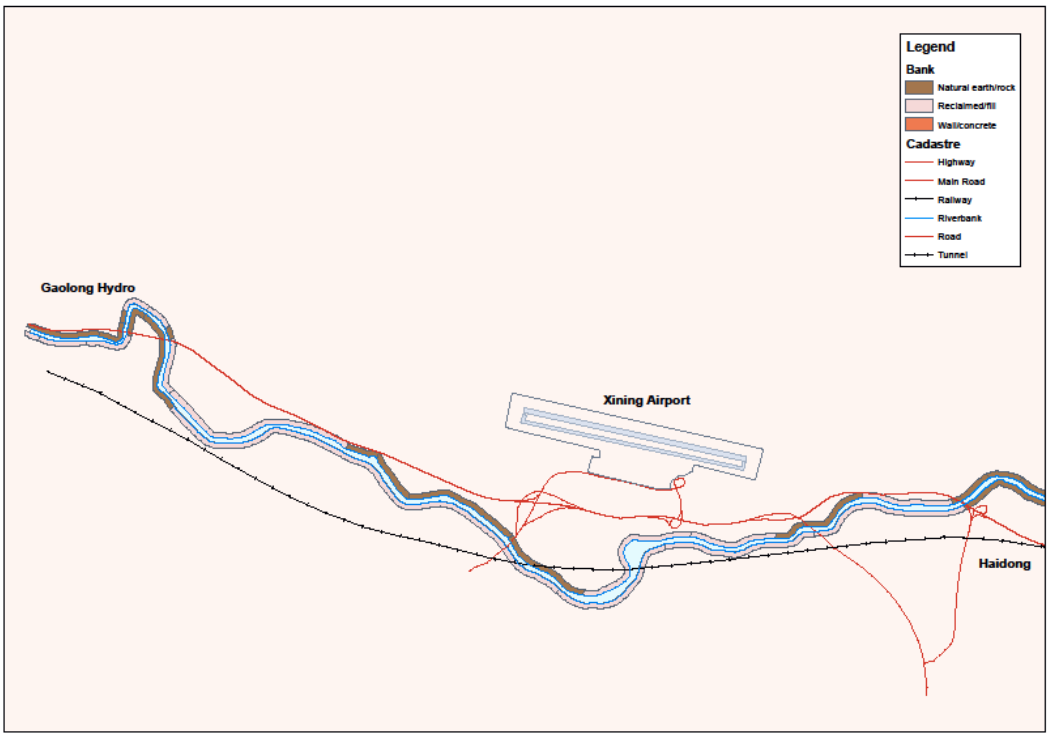


Figure IV.21a: Riverbank Form Huangshui West

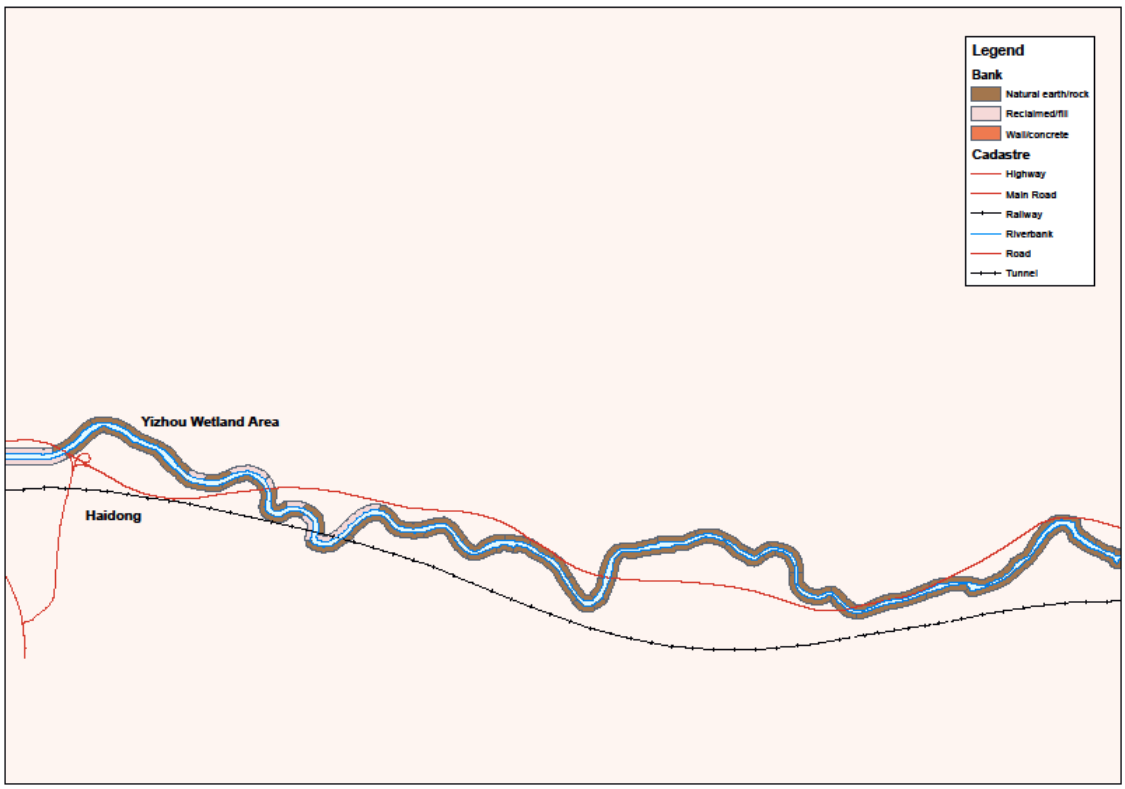


Figure IV.21b: Riverbank Form Huangshui Central

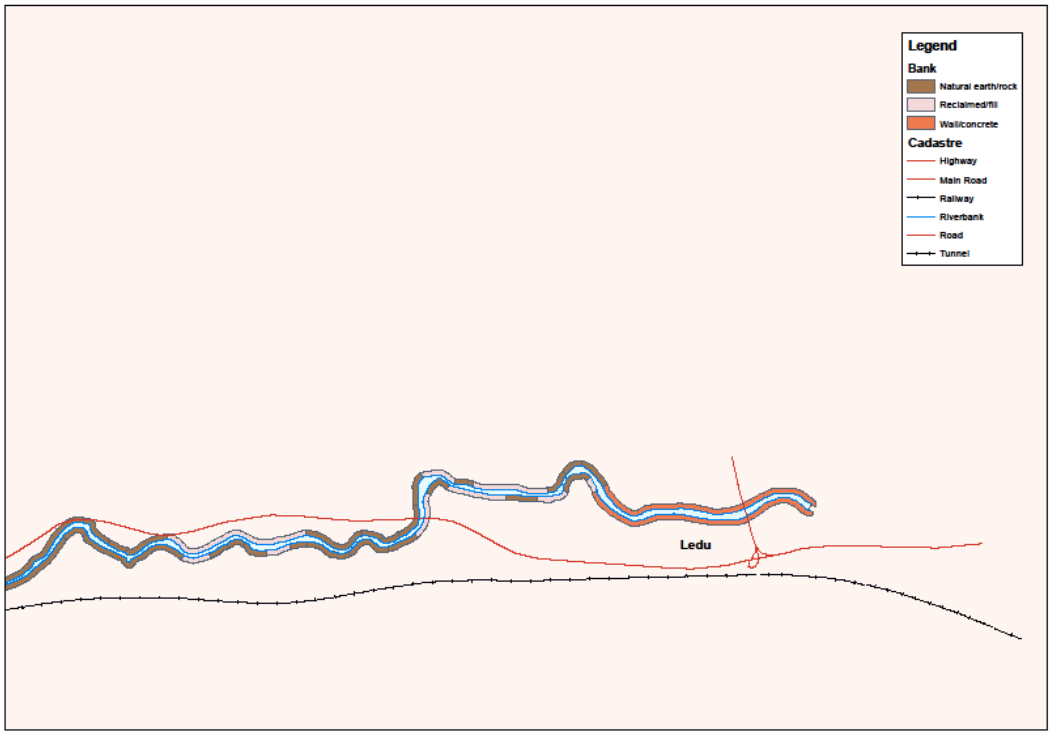


Figure IV.21c: Riverbank Form Huangshui East

Natural Earth/Rock

Natural Earth/Rock

Reclaimed/Fill

Wall/Concrete

Figure IV.22: Typical Riverbank Forms

188. **Fish Resources in Huangshui River.** Results of a study conducted in 2011 by local experts[10], show that fish biodiversity of Huangshui River is very low due to degraded water quality, development of cascade hydropower plants and introduction of invasive species. The fish recorded are *Misgurnus anguillicaudatus, Schizopygopsis pylzou, Triplophya pseudoscleroptera, Paramisgurnus dabryanus, Carassius auratus, Rhodeus sinensis*, and *Pseudorasbora parva.*

189. Species tolerant of high pollution, such as *S. pylzovi* and *T. pseudoscleroptera* were the dominant species in the downstream (segment from Xining to Minhe). None of the species recorded is on the PRC local or provincial lists for protected species, nor are these species of concern in IUCN lists.

Table V.15: Fish Species in the Mainstream of Huangshui River

Location	Species	No.	Captures				
			Percent	Weight	% Weight	Body length / cm	Body weight g
Ping'an	T. pseudoscleroptera	6	10.72	58.6	27.54	9.0 (5.8-9.8)	9.8 (8.3-37.1)
	P. parva	27	48.21	19.7	9.26	5.2-5.5	0.7 (2.6-3.8)
	C. auratus	15	26.79	65.5	30.78	3.5-7.4	4.4 (1.3-13.1)
	M. anguillicaudatus	4	7.14	25.2	11.84	5.0	0.7
	P. dabryanus	4	7.14	43.8	20.58	9.9 (8.4-11.4)	11.0 (7.5-14.7)
Ledu	S. pylzovi	3	20.00	147.0	63.77	13.0-16.2	49.0 (35.4-70.8)
	T. pseudoscleroptera	6	40.00	48.7	21.13	8.2 (5.4-10.8)	8.1 (2.3-14.6)
	P. parva	1	6.67	1.5	0.65	4.1	1.5
	R. sinensis	1	6.67	2.0	0.87	3.8	2.0
	C. auratus	4	26.66	31.3	13.58	5.5 (3.5-7.5)	7.8 (3.4-16.4)

190. **Birds.** During the three visits to Haidong by the PPTA wetland specialist, site observations were conducted for 5 days (intermittently, in September, November 2015 and January 2016). Small numbers of ducks were observed on the Huangshui River (~200) including Mallard (*Anas platyrhynchus*), Spot-billed Duck (*Anas poecilorhynchus*) and Common Pochard (*Aythya ferina*). In September, small numbers (<20 individuals) of migratory shorebirds occurred along the edges of the Huangshui River and at the mouth of its tributaries (Common Sandpiper and Wood Sandpiper). Three small bitterns (*Ixobrychus* spp.) were flushed from small reed beds in the river channel and two snipe (*Gallinago* spp.) from *Typha* beds across the road from the planned Ping'an Riverside Greenbelt – Urban Segment. In September, migrating wagtails (*Motacilla* spp.), were very common (>150) along the river edge on their southward migration.

191. These bird species are not listed of concern in IUCN lists nor are they IBA[11] Trigger Species nominated by Birdlife International as indicator species of ecosystem health for Qinghai Lake. However, they represent a mixed population of migratory birds which use the Huanshghui River corridor intermittently and which rely upon the presence of secure wetland and forested areas for roosting and feeding.

192. **Ping'an Mountain Edge**. Conditions for plant growth on the mountain slopes have been harsh for thousands of years due to the nature of the soils, the low rainfall and the cold winters. The vegetation that has adapted to the mountain sides surrounding Haidong City has also been

[10] The Current Situation and Protection of Fish Resources in Huangshui River in Qinghai Province, Tang Wenjia, Chen Yifeng, Ding Chenzhi, *Journal of Dalian Ocean University*, Volume 29, 2013.
[11] Important Bird and Biodiversity Areas

degraded by grazing of livestock and subsequent water and wind erosion. The erosion of the soils across Haidong District is contributing to higher sediment loads in the Huangshui River. The loss of vegetative cover from the mountain slopes is also contributing to dust storms.

193. In recent years the mountain slopes behind Haidong City have been terraced and planted with shrub species, Mainly *Artemisia* and *Potentilla*. In small areas, trials have been conducted by Ping'an Forestry Bureau to test the establishment of a range of experimental tree seedlings. Ping'an Forestry Bureau engages work crews from the local villages to maintain the terraces and expand the plantings.

194. The mountain slopes provide an important visual landscape setting for Haidong City. The city redevelopment plans call for tree coverage on the slopes to be increased to enhance the visual amenity of the city landscape.

Figure IV.23: Existing Mountain Edge Stabilization and Revegetation

195. Mountain slope revegetation is more advanced in areas on the northern side of Xining where there is an ongoing revegetation program, managed by Xining Forestry Bureau. This involves terracing, replanting and sprinkle irrigation (Figure V.11). The water supply for the irrigation is from the Huangshui River. The success of this work has encouraged Haidong Forestry Bureau to trial tree plantings and to install irrigation in small areas along the mountain edge that backs Haidong City.

Figure IV.24: Successful Mountain Edge Re-vegetation at Xining.

D. Socio-economic Conditions

196. Haidong City governs two urban districts, 4 autonomous counties (Minhe Hui-Tu Autonomous County, Huzhu Tu Autonomous County, Hualong Hui Autonomous County and Xunhua Salar Autonomous County). Ping'an and Ledu Districts are the two urban districts of Haidong City, in which Ping'an governs 3 towns and 5 minority Xiangs, and Ledu District governs 7 towns and 12 Xiangs.

197. **Population**. At the end of 2014, Haidong City had a resident population of 1.72 million, including 700,800 women, accounting for 48.55%; Population birth rate was 14.98%, death rate 6.26%, and natural population growth rate 8.72%. Ping'an District had a resident population of 128,822, including 64,021 women, (49.69%); an urban population of 50,732, (39.38%); and a minority population of 36,584, (28.4%). Population birth rate was 10.9%, death rate 5.5%, and natural population growth rate 5.5%. Ledu District had a resident population of 268,853; an urban population of 55,638, (18.94%); a female population of 143,644, (48.88%); and a minority population of 42,784, (14.5%). Population birth rate was 8.64%, death rate 5.21%, and natural population growth rate 3.43%.

Table IV.16: Population, Composition and Distribution

Division	HHs (0,000)	Population (0,000)	Family size	Gender (0,000)		Registration (0,000)	
				Female	Percent (%)	Urban	Percent (%)
Qinghai Province	1414	578	3.37	285	49.4	280	48.51
Haidong City	nd	144.34	nd	70.08	48.55	nd	nd
Ping'an District	43815	12.88	nd	6.4	49.69	5.1	33.26
Ledu District	94164	29.38	nd	14.36	53.42	5.56	18.94

Source: Statistical Yearbook 2014 of China; economic and social development statistical bulletins 2014 (Haidong, Ledu); Statistical Abstract of Ping'an District (2014).
nd = no data.

198. **Economic conditions**. In 2014, Haidong City's GDP was 37.77 billion yuan, up 15.1% from the previous year. The value of primary industries was 5.31 billion yuan, up 5.1%; secondary industries 20.13 billion yuan, up 20.4%; and tertiary industries 12.33 billion yuan, up 11.5%. Per capita GDP was 26,281 yuan, up 14.1%. The per capita disposable income of urban residents was 20,513.62 yuan, while the per capita net income of rural residents 6,978.71 yuan.

199. In 2014, Ping'an District's GDP was 6.057 billion yuan, up 18.3% year-on-year, in which the added values of primary, secondary and tertiary industries were 408 million yuan, 3.337 billion yuan and 2.312 billion yuan, up 5.03%, 26.2% and 12% respectively. The per capita disposable income of urban residents was 21,651.3 yuan, and the per capita net income of rural residents 7,378.68 yuan. For the same period, Ledu District's GDP was 7.54862 billion yuan. The value of primary industries was 1.13344 billion yuan, up 5.1%; secondary industries 3.68644 billion yuan, up 21.3%; and tertiary industries 2.72883 billion yuan, up 11.5%. Per capita GDP was 28,187 yuan, up 12.0%; the per capita disposable income of urban residents was 19,887 yuan, and the per capita net income of rural residents 7,399 yuan.

Table IV.17: GDP and Composition (2014)

Division	GDP (00 million yuan)	Primary industries		Secondary industries		Tertiary industries		Per capita GDP (yuan)
		Output value (00 million yuan)	%	Output value (00 million yuan)	%	Output value (00 million yuan)	%	
Qinghai Province	2301.12	215.93	9.4	1232.11	53.5	853.08	37.1	39633
Haidong City	377.7	53.1	5	201.3	69.1	123.3	25.9	26281
Ping'an District	60.57	4.08	2.18	33.37	68.84	23.12	28.98	nd
Ledu District	75.49	11.33	2.9	36.86	51.2	27.29	45.9	28187

Source: economic and social development statistical bulletins 2014 (China, Qinghai, Haidong, Ledu); Statistical Abstract of Ping'an District (2014)

Table IV.18: Income of Residents (2014)

Division	Per capita disposable income of urban residents (yuan)	Per capita net income of rural residents (yuan)
China	28,844	10,489
Qinghai Province	22,306	7,282
Haidong City	20,513	6,978
Ping'an District	21,651	7,379
Ledu District	19,887	7,399

Source: economic and social development statistical bulletins 2014 (China, Qinghai, Haidong, Ledu); Statistical Abstract of Ping'an District (2014)

200. **Urbanization Level**. In 2014, Haidong City's urbanization rate was 33.04%, up 1.75% from previous years. 79,474 residents were covered by endowment insurance for urban employees, 822,600 residents were covered by endowment insurance for urban and rural residents, 73,223 residents were covered by medical insurance for urban employees, and 94,047 residents were covered by medical insurance for urban residents.

201. In 2014, Ping'an District's urbanization rate was 54%. At the year end, 9,454 residents were covered by endowment insurance for urban employees, 45,062 residents covered by endowment insurance for urban and rural residents, and 22,506 residents covered by medical insurance. In 2014, Ledu District's urbanization rate was 40.9%. In that year, 15,717 residents were covered by medical insurance for urban employees, and 22,771 residents covered by medical insurance for urban residents.

202. **Ethnic minorities.** Haidong Municipality governs 96 townships, a land area of 13,200 km^2 and a population of 1.58 million, including a minority population of 690,000 (composed of Hui, Tibetan, Tu, Salar and Mongolian mainly), accounting for 43.9% of gross population.

a. *Ledu District:* The district governs two Tibetan Townships and one Tu Township, and its population is composed of mainly Han people, and also includes 14 ethnic minorities. The Han population of 251,078, accounts for 85.5% of gross population, and a minority population of 42,784, accounts for the remaining 14.5%.

b. *Ping'an District:* The district governs 3 towns and 5 Hui Townships, and its

population is composed of mainly Han people, and also includes 17 ethnic minorities. The population breakdown is shown in Table IV.19.

Table IV.19: Ethnic Minorities in the Project Districts

Ethnic Group	Ping'an District	Ledu District
Han	91,714	251,078
Tibetans	5,969	19,744
Hui	27,530	5,469
Tu	1,495	9,593
Salar	178	59
Mongolians	433	7,556
Manchu	116	170
Dongxiang	21	193
Tujia	19	
Zhuang	18	
Miao	10	
Other	12	

203. **Gender.** According to the Statistical Yearbook 2014 of Haidong, the female population of Haidong City was 841,000, accounting for 48.8% of the total population. Both boys and girls of school age have an enrollment rate of 100% at the elementary education stage, and there is no significant gender difference in terms of enrollment rate at the higher education stage. Almost all females aged 45 years were literate, and the average period of education receiving among females was 8.97 years. In addition, men and women enjoy equal medical security, where over 95% of women have covered rural new-type cooperative medical insurance or basic medical insurance for urban residents. 57.8% of government officials at the city level, 35.67% at the county level, and 18.55% at the township level are women.

204. **Poverty.** In Qinghai Province, a precise poverty reduction mechanism has been established down to the household level. At the end of 2014, Qinghai had a poor population of 735,603 (13.7%, based on the national rural poverty line of 2,300 yuan), and 15 state-level key counties for development-oriented poverty reduction. There are 964 poor villages in the east mountainous region (where Xining and Haidong City are located), accounting for 59.4% of all 1,622 poor villages.

205. In Haidong City, development-oriented poverty reduction patterns are shifting gradually to poverty reduction based on industrial development and infrastructure construction. In 2014, 634 poor villages were newly added, accounting for 39.1% of all poor villages. The city had a poor population of 293,601(14%), or 39.9% of provincial poor population.

206. The project areas in Ping'an and Ledu Districts are both state-level key counties for development-oriented poverty reduction. In 2014, both districts had 44 and 141 poor villages; and a poor population of 10,709 and 35,737 respectively. The poverty incidence of the project area is 14.4%, in which urban poverty incidence is 13.6% and rural poverty incidence 14.7%. The poverty incidence of Ping'an District is 13.12%, in which urban poverty incidence is 12.2% and rural poverty incidence 13.7%. The poverty incidence of Ledu District is 14.98%, in which urban poverty incidence is 14.9% and rural poverty incidence 16.9%. The socio-economic survey indicated that the main causes of poverty are the lack infrastructure, skills, job opportunities and land resources.

E. Physical Cultural Resources

207. The domestic environment impact assessments for the various project components have reviewed the status of cultural heritage within the project area of influence and concluded that no physical cultural resource existed within the project area of influence, with exception of the Baima temple which was built in 11th century. The Baima temple is located on the northern bank of the Huangshui River, facing Haidong and the Yizhou wetland. It is built into a cliff face high above the waterline. No embankment construction of blockage removal is proposed on this bank or river reach.

Figure IV.25: Baima Temple

208. Should buried artifacts of archaeological significance be uncovered during the construction stage within the project areas, construction will be stopped and immediately reported to the Pingxiang Cultural Bureau in accordance with the PRC's Cultural Relics Protection Law (2002).

F. Downstream Areas

209. The Huangshui River valley immediately downstream will be potentially affected by the cumulative impact of the project in Ledu and Ping'an districts. In particular, flood protection through embankments in these districts will change the flood behavior downstream. The river reaches downstream of the Ledu rural section need to be considered and their environmental setting is discussed here.

210. Figure IV.26 below shows the landscape downstream of Ledu. The river here is tightly constrained in a deep gorge (Laoya Gorge), and for the first seven kilometers has no floodplain.

Figure IV.26: Downstream Environment

211. There is no riverside vegetation and the first village settlement is located 9.5 km downstream. This village is not in a floodplain, but is elevated on high ancient river terraces. At 17 km downstream, the river valley widens out again allowing extensive urbanization and riverside cropping.

V. ANTICIPATED ENVRONMENTAL IMPACTS AND MITIGATION MEASURES

212. This section identifies and assesses the potential for adverse environmental and environment-related social impacts that may occur during the project construction and/or operational phases, and the mitigation measures to be implemented. The duration of impacts assessed in this IEE covers the construction and operational phases of the project. Construction works are expected to start in 2018. An operational phase of 5 years has been nominated by the PMO.

A. Project Beneficiaries

213. The direct impact of the project will be: (i) enhanced public infrastructure and environment for local residents enriching their quality of life and health; (ii) increasing protection from flooding of nearby residents; (iii) increased vegetation coverage, inhibit desertification, and create a favorable living environment by building mountain shelter forests and artificial wetlands; (iv) creation of skilled and unskilled job opportunities during construction and operation of the infrastructure; and iv) enhanced resident awareness of environmental protection, water safety, and flood risk management through public education program.

214. **Communities.** Ledu and Ping'an Districts are the main beneficiary areas. The Project has a direct beneficiary population of 217,000 in 18 villages in 9 townships in two districts, including an urban population of 152,000, accounting for 70.05%, and a rural population of 65,000, accounting for 29.95%. The Project has an indirect beneficiary population of 205,600, including an urban population of 26,900, accounting for 13.1%, and a rural population of 178,700, accounting for 86.9%. In the direct beneficiary area, only the Urban-Rural Water Supply component involves minority population in 3 Tibetan villages (Yima, Shihuiyao and Shiguasi) in Shihuiyao Xiang, with a Tibetan population of 370.

Table V.1: Direct Beneficiary Areas and Populations

District	Outputs	Directly affected areas	Directly affected population	Remarks
Ledu	Flood risks and soil erosion along Huangshui River reduced	Nianbo, Gaodian, Yurun, Hongshui and Gaomiao Towns	140,000	
	Sanitary landfill expansion completed	Main urban area of Ledu District	100,000	
Ping'an	Flood risks and soil erosion along Huangshui River reduced	Ping'an Town, Xiaoxia Town	65,000	
	Forest areas and wetlands increased and rehabilitated	Ping'an Town, Xiaoxia Town	65,000	Overlap with the population affected by River Rehabilitation
	Urban water reclamation increased	Ping'an Town	48,000	
	Water treatment and distribution expanded	18 villages in Sanhe Town and Shihuiyao Xiang; Ping'an Town	12,000	(Excluding overlap)
Total			217,000	(Excluding overlap)

Source: Statistical Yearbook of Haidong City (2014), Statistical Yearbooks of Ledu and Ping'an Districts (2014)

B. Project Benefits

215. The project components will have quantifiable and non-quantifiable benefits, including avoided flood damage, increased forest cover and landscaping to maintain soil and water

resources balance, ecotourism and environmental education, improved irrigation and avoided water scarcity, sustainable rural and urban water supplies, improved sanitation and cleaner environment and reduced health risks.

216. **River Rehabilitation, Riverside Greenbelt and Yizhou Wetland.** The subproject will provide protection against floods up to a minimum 30-year return period for an estimated 380 ha. Soil erosion will be reduced based on soil conservation at a yearly rate of 30 tons per ha for the greenbelt areas of 71.2 ha, totaling 2,136 tons/year. The subproject will greatly reduce pollutants in the water environment along the riverine area and improve the ecological environment. The FSR has calculated that the total area of riverside greenbelts will absorb 32 tons CO_2 and release 21.4 tons oxygen per day.

217. The constructed wetland will provide regulating services (including flood water storage, water treatment, micro-climate regulation), supporting services (biodiversity maintenance by providing resting, nesting, feeding and breeding habitats for wildlife), and cultural services (including research, education and recreation). According to the FSR, the water treatment function of the wetland will reduce emissions of TP by 0.648 tons, TN by 4.86 tons, COD by 23.43 tons and ammonia by 2.025 tons annually. The wetland is estimated to absorb 9 tons CO_2 per day and release 6 tons oxygen per day.

218. **Soil Erosion Control and Water Reclamation.** The component will result in soil and water conservation benefits by significantly reducing the safety zone of the mountain border protection forest through soil erosion and increasing the water storage capacity of mountain land, thus improving the microclimate and rich biodiversity of the surroundings, and reduce economic loss attributing to landslides and other disasters. Soil conservation is estimated at 30 tons per ha. The mountain edge shelterbelt will reduce soil erosion from those localities by 3,141 tons per year and the South Mountain planted forest by 19,890 tons/yr.

219. The reuse of treated wastewater will provide a new irrigation source, diversifying the city's water resources. The FSR has calculated that the mountain edge shelterbelt, which is irrigated by the reclaimed wastewater, will absorb 47.1 tons CO_2 and release 31.4 tons oxygen per day. It is estimated from these figures that the South Mountain greenbelt will absorb 311 tons CO_2 and release 208 tons oxygen per day.

220. **Rural Water Supply.** The component will increase water security for communities in the Qijiachuan valley for both domestic use and livestock. It will reduce the economic cost of obtaining water from existing supply sources, particularly in the rural area, replace private water supplies currently consumed (non-incremental demand), and enable users to increase consumption levels, with health benefits from improved hygiene and livelihood benefits through more certain livestock raising.

221. **Urban Solid Waste Infrastructure.** The services will ensure sufficient landfill disposal capacity and result in environmental protection that prevents threats to public health. The project will correct poor design and management at the landfill to stop the decline in local environmental values, with special threats to the quality of groundwater and soil resources.

C. Impacts Associated with Project Location, Planning, and Design

1. Direct Losses from the Project's Footprint

222. **Riverbank.** Areas of riverbank vegetation and land cover to be affected by the project were estimated using the percentage figures for vegetation or land cover type in Chapter V, combined with land take figures in Table IV.16. To estimate the area of disturbance for embankment construction, an average disturbance width of 20 m from the river was applied.

Estimates of permanent and temporary land take, for different land use classes, is in Table V.2.

Table V.2: Permanent and Temporary Land Occupation by Land Cover Type

Land Cover	Permanent Land Take (ha)		Temporary Land Take (ha)	
	Ping'an	Ledu	Ping'an	Ledu
Crop cultivation	108	205.9	4.4	25.35
Flood plain	27	180.35	1.1	0
Planted riverside trees	0	359.27	0	0
Natural forest	0	35.93	0	0
Grassland/wasteland	0	121.95	0	3.37
Totals	135	903.4	5.5	28.72

Source: PPTA Team, adapted from river condition survey and data from FSR

223. Total loss of regrowth riverside vegetation (36 ha) is low. The areas of regrowth natural vegetation potentially disturbed are only in Ledu. This is because the urban area of Ledu leaves only a narrow area for riverside works. Land take for the WTPs at Sanhe, Wenzukou and Fatai and pipelines between them will be 20.34 ha, mostly agricultural and waste land. The reforestation and shelterbelts occur on currently degraded or denuded lands and will result in net increases in naturally vegetated areas.

224. **Asset acquisition and resettlement.** The project will involve the permanent occupation of 5323.96 mu of land, including 1,460.97mu of collective land (including 540.87 mu of irrigated land, 207.35 mu of river flat, 470.8 mu of woodland, 121.95 mu of grassland and 120 mu of wasteland), the circulation of 876 mu of collective land and 1,570.5 mu of barren hills, and the occupation of 1,416.49 mu of state-owned non-farmland. The Project will occupy 106.82 mu of collective land due to construction facilities, temporary roads, etc., including 83.15 mu of cultivated land. A resettlement plan has been prepared which complies with ADB's SPS and related laws and regulations of the PRC.

225. The occupation of farmed land (crops and orchards) in both districts is 344 ha (Table V.2.). Only 8.6% of that is temporary use and will return to agriculture following construction. The loss of agricultural land assets, with or without resettlement, is covered in the project Resettlement Plan, where informed consent, compensation, acquisition process and disputes settlement is prescribed. The compensation rates of the Project are based mainly on the Notice of the Qinghai Provincial Government on *Disclosing Updated Uniform AAOV Rates and Composite Location- based Land Prices for Land Acquisition of Qinghai Province (QPG [2015] No.61)*.

226. **Economic displacement.** The main informal economic activity that will be impacted by the project is the opportunistic growing of crops on unused land beside the river, sometimes in very narrow bands of collected alluvium at the base of high riverbanks. The resettlement plan has inventoried these lands and the PMO has confirmed that they will be included in the compensation plan for loss of assets.[12]

227. **Impact on ethnic minorities.** The PPTA social survey identified almost 80,000 people of ethnic minorities, belonging to 11 ethnic groups, living in the project area. Project construction does not involve the disturbance of any ethnic cultural or religious buildings and it is predicted that the construction activities will not hinder any religious activities or festivals. Ethnic minorities will be potentially affected by construction dust, noise and disturbance to a similar degree as the general community, and will be safeguarded by the impact mitigation measures identified in this

[12] See paragraph 181 of LD14 Resettlement Plan

IEE and EMP. The Ethnic Minority development Plan (LD 12 DFR) notes that workers of different ethnic groups will participate in construction activities with potential for conflict over dietary and living habits. Additionally, places of worship may not be convenient to work sites. Measures addressing these potential impacts are included in the EMDP and are cross referenced in the EMP.

228. The ethnic minority groups will receive benefits of the same level from the Project as the other residents of both Ping'an and Ledu. The Project is not anticipated to result in any impacts to traditional lands, or the dignity, human rights, culture, or livelihoods of the ethnic groups in the project area.

D. Detailed Design and Pre-Construction Phase: Measures to be Undertaken

229. During the PPTA period the following environmental management measures were implemented to ensure that appropriate plans and documentation to guide environmental performance of construction and operation are in place: (i) completion of two rounds of public consultations in each subproject locality on environmental issues, poverty, resettlement and the Grievance Redress Mechanism; (ii) approval of the domestic environmental impact assessments by the Haidong City EPB;; and (ii) clearance of this project IEE and resettlement plan by the executing agency and ADB, confirming compliance with respective policies and regulations.

230. The following measures will be implemented in the pre-construction phase of the project to ensure the project's environment management readiness:

i. Finalization of detailed site plans for project construction – especially relating to embankments, landscaping and pipeline alignments;

ii. Finalization of seasonal water demand and water availability studies confirming sustainability of greenbelt and shelterbelt plantation plans;

iii. Institutional strengthening, including (a) appointment of a qualified environment officer within the PMO for the implementation phase; and (b) hiring of loan implementation environment consultants (LIEC), (c) sector specialists, including solid waste, water resources management, water safety, climate adaptation, wetland and river ecology specialists, within loan administration consultant services by the PMO;

iv. Assignment of environmental specialists in the IAs;

v. Updating the EMP. The mitigation measures defined in the project EMP (Attachment 1) will be updated (if necessary) based on the final technical design. This will be the responsibility of the PMO, with support of the LIEC;

vi. Contract documents. All tender documents for construction will include the EMP obligations, including the environmental monitoring program. This will be the responsibility of the PMO who will contract a Tendering Agency for the task;

vii. Environmental protection training. The LIEC and LIC specialists, in conjunction with the PMO environmental officer and Haidong city EPB, will provide training on implementation and supervision of environmental mitigation measures to the IAs and their contractors and construction supervision companies (CSC). This will be organized by the PMO.

E. Impacts and Mitigation Measures in the Construction Phase

231. Impacts and mitigation measures for the construction phase of the project are discussed below under the headings of the major sectorial components. Each mitigation measure is carried forward into the EMP in Attachment 1.

232. **Contractor Performance and Site Management.** To ensure that construction contractors are able to implement the mitigation measures, the IAs will put in place the following arrangements: (i) environmental specifications will be included in the bidding documents to contractors; (ii) an appropriate environment section describing standards and responsibilities will be included in the terms of reference for bidders; (iii) material haulage routes, and waste disposal arrangements will be defined in the construction tender documents as appropriate; and (iv) clauses referencing the EMP mitigation provisions and monitoring plans will be written into the construction contracts. Following the award of construction contracts, the successful head contractor will prepare a Site Environmental Management and Supervision Plan, based on the EMP, including a site environmental health and safety plan, for approval by each IA.

233. A plan for environmental training for contractors, especially related to environmental management, is included in the EMP. The contractor will take reasonable measures to minimize the impact of construction on the environment.

1. Output 1: Integrated flood plain management infrastructure for Huangshui River

234. **Earthworks.** Earthmoving equipment will be used to configure fill into embankments and landscaped amenity areas as well as excavation and land-forming for the wetland construction. The total earthworks and surplus spoil from the different components are summarized in Table V.3 (Ping'an) and Table V.4 (Ledu). The amount of soil to be excavated is not significant, amounting to 0.327 million m^3 in Ping'an, and 0.86 million m^3 in Ledu. In Ping'an, the small amount of surplus soil will be used in the construction of access tracks along embankments. The excavation for the artificial wetland construction will be fully reused for wetland bunds and features (see Figure V.1).

Table V.3: Cutting and Filling Earthworks, Ping'an

Component	Fill (m^3)	Cut(m^3)	Surplus Spoil (m^3)
Embankments	246,200	260,600	14,400
Landscaping Riverside Greenbelt	15,000	15,000	0
Yizhou Wetland	65,760	65,760	0
Total	326,960	341,360	14,400

Source: Domestic component EIA and SEPP

Note: yellow refers to filling and blue refers to cutting.

Figure V.1: Cutting and Filling earthworks of Yizhou Wetland

Table V.4: Cutting and Filling Earthworks, Ledu

Sub-projects	Fill (m^3)	Cut (m^3)	From Borrow (m^3)	Surplus Spoil (m^3)
Embankments – Urban Segment	180,000	180,000	0	0
Embankments – Rural Segment	683,700	732,800	0	49,100
Total	*863,700*	*912,800*	*0*	*49,100*

Source: Domestic component EIA and SEPP

235. **Spoil.** The small amount of surplus spoil (14,400 m^3 in Ping'an and 49,100 m^3 in Ledu) will be used for the crest road or to fill in the hollow within 6 m of the river management boundary and re-vegetated. Excavated river blockages amounting to 130,000 m^3 will consist mainly of rocks and stones will be sorted on site and reused for embankment strengthening:

a. rocks and stones with diameter greater than 12cm: used for gabions; and

b. 2cm <diameter<12cm: bedding for metal cages or road foundation.

236. **Erosion.** Soil erosion is expected during the construction phase when surface vegetation and soil are removed. Soil erosion can also occur after completion of construction in areas where site restoration has been inadequate. Four Soil Erosion Protection Plans (SEPPs) have been prepared for this project. Three of them relate to Output 1 components (Ledu Urban area embankments, Ledu Rural area embankments, and Ping'an embankments). They include appropriate mitigation measures during construction as well as borrow pits, spoil sites, and temporary land use. The SEPPs calculated current and predicted erosion intensities for components in soil erosion amount for each phase as shown in Table V.5 (Ping'an) and Table V.6 (Ledu). According to the domestic EIA reports and the SEPPs, the current average soil erosion intensity in the project's area of influence is 1,800-2,420 t/km^2/yr, and will increase to up to 6,030-7,900 t/km^2/yr and 2,116-2,696 t/km^2/yr respectively during the construction and the third year of natural recovery.

Table V.5: Projected Increase in Soil Erosion Amount (t), Ping'an Project Components

Sub-projects	Prediction period	Erosion area (ha)	Erosion time (years)	Erosion Amount before Construction (t)	Erosion Amount during Construction (t)	Increased Erosion Amount (t)
Embankments	Construction	11.2	2	541	1343	802
	Natural recovery	4.1	3	296	387	96

Source: Domestic EIA and SEPP

Table V.6: Projected Increase in Soil Erosion Amount (t), Ledu Project Components

Sub-projects	Prediction period	Erosion area (ha)	Erosion time (years)	Erosion Amount before Construction (t)	Erosion Amount during Construction (t)	Increased Erosion Amount (t)
Embankments – Urban Segment	Construction	116	2	2721	8162	5441
	Natural recovery	67.2	3	1856	3172	1316
Embankments – Rural Segment	Construction	64.01	2	2721	8162	5441
	Natural recovery period	28.86	3	1856	3172	1316

Source: Domestic EIA and SEPP

237. The areas most vulnerable to erosion include temporary construction sites, and other areas where surface soil will be disturbed. The prescriptions for erosion control in the SEPPs have been incorporated into the EMP of this IEE and will be included as contractual obligations for Contractors. The most effective erosion control will be interception drainage to protect disturbed surfaces from surface flows.

238. Construction plans will include erosion control prescriptions for construction work areas, including (i) constructing intercepting ditches and drains to prevent runoff entering construction sites, and diverting runoff from sites to existing drainage; (ii) limiting construction and material handling during periods of rains and high winds; and (iii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on; (iv) stockpiles shall be short-termed, placed in sheltered and guarded areas near the actual construction sites or within the fenced camp sites, covered with clean tarpaulins, and spray water shall be applied during dry and windy weather conditions. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites.

239. There are two flood seasons in the Huangshui River basin, spring flood and summer flood. Large floods usually occur during June to September. The construction will not be conducted in these months. The structure for flow diversion during riverbank construction is designed based on 1/5 year flood. The designed diversion flow is shown in Table V.7 below. The height of confer dams is 2.0-2.5 m. The construction section is 300- 500 m.

Table V.7: Temporary Construction Diversion Flows

District	Segment	Construction Diversion flow (p=20%) (m3/s)
Ping'an	Xiaoxia-Haidong Industry Park	480
	Shangtan Power station-Zhangjiazhai Village	498
	Zhangjiazhai Village to Hetanzhai village	498
Ledu	Hetanzhai Village to Daxia Village	522
	Daxia Village to Hewan Bridge	529-545
	Shuimoying Bridge to Lubanting Bridge	648

Source: FSR

240. **Dust.** Earthworks, terrain shaping and topdressing of embankments and riverside landscape areas will generate dust. In most localities however, construction of embankments will occur in peri-urban and agricultural areas. In both districts the most impacted land cover type will be agricultural. For these lands therefore distance from residents and sensitive receptor sites will be sufficient to avoid impacts.

241. For the embankment construction sites on riverbanks categorized as urban and commercial (41% of the Ledu segment is in central urban area) protection against fugitive dust will be provided by water spraying of unstabilized earth surfaces twice daily, covering of all stockpiled materials and the erection of dust barriers (plastic or hessian screens) between works and buildings.

242. **Noise.** Noise will occur during construction due to construction machinery operation and transport activities. Construction will involve bulldozers, graders, excavators, concrete-mixing plants, and other heavy machinery. Noise intensity from these large machines is typically 80-100 decibels at the site (measured 5 m from the operating machinery). The major construction machinery noise testing values from Technical Guidelines for Environmental Impact Assessment of the Acoustic Environment (HJ/T2.4-2009) are in Table V.8.

Table V.8: Testing Values of Construction Machinery Noise

Machine Type	Distance between Measuring Site and Construction Machinery (m)	Maximum Sound Level dB (A)
Paver	5	87
Bulldozer	5	100
Roller/compactor	5	86
Excavator	5	98

243. Noise levels at different distances have been calculated for machinery and equipment use and are shown in Table V.9.

Table V.9: Construction Equipment Noise Impact Distance

Source	Source strength (dB(A))	Noise from the sound source attenuated by distance (dB(A))								Daytime Distance to comply with standard (m)	Night Distance to comply with standard (m)
		20 m	50 m	100 m	150 m	200 m	300 m	400 m	600 m		
Excavator	98	72	64	58	54	52	48	46	42	25	141
Bulldozer	100	74	66	60	56	54	50	48	44	32	178
Mixer	96	70	62	56	52	50	46	44	40	20	112

244. The results show that if construction machinery is used singly, the impact distance is 32 m away from the source during the day and 178 m at night. These impacts meet the PRC standard of Construction Site Environmental Noise Emission Standards (GB12523-2011). However, it will often be the case that a number of machines will be at use simultaneously during construction, and the cumulative noise impact will be larger. The domestic EIAs have calculated the minimum complying distance for noise from multiple machines as 50 m in daytime and 300 m at night.

245. A comparison of noise levels and baseline ambient noise at the following sensitive receptors (Table V.10) shows that in Ping'an district, parts of Mayi Shangtan and Xiaoxia villages will be within these impact distances and in Ledu, Hetanzhai village and all the riverside urban residents will be potentially affected.

Table V.10: Noise Levels at Sensitive Receptors

Component	**Receptor Sites**	**Minimum distance from work area**
Huangshui River Embankments (including Yizhou Wetland) Ping'an	Wangjiazhuang Village	104 m
	Shangtan Village	45 m
	Zhangjiazhai Village	173 m
	Sanshilipu Village	104 m
	Dongzhuang Village	311 m
	Mayi Village	30 m
	Xiaoxi Village	30 m
Huangshui River Embankments Ledu	Hetanzhai Village	Very close
	Xiaohetanzhai Village	167 m
	Qingwan Village	67 m
	Xiakou Village	65 m
	Donggang Village	157 m
	Shangzhai Village	88 m
	Xinsheng Village	91 m
	Jiangwan Village	104 m
	Hongshui Town	114 m
	Communities near Ledu urban segment	21.5-40.5 m

246. At sensitive receptor sites where construction noise is a likely impact, he contractor will be required to ensure that: (a) machinery is well-maintained to minimize noise; and (b) temporary anti-noise barriers will be installed around the work site. Prior to such works, residents will be notified by the IA and/or contractors and any site-specific concerns or working arrangements addressed. These measures are included in the EMP and are subject to internal and external monitoring as part of that plan.

247. **Gaseous air pollution.** Construction machinery on all sites will consume petrol and diesel, releasing gaseous PM_{10}, CO, and NO_x. Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. High-intensity equipment will be provided with tail gas purifiers. Automated air quality monitoring is conducted by the Haidong Environmental Monitoring Station (HEMS) and disclosed monthly on the HEPB web site. All vehicle emissions will be in compliance with relevant PRC emission standards.

248. **Construction wastewater.** Wastewater produced on the construction sites, leakage of construction material (i.e. concrete), and oil leaks from machinery, may enter the river and cause increases in suspended matter and pollution levels. Site planning, management and safeguards will be needed to prevent these impacts: (i) storage facilities for fuels, oil, and other hazardous materials shall be within secured areas on impermeable surfaces, and provided with bunds and cleanup installations; (ii) vehicles and equipment will be properly staged in designated areas to prevent contamination of soil and surface water; (iii) vehicle, machinery and equipment maintenance and refueling shall be properly carried out so that spilled materials do not seep into the soil; (iv) oil traps shall be provided for service areas and parking areas; and (v) fuel storage and refilling areas will be located on the part of the construction site furthest from the river; and material stockpiles will be protected against wind and runoff waters which might transport them to the river.

249. **Loss of terrestrial and aquatic habitat.** Embankment construction will occupy some areas of modified habitat of regrowth trees, weeds and grasses, as well as the narrow bands of fringing riverbank trees (see Section C.1). These areas may support some fauna e.g. frogs, lizards and snakes. Construction will also disturb fauna (e.g. wetland birds) foraging in the river.

The recorded species (Section V.C) are widespread and already utilize the modified habitats in the project area, and are expected to recolonize the rehabilitated areas readily.

250. In the final designs, special provision will be made in the embankments and landscaping to ensure specific habitats for riverside fauna are provided. A monitoring program to check and adjust these habitats is required by the EMP. The Ping'an Water Course Management Station and Ledu River Course Management Center will provide quarterly monitoring reports to the PMO on the survival and growth of planted trees, shrubs and herbs, with replacement and corrective actions as necessary. The performance of built habitat niches will also be reported. In all cases, the taking or harming of any wildlife by construction workers will be strictly prohibited.

251. Of the main fish species captured in the sampling survey described in Chapter IV, Table IV.15), two lay their eggs on aquatic plants. The other identified species have floating eggs or attached to the riverbed or crustaceans (see Table V.11). *Carassius* species will be potentially impacted by work along the riverbanks if near-inshore aquatic plants are damaged. The extent of breeding in the specific river sections of the project is not known, but if any breeding does occur during construction of embankment and wetlands earthworks and consequent increases in local turbidity would cause temporary impacts. These temporary potential impacts will be offset by: (i) the constructed wetlands to be built in the Huangshui river reaches; and (ii) extensive use of embankment Type B and D (Figures V.6 and V.8), which will be installed in the Ping'an and Ledu rural sections. *Carassius* are of least concern in IUCN lists and are too small to be a fisheries resource.

Table V.11: Local status and Habitats of Huangshui Fish

Species	Local Population	Feeding	Habitat for Eggs
Misgurnus anguillicaudatus	+	generalist	riverbed
Schizopygopsis pylzou	++	generalist	floating
Triplophya pseudoscleroptera	+++	generalist	riverbed
Paramisgurnus dabryanus	+	carnivore	floating
Carassius auratus	++	generalist	Plant surfaces
Rhodeus sinensis	+	generalist	gills of shellfish
Pseudorasbora parva	+	generalist	riverbed rocks

Source: PPTA Team

+++ = main population; ++ = present in significant numbers; + = low populations

252. During construction the CSC, LIEC and wetland and river ecology specialists will conduct inspections of the sites. Local residents will be consulted for views and suggestions with respect to impacts on the river environment and wetlands and mitigation measures. If and when undue impacts occur, contractors will be required to halt construction until corrective actions are satisfactorily implemented.

253. **Invasive species.** Most habitats in the project area are highly modified and degraded, and weeds are prevalent. The project earthworks do not involve the import or export of soil from outside the project area (which might introduce or spread soil-based organisms). All project re-vegetation will use only native species, and which are locally sourced. The plant species to be used are listed in Table III.4 (Section III.D). As a further safeguard, a project assurance has been developed (Section X.B) to prohibit the use of any plant species classified in the PRC as weeds, as defined by the China National Invasive Plant Database (http://www.agripests.cn; 229 species) and by the Ministry of Environment Protection and Chinese Academy of Sciences (19 species).

254. **Earthwork and construction related to Yizhou wetland.** The wetland construction works will involve excavations and land-forming to increase the hydraulic retention capacity of

the site, especially the open water areas, marshes and the inlet/outlet canals and bunds, requiring the removal of 65,760 m³ of soil. Quality of the soil to be excavated was assessed against Class II of Soil Environmental Quality Standard (GB15618-1995), which is the equivalent soil quality for the adjoining agricultural lands. The quality of the material to be excavated complies with the above standards, and can be used for the re-modeling and landscaping of the wetlands.

255. Measures to minimize negative impacts on the existing wetland and riverside habitats during project implementation include the following: (i) prohibit construction activities or use of noise-intensive machinery during the migration season (end of March to end of April; mid-September to end of October); (ii) prohibit construction activities at night; (iii) avoid water pollution from construction spoils and oil leakage; (iv) locate construction camp at least 500-m away from the wetlands; (v) erect warning signs to prohibit horn blowing and garbage throwing from diverted traffic; and (vi) awareness building and training of construction workers.

2. Output 2: Haidong Urban Catchment Soil Erosion Control Measures

256. The major impact-producing activities in the construction phase of this component will be the removal of existing land use (if any) in the footprints of the shelterbelts and plantations, earthworks and land forming to prepare the ground for forest plantations, and the pipelines and irrigation infrastructure to support them.

257. **Erosion.** The areas prepared for the planting of shelterbelts and forest plantations will be vulnerable to erosion before the sites are stabilized. According to the domestic EIA reports and the SEPPs, the soil erosion potential is high in Huangshui valleys. The average soil erosion intensity for un-stabilized soil in this environment is 10,000 t/km^2/yr.

258. Construction plans will include erosion control prescriptions for planting areas, including (i) constructing interception ditches and drains to prevent runoff entering the sites, and diverting runoff to existing drainage; (ii) stabilizing all cut slopes, embankments, and other erosion-prone working areas while works are going on with geotextile and straw mulch; (iii) stockpiles shall be short-term, placed in sheltered and guarded areas near the actual work sites or within the fenced camp sites, covered with clean tarpaulins, and spray water applied during dry and windy weather conditions. Mulch should be retained after tree planting and groundcovers (natural or artificial) quickly established (within 30 days after earthworks have ceased at the sites).

259. On sloping lands, all preparation for plantations must be conducted according to technical specifications of soil and water conservation for sloping land set in *Soil and Water Conservation Law of PRC* (25 December, 2010). In particular, soil tillage on terraces must be carried out along contours, keeping any existing vegetation between contour terraces to prevent soil erosion.

Figure V.2: Slope stabilization in compliance with *Soil and Water Conservation Law (2010)*

260. **Irrigation infrastructure.** The installation of irrigation water supply pipes, irrigation reticulation pipes and drip-feed outlets will require little additional on-site disturbance since it will be carried out during the final stages of site preparation. The major water supply pipelines however, will traverse built up city areas between the sources (Huangshui River and Ping'an WWTP) and the three major plantation areas (Haidong industrial Park and New Urban Area Shelterbelt, Ping'an Urban Area and Eastern Area shelterbelt, and South Mountain Landscaping Area).

261. The supply pipes will be laid along existing urban streets and sensitive receivers will be all residents within range of dust fall and noise. As pipe-laying proceeds along streets most residents and commercial properties in the planned service areas will be potentially impacted. To address this, the following mitigation measures will be implemented.

262. **Pipe-laying method.** Construction safeguards for pipeline-laying will be implemented; including soil stabilization, dust and noise control as well as management of the impacts from machinery operation, transport and haulage of materials. Trenches will be dug, pipes laid, and the trenches closed, in the same operation. This will ensure that open trenches are not left over an extended period to pose a safety risk or to erode and cave-in. No horizontal directional drilling is planned.

263. **Dust control.** Pipe-laying sites will potentially produce fugitive dust from material haulage, concrete mixing, excavation and general site usage – especially under windy conditions. Dust will be suppressed during construction by routine water spraying of all active work areas, including access roads, twice per day. Material stockpiles and concrete mixing equipment will be equipped with dust shrouds. The operators will regularly maintain the shrouds to ensure their effective operation. Vehicles carrying soil, sand, or other fine materials around the construction sites will be covered.

264. **Noise control**. These impacts will be transient and temporary the following mitigation measures will be conducted: (i) construction at night is prohibited or limited to low-noise activities and first subject to consultation with communities; (ii) during daytime construction, the contractor will ensure that: (a) noise levels from equipment and machinery conform to PRC standard GB12523-2011, and machinery is well-maintained to minimize noise; (b) equipment with high noise and high vibration will not be used in urban areas and only low noise machinery or equipment with sound insulation is employed. For sensitive receptors such as schools and medical centers temporary anti-noise barriers will be installed when works are within 100 m of them; (iii) prior to such works, residents will be notified by the PMO and/or contractors and any site-specific concerns or working arrangements addressed.

265. **Traffic Management.** Construction traffic for the pipe-laying component has potential to cause temporary traffic congestion and inconvenience and safety issues to residents. Construction will be undertaken section by section, which will improve efficiency and reduce the potential safety hazard during construction. A traffic control and operation plan will be prepared by the contractor in consultation with the local traffic management authority prior to any construction. The plan will include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours and regulating traffic at intersections.

3. Output 3: Rural Water Supply and Urban Solid Waste Infrastructure

Water Treatment Plants and Pipelines

266. The construction footprint of the two WTPs will be 0.14 ha each for Fatai and Wenzukou WTPs and 0.89 ha for the larger capacity Sanhe WTP.

267. The Wenzukou WTP will be constructed within the site where current construction infrastructure for the reservoir (incorporating site offices, construction staff housing, machinery parks, workshops and stockpiles) is located. This site is cleared and resurfaced and construction here will damage neither valuable land use nor impact upon any sensitive receptors (Figure V.3).

268. The WTP site at Fatai is within the boundary of the existing Water Affairs Bureau field office. Again, the site is already alienated from any natural or productive land use. The construction will damage no natural or agricultural land, nor impact upon any sensitive receptors (Figure V.4).

Figure V.3: Site of Wenzukou WTP

Figure V.4: Site of Fatai WTP

269. The WTP site at Sanhe will encroach upon agricultural land and potentially disturb riparian vegetation (Figure V.5). Detailed site planning will follow the following principles:

i. Minimization of disturbance to adjoining agricultural lands and tree-lines
ii. A buffer zone along the creek to protect riparian vegetation and drainage.

Figure V.5: Site of Sanhe WTP

270. The construction of the major pipelines from reservoirs to the WTPs, and then on to consumer areas, will require earthworks, soil stabilization, dust and noise control as well as management of the impacts from machinery operation, transport and haulage of building materials and the domestic needs of the work force.

271. Major supply pipes will be laid along valley floors, roughly following the existing road easements and natural drainage lines. The alignments will be finalized during the detailed design phase and will conform to the following impact minimization principles.

- Construction activities and the provision of access for pipeline inspections and maintenance will necessitate an impact corridor of up to 15m in width.
- Site management planning will ensure that all construction activities, including materials stockpiling, will be confined to this work area, and
- Accidental damage to adjoining crop lands, trees and creek lines will be avoided.

272. **Dust and Noise.** The effects of dust and noise will impact on no sensitive receptors in these isolated rural sites. Site management for the construction of all WTPs will ensure that (i) construction solid waste will be collected and transported to landfill; (ii) construction wastewater will be intercepted and filtered through sedimentation traps and, in the case of runoff from machinery areas, oil separators before discharge to local drainage lines.

273. Dust will be suppressed during construction by routine water spraying of all active work areas, including access roads. Material stockpiles and concrete mixing equipment will be equipped with dust shrouds. The operators will regularly maintain the shrouds to ensure their effective operation. Vehicles carrying soil, sand, or other fine materials around the construction sites will be covered.

274. Where pipe-laying occurs in or adjacent to villages and residential areas the following noise mitigation measures will be conducted: (i) construction at night is prohibited or limited to low-noise activities and first subject to consultation with communities; (ii) during daytime construction, the contractor will ensure that noise levels from equipment and machinery conform to PRC standard GB12523-2011, and machinery is well-maintained to minimize noise.

275. **Spoil Disposal.** Pipe-laying will make maximum use of spoil through balancing excavation and fill volumes. The total excavation is 83,699 m^3 and will be reused. The spoil earth from the earthworks for the foundations of the treatment plants will be reused for the access roads and temporary roads during construction. No surplus spoil will be generated from the subprojects.

Table V.12: Excavation, Backfill and Surplus Spoil (unit: m^3) for Water Transmission Pipelines

Engineering works		Type and Length	Cut	Fill	Surplus	Remarks
Treatment plants	Wenzukou WTP		2800	1960	840	Surplus used for access road
	Fatai WTP		2800	1960	840	Surplus used for access road
	Sanhe Town WTP	17800	12460		5340	Surplus used for access road
Pipe-laying	Raw water pipeline from Wenzukou Reservoir to Sanhe Town WTP	DN500, 11.9km	11900	11900		
	Raw water pipeline from Fatai Reservoir to Sanhe Town WTP	DN400, 8.6km	8600	8600		
	Clean water pipeline from Sanhe Town WTP to Ping'an urban area Guchengya	DN600, 15.9km	15900	15900		
	Water storage tank	3300	2300			Surplus used for temporary road
Roads	Access road to the WTP	6300	13320			
	Construction temporary road	14269	15269			

276. Construction wastewater will not be directly discharged onto the surrounding soil or into creeks. Sedimentation tanks will be held on site and, after settling out of solids, the upper clear liquid will be recycled for spraying the construction site (dust control) and disposal into the creek. Oil-containing wastewater will require the installation of oil-water separators before the sedimentation tank. After site treatment, construction wastewater will comply with (GB8978-1996) Integrated Wastewater Discharge Standard.[13] The indicative pollution parameters are total suspended solids (TSS) and oil/petrochemical residues. These will be periodically monitored as part of the EMP.

Waste Management and Landfill

277. Construction at the landfill site will comprise earthworks, land forming, installation of hygienic landfill infrastructure (leachate membrane, piping, collection tank and spray equipment) security fencing and sealed access roads. Impacts from these activities in terms of dust, noise, and traffic will approximate current operational activities at the landfill.

278. **Dust and Air Pollution.** At the landfill site, excavation, stockpiling, general site usage and haulage of equipment has the potential to cause fugitive dust in dry weather – especially under windy conditions. At an average wind speed of 2.3 m/s. TSP from the construction sites will be 8.90 mg/m^3 50 m downwind and 1.65 mg/m^3 100 m downwind. Only at a distance of 150 m downwind will dust levels meet the WHO standard two-day average level of 0.3 mg/m^3

279. The nearest residence to the landfill site is 400 m from the site boundary, so dust impact on sensitive receivers during construction will not be a problem. Vehicles carrying soil, sand, or other fine materials onto or away from the construction sites will be covered.

280. To protect workers, sanitary staff and rag-pickers, dust will be suppressed during excavation and land forming work by routine water spraying of all active work areas, once per day. Material stockpiles and any concrete mixing equipment will be equipped with dust shrouds.

[13] The standard provides the upper limit for pollutant concentrations and the total allowed water discharge for industries and construction sites.

The operators will regularly maintain the shrouds to ensure their effective operation.

281. **Noise.** Rehabilitation and expansion of the landfill will involve bulldozers and excavators both of which have high noise ratings in operation (typically 100 and 98 dB respectively). Noise levels at different distances have been calculated for these machines and are shown in Table V.6. The results show that if construction machinery is used singly, the distance to meet PRC standards is 32 m away from the source during the day and 178 m at night.

282. There are no sensitive receptors (schools, medical centers) within these distances at the landfill site. The closest permanent residences are 400 m from the northeastern site boundary, and will not be affected.

283. **Erosion and Soil Stability.** During earthworks for exposing and re-laying the base impermeable membrane, unstabilized soil surfaces will be exposed and will be vulnerable to erosion and mass sediment transport during rain storms. Mitigation measures will include: (i) the protection of spoil and old garbage stockpiling during excavation. Excavated old garbage will be deposited on a prepared clay bed and compacted, underlying soil placed on top, with clean topsoil cover. No stockpile will exceed 1 in 3 slope and will be protected by interception drains; (ii) geotextile or hessian matting will be laid and pegged over exposed slopes during storms and overnight; (iii) silt traps will be erected around site boundary to catch rain-transported sediment.

4. Worker and Community Health and Safety - Construction

284. The objective of environmental health and safety is to provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. It also covers the establishment of preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. It is therefore a combination of occupational health and safety of staff/workers at the subproject facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities.

285. **Construction Camps Solid Waste.** For pipe-laying the construction workforce will be centralized since individual work sites will be of short duration. Contractors will provide portable toilets at construction sites. For sewage, the portable toilets will be emptied and the contents transported by truck to Ping'an WWTP. For litter, construction contractors will provide sufficient garbage bins at strategic locations and ensure that they: (i) cannot be accessed by animals (e.g. rodents, insects, dogs); (ii) are emptied regularly (using the city solid waste collection system and landfill); and (iii) do not overflow.

286. **Hazardous and Polluting Materials.** Construction material handling and disposal guidelines and directions that include spill responses will be prepared and implemented as part of the Site Environmental Management and Supervision Plan. The following measures will be taken to prevent pollution of soil and surface water/groundwater: (i) storage facilities for fuels, oil, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and cleanup installations; (ii) vehicles and equipment will be properly staged in designated areas to prevent contamination of soil and surface water; (iii) vehicle, machinery, and equipment maintenance and refueling will be carried out in paved areas with spill cleanup kits, so that spilled materials will not seep into the soil; (iv) oil traps will be provided for service areas and parking areas; (v) fuel storage and refilling areas will be located at least 300 m from stormwater drains, the Huangshui River or any of its tributaries.

287. The contractors fuel suppliers will be properly licensed, follow proper protocol for transferring fuel, and be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88).

288. **Site and access safety.** The civil works contractors will implement adequate precautions to protect the health and safety of the workers and community. Signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles and excavations, and raising awareness on safety issues. At the end of each day, all sites and equipment will be made secure (through fencing and/or lock-down of equipment) to prevent public access.

289. **Occupational health.** The contractors will also implement precautions to protect the health and safety of construction workers. The occupational health and safety risks will be managed by applying measures in the following order of preference: avoiding, controlling, minimizing hazards, and providing adequate protective equipment. Each contractor's Site Environmental Management and Supervision Plan will include measures for health and safety for personnel. The plan will be submitted to the PMO for review and appraisal and will include the following provisions for health and safety:

i. *Personal protection.* Provide personal protection equipment (PPE) appropriate to the job, such as safety boots, helmets, gloves, protective clothing, goggles, and ear protection, in accordance with relevant health and safety regulations, for workers.

ii. *Emergency Preparedness and Response.* An emergency response plan to take actions on accidents and emergencies, including environmental and public health emergencies associated with hazardous material spills and similar events will be prepared, and submitted to the IA for review and appraisal. A fully equipped first-aid base in each construction site will be provided.

iii. *Records Management.* A Records Management System will be established to document occupational accidents, diseases, and incidents, that: (a) includes a tracking system to ensure that incidents are followed-up; (b) can easily retrieve records; and (c) can be used during compliance monitoring and audits. The system will be backed up on at least one external hard drive to protect records against loss or damage.

iv. *Safety communication.* Ensure that safety, rescue and industrial health matters are given a high degree of publicity to all persons regularly or occasionally on the Site. Posters drawing attention to site safety, rescue and industrial health regulations will be made or obtained from the appropriate sources and will be displayed prominently in relevant areas of the site.

v. *Training, awareness and competence.* Train all construction workers in basic sanitation and health care issues, general health and safety matters, and on the specific hazards of their work.

290. The EMDP includes further measures to protect workers and nearby communities during construction: (1) Include HIV/AIDS/STI and other communicable disease clauses into contract bidding documents; (2) Public health and HIV/AIDS prevention education program conducted to the civil works contract and Development Zone employee are conducted; (3) Health measures for construction workers (e.g., adequate protective gear such as condoms will be provided to workers,) are established;(4) Conduct publicity activities on HIV/AIDS for both workers and local communities, e.g., brochures, posters and picture album.

F. Impacts and Mitigation Measures in the Operational Phase

291. Impacts and mitigation measures for the operational phase of the project are discussed below under the headings of the major relevant components. Each measure is carried forward into the EMP in Attachment 1.

1. Output 1: Integrated flood plain management infrastructure for Huangshui River

292. The built embankments will operate as flood protection structures and as part of Haidong's comprehensive flood management system, requiring monitoring and maintenance. The riverbank edges will be managed to re-establish riverine habitats. Greenbelts[14] planted in conjunction with embankments will function as urban greening and the constructed wetland will be managed for water quality improvement function as well as habitat and education.

Embankments and Landscaping

293. The mitigation measures during operation include proper maintenance of the riverside 20 m wide embankment protection belt, emergent aquatic plants and other vegetation; and regular inspection of the river embankment for stability issues. If signs of failure are discovered, a repair program will be implemented immediately. The flood control works will have no significant impacts on downstream areas, in terms of water quality, quantity, and flood peaks (see discussion on induced impacts at the end of this chapter).

294. **Embankment maintenance.** The different designs for the project embankments take a variety of forms. These are "ecological" designs which include use of a range of flora and some riverine habitats i.e. use of rocks and reedbeds. These have not been designed for particular species of fauna, but are anticipated to provide habitat niches for a range of birds, reptiles, amphibian and small mammals. A monitoring program to check and adjust these habitats is required by the EMP. The operating and maintenance units will provide monitoring reports to the PMO on the survival and growth of planted trees, shrubs and herbs, and replacement and corrective actions as necessary.

295. **Flood monitoring and early warning.** A flood monitoring and early warning system exists at the provincial and municipal levels. The provincial level system employs automatic real-time monitoring of rainfall and Haidong River level monitoring in the various catchments which are calibrated against observed flood events in the water bodies. The Haidong municipal level flood warning system has been in operation since 2012, within the Haidong WRB, and employs automatic real-time monitoring of rainfall in the various catchments within the municipality, which are calibrated against observed flood events in the water bodies. It operates as a flash flood warning system for local communities and also covers reservoir level monitoring. It passes its data up to the provincial level where higher order flood warnings are generated. The inherent problems of data sharing and coordination of warnings and responses across administrative boundaries have been, in part, addressed by the recent (2015) *Agreement between Three Cities (Xining, Haidong and Lanzhou) in the Huangshui River Basin*. During project implementation, opportunities to strengthen this system will be identified and promoted by the capacity building component.

296. **Irrigation water demand for the Riverside Greenbelts.** The combined vegetated areas along the river embankments total 77.9 ha. According to the FSR, the annual average irrigation demand is 1200 m^3/day (taking account of pipe leakage, absorption, evaporation and a safety factor). The total demand of the riverside greenbelts is 85,400 m^3/year. This water will be drawn directly from the existing irrigation canals. Their average flow is 0.8 m^3/s with annual water availability of 24 million m^3/a. The canals originally served cultivated land which has lately been turned over to construction land and will therefore not compete with agricultural water users. The irrigation schedule is: (i) three times continuous irrigation during spring; (ii) 4-5 times irrigation during May-July; and (iii) one irrigation prior to winter.

[14] In this IEE, forest plantings along riverbanks, embankments and in riverside parks are called "greenbelts". Tree planting along the mountain edge to protect the urban area are called "shelterbelts".

297. **Fertilizer and Pest Management**. On average, each tree planted needs 0.1 kg fertilizer per year. The fertilizer will be applied in a small hole near the plant and covered by soil. The total application is 250 kg/ha/year. Due to the proximity of the Huangshui River, only low-toxicity pesticide will be used. The average pesticide usage of the existing forest is 15 kg/ha/yr. Both silvicultural and pesticide management will be the subject of training programs under the EMP. This training will emphasize techniques in low chemical use and integrated pest management. Package CS6 of the capacity building component will engage consultants to assist Haidong Municipality Government in the development of riverside and mountain edge forest management planning and deliver training in silvicultural management and integrated pest management within the context of the creation and maintenance of forest ecosystems.

Yizhou Wetland

298. **Water regulation.** The Yizhou wetland will be created on a low-lying tract of non-urban land bordering the Huangshui River. This land has been formed by a build-up of silt on the convex side of a river bend, and is seasonally flooded. Water will be designed to flow through the wetland areas as an open system. Design of the wetland is based upon a yearly water retention volume of 232,000 m^3 and a total through flow of 2.832 million m^3 per year, made up of 2.21 million m^3 flowing in from the Huangshui River (78%) at the upstream inlet, 201,800 m^3 inflow from ground water (7%) and 420,000 m^3 from rainfall (15%).

299. The inflow amount will roughly equal the outflow back to the river, diminished only by loss through evaporation which will be slightly higher than that of the Huangshui River due to slower water velocity through the wetland and level-adjusting weirs (for the 14m overall fall across the wetland area). The water resources of the Huangshui River will not be significantly affected by the operation of the wetland.

300. **Biodiversity conservation and monitoring.** Low lying parts of the site currently support a low species diversity of birds, with only eight species being recorded during PPTA survey (see Chapter IV, Section C). With improved management of ecosystems and habitats, improved protection and lower levels of disturbance, it is likely that the Yizhou wetland will be able to support more birds. While it is less likely that the site will support more diversity of other taxa (animals and plants), it is expected that an increase in the extent of habitats and improvements in management will create the conditions for improved population sizes.

301. Management of the constructed wetland will involve the following essential activities, undertaken by the Conservation Station (O&M Unit) set up by the Ping'an Housing Construction & Environmental Protection Bureau:

i. Control of water flow over weirs and other structures separating functional wetland elements and control of flow rates across the wetland;
ii. Maintenance of sedimentation basins, including yearly removal of collected sediment;
iii. Trash rack clearing and general litter removal;'
iv. Weeding and removal of unwanted plants;
v. Yearly harvesting of reeds and removal of macrophyte masses to maintain water treatment function; and
vi. Control of fishing, trapping or other illegal exploitation or misuse of natural resources.

302. The management role will also include a monitoring program to track the environmental performance of the wetland and reinforce its educational function. This will include:

i. Periodic sampling and recording of aquatic plants and animals to track biodiversity changes;
ii. Maintaining a record of bird sightings and establishment of an inventory of bird species and populations; and
iii. Maintaining a record of intake water quality and discharge water quality.

303. Package CS6 of the capacity building component will engage consultants to assist Ping'an Housing and Construction Bureau in developing the Yizhou Wetland O&M manual, and provide training to relevant personnel in the bureau and the O&M entity, covering management of wetland ecological processes, habitat protection and integrated pest management within the context of the creation and maintenance of wetland ecosystems.

304. The wetland specialist of the LIC will assist the Ping'an Housing Construction & Environmental Protection Bureau to (i) establish a wetland monitoring and management system, develop a manual and instructions to carry out the wetland monitoring for data collection and analysis; (ii) develop training and education programs for local residents, schools, government agencies for wetland protection and conservation; and (iii) designing and implementing a habitat survey/monitoring program. The program will focus on comparing seasonal species richness and abundance of animals, with a special emphasis on migratory water birds in the project area; providing hands-on training on wildlife monitoring.

305. Key local officials will be involved in a focused capacity building component on the design and operation of Wetland Parks in the PRC. This would greatly assist in the detailed design decisions that will need to be made on the development and management of the artificial wetlands and the operation of the wetland center. To address the apparent limited local agency expertise in wetland ecology, the participants will be drawn from both the Environment and Forestry Bureau's (Haidong and Ledu).

2. Output 2: Haidong Urban Catchment Soil Erosion Control Measures

306. Shelterbelt forest along the mountain edge will be managed to protect fragile landscapes. The use of water for irrigation will be carefully managed to ensure sustainability of water use in both quantity and quality.

307. **Sustainability of irrigation water source.** Water for irrigation of mountain edge greenbelts and urban plantation forests will be drawn from major tributaries of the Huangshui River and from reusing discharged treated wastewater from the Ping'an WWTP.

308. The size of the proposed South Mountain greenbelt area has been designed to match the amount of treated wastewater which the Ping'an WWTP can sustainably provide in the short- and long-term. The 663 ha of greenbelt, allowing for pipe leakage, absorption, evaporation and a safety factor, will require an average of 9,500 m^3/day for the 280 day frost free period each year. The existing wastewater effluent from the WWTP has recently been increased to just below 8,000 m^3/d in the second half of 2015 (Table V.13).

Table V.13: Wastewater Influent and Effluent Data of 2015, Ping'an WWTP

2015	Wastewater Influent (m3/d)	Wastewater Effluent (m3/d)
January	6,032.3	4,451.6
February	5,042.9	4,310.7
March	7,838.7	5,774.2
April	7,466.7	7,166.7
May	7,571.0	6,080.6
June	7,966.7	6,866.7

2015	Wastewater Influent (m3/d)	Wastewater Effluent (m3/d)
July	7,645.2	7,193.5
August	8,580.6	7,709.7
September	9,100.0	7,800.0
October	7,700.0	6,858.1

Source: Ping'an District Housing and Construction and Environmental Protection Bureau

309. When Phase I and Phase II of the planned plant expansions are completed in 2016, Ping'an WWTP will have a treatment capacity of 30,000 m^3/d. It is planned to further increase the capacity to 50,000 m^3/d by 2020. The wastewater influent is mainly domestic wastewater from the urban areas in Ping'an District. With these expansions, the long-term sustainability of 9,500 m^3/d for the South Mountain is feasible and well within the capacity of the plant.

310. The water demand for the mountain edge greenbelts (totaling 104.7 ha) has been calculated in the FSR at an average of 1,500 m^3/day. The combined average flow rate of the Xiaoxia canal and the Ping'an canal, from which irrigation water will be sourced, is 294,000 m^3/day. On the basis of yearly averages, the irrigation of the mountain edge greenbelts will use 0.51% of the combined flow of these tributaries[15], and is concluded to be sustainable on a yearly flow basis.

311. Although yearly estimates of demand and supply indicate the sustainability of both irrigation components in this output, seasonal availability of water resources needs to be confirmed in the detailed design phase.

312. **Water quality.** The existing treated wastewater effluent from the WWTP meets Class 1A under *Discharge Standards of Pollutants for Municipal Wastewater Treatment Plant* GB18918-2002 and is currently discharged into Huangshui River. The effluent used for forest irrigation shall comply with the Reuse of Urban Recycling Water-Water Quality Standard for Green Space Irrigation GB/T 25499-2010. Disinfection facilities using chlorine dioxide (ClO_2) is designed in the FSR of Phase I to ensure the effluent satisfy the requirement of water reuse. The water quality will be monitored by the Ping'an Housing Construction & Environmental Protection Bureau on a quarterly basis as a requirement of the EMP to ensure that acceptable quality is maintained.

313. **Noise.** The operation of irrigation infrastructure for the shelterbelts will rely upon pumping stations to raise water from the Huangshui River and the Ping'an WWTP. The predicted noise level of pump is 90 dB at 1 m (unshielded). The pump stations will be built on hillsides away from residences or under roads. The pump stations will have noise dampening to achieve as level of 55 dB(A) at a distance of 15 m from the pump house. No houses are less than 15 m from the pumping station sites in either district. Noise levels at all houses in the vicinity of pumping stations comply with the PRC standard and the World Bank Group EHS standard for residential areas.

314. **Forest management.** Shelterbelt forests will require intensive management during the establishment phase and silvicultural management later. Possible operational impacts will arise from fertilizer and pesticide use, resulting in nutrient rich or contaminated runoff water from irrigation. The capacity building component has a sub-component to address this. Package CS6 of the capacity building component will engage consultants to assist Haidong Municipality Government in the development of riverside and mountain edge forest management planning

[15] Return flow is not calculated as it would be negligible in these soil conditions

and deliver training in silvicultural management and integrated pest management within the context of the creation and maintenance of forest ecosystems.

3. Output 3: Rural Water Supply and Urban Solid Waste Infrastructure

Rural Water Supply Component

315. The operational impacts of the rural water supply will focus on whether the water resource is being used sustainably, whether the target communities have water security and the health and safety of the water treatment plants and pipelines operators.

316. **Sustainability of water resource.** The three project WTPs have a design capacity of 1,500 m^3/day, 1,500 m^3/day and 20,000 m^3/day – a combined operational capacity of 23,000 m^3/day. To supply the water for these WTPs and the communities they serve, the water resources of Wenzukou Reservoir and Fatai Reservoir will be used in combination as depicted in the annual water balance at Figure V.6. Any water which is surplus to the requirements of the local communities for domestic and livestock use will be provided as a back-up resource for the Ping'an urban area.

317. Water supply security for the target communities has been checked using seasonal variability in runoff into the reservoirs for average years to very dry years to assess the risk of water shortages. The analysis is shown in by the graphs in Figure V.7 and Figure V.8 below

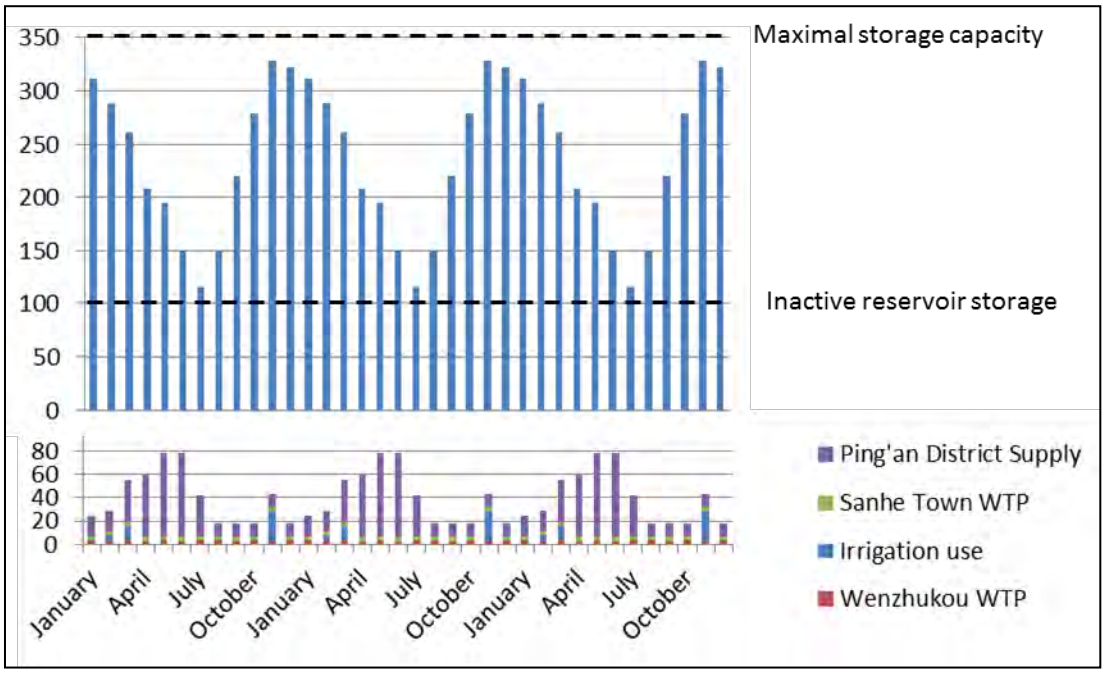


Figure V.7: Wenzukou Reservoir storage level (in 10,000m3) and water use for average years (in 10,000m^3/month), computed based on reservoir characteristics, catchment area and water demand projections.

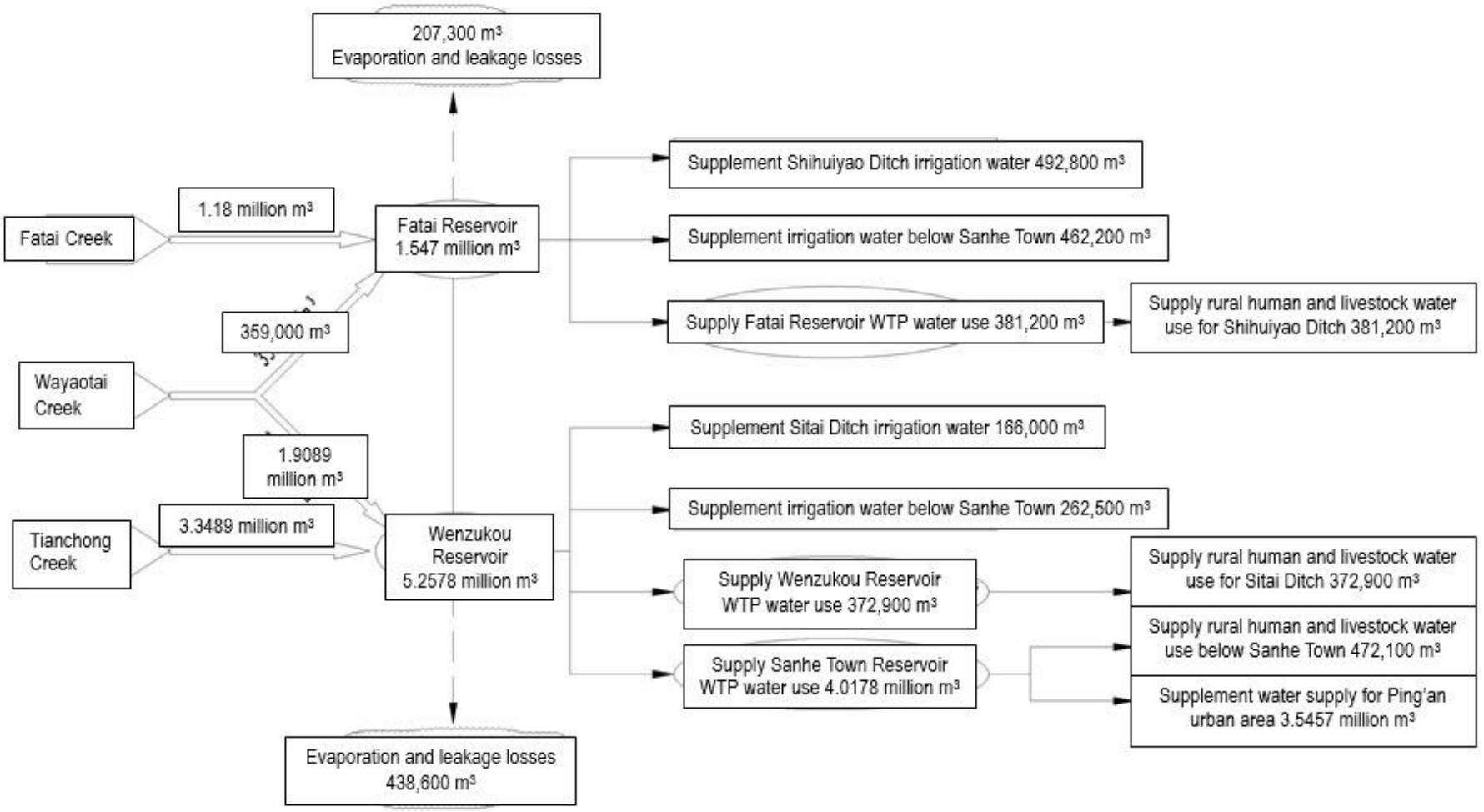


Figure V.6: Water Balance for the Rural Water Supply Component

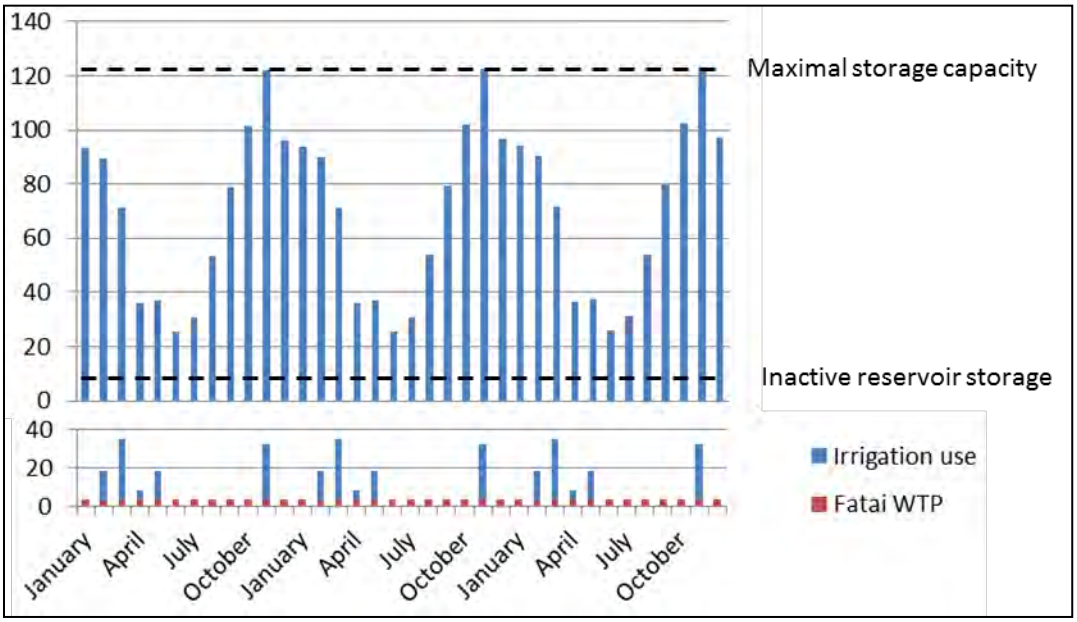


Figure V.8: Fatai Reservoir storage levels (in 10,000m3) and water use for average years (in 10,000m^3/month), computed based on reservoir characteristics, catchment area and water demand projections.

318. The analyses show that the small Fatai reservoir has adequate storage capacity and average (i.e. 50% exceedance probability) annual water inflow to cover water demand of the Shihuiyao Township and surrounding villages, as well as for irrigation use, but could face water shortage in very dry years (i.e.90% exceedance probability, or 1-in-10 years occurrence). This is not new in the reservoirs area of influence and irrigation water use will be adjusted accordingly (see water regulations planning below).

319. Wenzukou Reservoir has ample storage capacity and annual inflow to cover water demand of Shitai Township and surrounding villages, Sanhe Township and surrounding villages, irrigation water demand in the Qijiachuan watershed downstream of the Fatai reservoir. The amount of water that can be supplied to the Ping'an urban district will depend on the annual precipitation and will vary from 3.54 million m^3/a for an average year (with 50% exceedance probability); 2.23 million m^3/a for a dry year (with 80% exceedance probability, or 1-in-5 years); and 0.91 million m^3/a for a very dry year (with 95% exceedance probability, or 1-in-20 years).

320. The minimum ecological base flows for the water bodies downstream of the reservoir offtakes have been estimated according to the Water Resources Assessment Guideline for Construction Project (trial) (SL/Z322-2005), which is defined as a minimum of 10% of multi-year average flow in northern PRC. The minimum ecological base flows from Wenzukou reservoir and Fatai reservoir are 372,100 m^3/day and 132,200 m^3/day. The minimum ecological flows has already been subtracted from the reservoir offtake volumes in the water balance (Figure V.6) and the seasonal water availability analyses (Figures V.7 and V.8).

321. Water regulation plans will be prepared by the Ping'an Water Affairs Bureau for the Fatai and Wenzukou reservoir in accordance with the PRC *Guidelines for formulation of reservoir regulation rules* (SL 706-2015). These will define water allocation priorities and quotas to ensure continuous supply of drinking water to the serviced towns and villages even in dry years, with irrigation water use and supply of the Ping'an urban district as second and third priority, respectively. The need to release a minimum ecological flow at all times will also be defined in

the water regulation plans for the reservoirs, and flagged as loan assurance. This will be supplemented by sound water safety planning for the three water treatment plants to be developed with support of loan implementation consultants and in compliance with international good practice (as defined in most recent WHO guidelines for water safety planning).

322. **Water Source Protection Planning**. The *Ping'an County Drinking Water Resource Protection Zoning Technical Report* prepared in 2009 sets out the requirements for water source protection zoning in the Ping'an District. Protection zoning for Wenzukou reservoir has already been promulgated. A description of the protection is at Section V.J *Associated Facilities* below. Similar protection of the Fatai Reservoir watershed under this Technical Report will be required as a loan assurance.

323. **Water safety planning.** Monitoring data of the quality of the water sources in Chapter IV "Description of the Environment" show that the raw water quality in the reservoirs can meet Water Quality Standards for Domestic Drinking Water Sources (CJ3020-93). Routine monitoring program for water quality will be undertaken by the operators. A water safety plan which complies with WHO Guidelines will be prepared and implemented by the Ping'an Water Affairs Bureau for all 3 water supply plants. It will cover the detection, risk assessment and corrective actions in response to all sources of possible contamination of water - from the water source, through conveyancing through pipelines and pressure release structures, during water treatment and in the final distribution network. It will also include verification schedules based upon a monitoring program which combines PRC Drinking Water Standards and WHO guidelines.

324. **Water leaks and losses.** There is a risk that water pipes may leak and burst, leading to localized flooding, with environmental and economic impacts. Adequately designed pipes, properly selected piping materials, proper supervision during construction, and proper O&M will mitigate such a risk. In supplying water from the Sanhe water treatment plant to the Ping'an urban district the Haidong Water Group Co. Ltd will comply with the leakage control requirements in the Standard for Leakage Control and Assessment of Water Supply Distribution Systems CJJ92-2002. Haidong Water Group Co. Ltd plans to cut the NRW, targeting a reduction to less than 20% from 27%. A NRW management plan has been outlined by the PPTA Consultant and shared with Haidong Water Group Co. Ltd., defining targets, institutional strengthening, equipment requirements, and a roadmap for NRW plan implementation.

325. **Hazardous Materials Handling and Disposal.** The water purification plants will use bleach (sodium hypochlorite) for water disinfection. Hazards exist in preparing, transporting, storing and handling sodium hydrochloride used for chlorine dioxide generation. In the chlorination room of water purification plants, there is an environmental risk of hydrogen chloride and chlorine dioxide leakage. Chemicals will be transported and managed in compliance with relevant state regulations on hazardous chemical substance management. Transport vehicles and personnel should be qualified and trained with hazardous chemical substance transportation. Storage will be arranged with certificates procured from the police department and fire authorities. Additional on-site mitigation measures fall under the heading of occupational health and safety and are discussed below.

326. The chlorination room and chemical storage area will be equipped with automatic alarms, which will be triggered by chlorine dioxide leakage. To protect personnel on duty from hazard caused by hydrogen chloride and chlorine dioxide leakage, the duty room will be equipped with gas masks, oxygen breathing apparatus and other rescue materials. An emergency response plan will be developed and implemented. The plan will inform staff and visitors about the characteristics of chlorine dioxide and hydrochloric acid, describe potential health hazards, and define accident prevention measures and an evacuation plan.

Waste Management and Landfill

327. The key potential impacts from the landfill during the operational phase are from leachate produced by the decomposing garbage entering the environment and odors and other gaseous emissions impacting on nearby communities. Noise, fugitive dust and trash, and pests can be directly minimized through site control and management practices.

328. **Leachate.** Calculations in the Solid Waste Feasibility Study and Due Diligence Report indicate that there could be a net leachate yield during the early stages of the landfill development, but later stages will not produce excess leachate beyond the landfill capacity to retain or evaporate the quantity produced. The maximum predicted leachate yield in the landfill has been calculated at maximum of 50 m^3/day. General leachate quality calculations have also been made based on the nature of the domestic garbage and from data of landfill leachate of other cities. The leachate will have very high concentrations of BOD, COD, and NH_3-N. If not collected and managed, there is potential for seepage and contamination of soil and groundwater.

Table V.15: Design Leachate Water Quality

Item	COD_{cr} (mg/L)	BOD_5 (mg/L)	Total N (mg/L)	SS (mg/L)	PH
Influent quality	10,000 -30,000	7,500 -20,000	350 - 1,000	900- 1,800	6 - 10
Effluent (treated) quality	≤100	≤30	≤40	≤30	6 - 7

329. Leachate collection pipes at the bottom of the landfills will guide leachate to a leachate holding tanks. The tanks will be designed for 300 day's storage of leachate in the event of plant malfunction (15,000 m^3). In the event of longer malfunctions, the collected leachate will be back-pumped onto the landfill to obtain leachate volume reduction and to increase the concentration of leachate (to aid solidification and "fixing")[16].

330. Effluent from the holding tank will enter the leachate treatment plant, which has preliminary treatment of sedimentation and filtration followed by a 2-stage DTRO process. The treated leachate discharged will comply with GB16889-2008 Standard for Pollution Control on Landfill Sites and is suitable for reuse in site landscaping and spray back onto landfill to reduce dust. The sludge from leachate treatment system will be dewatered to 60% water content by air drying followed by disposal in the landfill.

331. To ensure that leachate is not penetrating into the groundwater, a monitoring program will be implemented (see details in Table A1.4 of the EMP). Continuous groundwater monitoring will be carried out by the Ledu City Management Bureau during operation. The ground water monitoring indices will be pH, total turbidity, total soluble solid, nitrate, nitrite, sulfate, chloride, mercury, lead, fluorine, iron, manganese, copper, zinc, and fecal coliforms.

332. **Odors and pest control.** The odor from leachate treatment system (point source) and landfill site (non-point) diffusion were forecast by SCREEN 3 model according to HJ/2.2-2008 Technical Guideline for EIA regarding Air Quality (Table V.14a and b).

[16] In this process toxic organic compounds are broken down by microbial biotransformation over time. In parallel, a macro-molecular humus is generated from the refuse during degradation, which fixes the heavy metal ions and other leachate residues in a stable chelate.

Table V.14a: Predicted emissions from landfill (Non-Point Source)

	Distance to the source D(m)	NH_3		H_2S	
		Concentration C_{ij}(mg/m³)	Percentage of the standard P_{ij}(%)	Concentration C_{ij}(mg/m³)	Percentage of the standard P_{ij}(%)
Forecast results	10	0.005057	2.53	0.0002383	2.38
	100	0.006541	3.27	0.0003082	3.08
	200	0.008077	4.04	0.0003806	3.81
	300	0.009735	4.87	0.0004588	4.59
	400	0.01134	5.67	0.0005344	5.34
	500	0.01219	6.09	0.0005747	5.75
	600	0.01318	6.59	0.0006209	6.21
	689	0.01348	6.74	0.0006354	6.35
	700	0.01348	6.74	0.0006352	6.35
	800	0.01316	6.58	0.0006202	6.2
	900	0.01253	6.26	0.0005904	5.9
	1000	0.01176	5.88	0.0005543	5.54
	1100	0.01097	5.49	0.0005168	5.17
	1200	0.0102	5.1	0.0004804	4.8
	1300	0.009473	4.74	0.0004464	4.46
	1400	0.008802	4.4	0.0004148	4.15
	1500	0.008189	4.09	0.0003859	3.86
	1600	0.007629	3.81	0.0003595	3.59
	1700	0.00712	3.56	0.0003355	3.36
	1800	0.006661	3.33	0.0003139	3.14
	1900	0.006244	3.12	0.0002943	2.94
	2000	0.00587	2.93	0.0002766	2.77
	2100	0.005531	2.77	0.0002606	2.61
	2200	0.005225	2.61	0.0002462	2.46
	2300	0.004947	2.47	0.0002331	2.33
	2400	0.004694	2.35	0.0002212	2.21
	2500	0.004462	2.23	0.0002103	2.1
	2600	0.004247	2.12	0.0002002	2
	2700	0.004049	2.02	0.0001908	1.91
	2800	0.003866	1.93	0.0001822	1.82
	2900	0.003698	1.85	0.0001743	1.74
	3000	0.003543	1.77	0.0001669	1.67
Qilidian Village (northeast)	300	0.009735	4.87	0.0004588	4.59
Taomajia Village	1600	0.007629	3.81	0.0003595	3.59
Qilidian Village	1300	0.009473	4.74	0.0004464	4.46
Shuimowan Village	1500	0.008189	4.09	0.0003859	3.86
Distance of Max ground concentration （m）		689		689	

Source: Domestic EIA for Landfill Component, 2016

Table V.14b: Predicted emissions from Leachate Treatment Plant (Point Source)

	Distance to the source D(m)	NH_3		H_2S	
		Concentration C_{ij}(mg/m³)	Percentage of the standard P_{ij}(%)	Concentration C_{ij}(mg/m³)	Percentage of the standard P_{ij}(%)
Forecast results	10	8.255E-21	0	2.359E-21	0
	100	0.00006461	0.03	0.00001846	0.18
	143	0.00006918	0.03	0.00001976	0.2
	200	0.00005932	0.03	0.00001695	0.17
	300	0.00005842	0.03	0.00001669	0.17
	400	0.00005184	0.03	0.00001481	0.15
	500	0.0000463	0.02	0.00001323	0.13
	600	0.00004455	0.02	0.00001273	0.13
	700	0.00004366	0.02	0.00001247	0.12
	800	0.00004088	0.02	0.00001168	0.12
	900	0.00003779	0.02	0.0000108	0.11
	1000	0.00003474	0.02	0.000009926	0.1
	1100	0.00003189	0.02	0.000009112	0.09
	1200	0.00002932	0.01	0.000008376	0.08
	1300	0.00002701	0.01	0.000007716	0.08
	1400	0.00002494	0.01	0.000007127	0.07
	1500	0.0000231	0.01	0.0000066	0.07
	1600	0.00002145	0.01	0.000006129	0.06
	1700	0.00001998	0.01	0.000005707	0.06
	1800	0.00001865	0.01	0.000005328	0.05
	1900	0.00001745	0.01	0.000004987	0.05
	2000	0.00001637	0.01	0.000004678	0.05
	2100	0.00001543	0.01	0.00000441	0.04
	2200	0.00001458	0.01	0.000004166	0.04
	2300	0.0000138	0.01	0.000003943	0.04
	2400	0.00001309	0.01	0.00000374	0.04
	2500	0.00001244	0.01	0.000003553	0.04
	2600	0.00001184	0.01	0.000003382	0.03
	2700	0.00001128	0.01	0.000003224	0.03
	2800	0.00001077	0.01	0.000003078	0.03
	2900	0.0000103	0.01	0.000002942	0.03
	3000	0.000009858	0	0.000002817	0.03
Qilidian Village (northeast)	300	0.00005842	0.03	0.00001669	0.17
Taomajia Village	1600	0.00002145	0.01	0.000006129	0.06
Qilidian Village	1300	0.00002701	0.01	0.000007716	0.08
Shuimowan Village	1500	0.0000231	0.01	0.0000066	0.07
Distance of Max ground concentration（m）		143	0.03	143	0.2

Source: Domestic EIA for Landfill Component, 2016

333. The maximum ground cumulative concentrations of NH_3 and H_2S are 0.0135mg/m^3 and 0.0006mg/m^3 at 689m. The cumulative concentrations of NH_3 and H_2S at Qilidian Village are 0.0098mg/m^3 and 0.0005mg/m^3. According to the standard in TJ36-79 Hygienic Design Standard for Industrial Enterprises, the maximum allowable concentrations of NH_3 and H_2S are 0.2mg/m^3 and 0.01mg/m^3.

334. On the basis of this analysis the Haidong EPB, in its approval of the domestic EIA for the landfill extension in 2016, has stipulated a buffer zone of 300 m from the landfill site boundary, where no residential development will be allowed.

335. To reduce the breeding of flies, mosquitoes, rats and other vermin, and to prevent odor and wind-borne dispersal of garbage, compaction and earth covering of the active tip face or landfill cell will be undertaken daily. Additionally, periodic spraying with approved pesticide will further control the breeding of flies and mosquitoes and regular rat trapping programs will be undertaken.

336. **Gaseous Emissions.** Gas will be generated from the biochemical degradation within the landfill. The main components are CO_2 and CH_4, accounting for 40% and 50% of the waste gas contents respectively. CH_4 can be recycled and used as energy, but due to unstable yield and impurities, its recycling on this small scale is not considered feasible.

337. If the concentration of CH_4 builds up to surface concentrations in the range 5-15%, there is a danger of ignition. Landfill generated CH_4 concentration in the air within the landfill's area of influence should not exceed 5%. Specifically, below 2m height above landfill work surface, the concentration of methane should not exceed 0.1%. Collection of methane gas from decomposing garbage will be channeled through a specially constructed gas collection system comprising gas transmitting gabions, collecting pipes and gas flaring chimneys. Regular monitoring of surface concentrations of CH_4 are requirements of the project EMP.

338. **Runoff.** Waters entering the site can pick up garbage, spoil and leachate contaminants – carrying them downstream into farming areas, residences and water bodies. Runoff interception channels and concrete flood control structures will be constructed around the landfill sites. These will be configured to cope with more frequent storm events which are indicated by climate change scenarios.

339. **Waste Leakage from Waste Transportation and Disposal.** During operation, wind can blow solid waste into the air and carry it off site. In addition, improper handling can cause waste leakage or loss during transportation, resulting in odor and secondary solid waste pollution. To reduce these impacts to a minimum, all haulage vehicles will be covered, and progressively enclosed as the fleet is modernized. Retaining fences will be erected around the landfill sites to prevent the waste from spreading during windy or rainy season. In the medium term the number of truck haulage movements each day will be further reduced by the introduction of compactor collection trucks.

340. **Noise.** Operational machinery includes front-end loaders, bulldozers (with roller compaction), excavators, dump trucks, pumping tankers, and transportation vehicles for garbage loading and unloading. Their typical average cumulative noise level is 88-96 dB(A). While this level of noise will be of concern for occupational health and safety of landfill workers (see below), the isolated locations of the landfill site will ensure that there will be minimal effects on the nearest residences. Noise mitigation measures will include: (i) Scheduling working hours and transportation routes for garbage collection and disposal, avoiding urban traffic peak period and sensitive locations; (ii) Selecting low noise equipment in the acquisition of machines and vehicles; and (iii) Installing sound insulation at pumps and pumping stations.

341. **Capacity building.** The FSR covered requirements on the landfill management organizations and their responsibilities. However, the FSR did not provide detailed requirements of size or capabilities of staffing. Based on the discussion with Ledu District local government, the current operation management units will take charge of the landfill in the future. The PPTA team has noted that the current landfill management is poor. Therefore, during the project implementation, it will be necessary to prepare an O&M manual for facilities operation management and to carry on on-the-job training for O&M units, in order to ensure sustainable operation of the proposed facilities. Package CS5– Landfill O&M and solid waste management support is included in the project capacity building program. Consulting services will assist Ledu Housing and Construction Bureau in developing the landfill Standard operational procedure

(SOP) and provide training to relevant personnel in the bureau and the Ledu City Management Bureau. Training in landfill environmental management is also included in the EMP.

4. Worker and Community Health and Safety - Operations

342. Water treatment plant and leachate treatment plant operators and staff are exposed to occupational risks of falls on wet floors or into treatment ponds, pits, clarifiers or vats, splashes of hazardous liquids, or cuts and contusions from equipment. They are exposed to hazards related to work in confined spaces. The following measures will be implemented to safeguard the safety and health of WWTP operators: (i) compulsory use of safety shoes or boots with non-slip soles, protective equipment, and chemical resistant clothing and safety goggles to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapors; (ii) posting of safety instructions in each workshop regarding the storage, transport, handling or pouring of chemicals; (iii) check electrical equipment for safety before use; verify that all electric cables are properly insulated; take faulty or suspect electrical equipment to a qualified electricity technician for testing and repair; (iv) wearing of respiratory mask in sludge dewatering areas and when moving and transporting sludge; and (v) adherence to safety instructions concerning entry into confined spaces, e.g., check atmosphere for oxygen or for poisonous gases, use respiratory protection equipment if needed, have a co-worker stand guard in case of need for help. All workers will undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies. Finally, health and safety will be incorporated into the regular staff training programs.

343. **Emergency plan.** In the PRC the various levels of government have put in place emergency preparedness and response procedures. The *National Master Plan for Public Emergency Preparedness and Response* was released by the State Council on 8 January 2006. The national master plan establishes the principles, policy and institutional framework for preparing and responding to public emergencies. In turn, provinces have proclaimed master plans for public emergency preparedness and response. As part of project implementation, an emergency preparedness and response plan at each WTP and the leachate treatment plant at the landfill will be formulated and put in place before each becomes operational. The emergency preparedness and response plans will uses the provisions of the provincial plan and address, among other things, training, resources, responsibilities, communication, procedures, and other aspects required to respond effectively to emergencies associated with the risk of accidental discharges. Appropriate information about emergency preparedness and response activities, resources, and responsibilities will be disclosed to affected communities.

G. Greenhouse Gas Emissions

344. The project will generate greenhouse gas (GHG) emissions in a number of ways, including use of fossil fuels and electricity for machinery and vehicles, emissions from constructed wetlands and emissions from landfill decomposition. The project construction phase is unlikely to produce large GHG emissions because existing construction equipment will be used and diverted to the current project.

345. **Power Usage.** The LDI and EIA Institutes have been unable to provide information on projected power usage or the employment of pumps for irrigation. As an alternative, the PPTA team has estimated power usage and greenhouse gas emissions using the following assumptions:[17]

[17] Friction losses in pumping have not been used in the calculations

i. Irrigation water delivered per year by pump (South Mountain only, others are gravity fed) = 2,660,000 m^3
ii. Average static head for pumping between WWTP and South Mountain = 100 m
iii. Cumulative static head for total internal pumping in WTPs and leachate plant = 10 m
iv. Small to medium pumps used in the power range 15-30 kW each
v. Power to move 1,000,000 m^3 of water over a static head of 100 m using medium pumps is estimated at 30,800 kWh.
vi. Conversion factor of power generation in the PRC grid to greenhouse gas emissions is 0.65 kg CO_{2e}/kWh.

346. On the basis of the assumptions above, power to move the total yearly irrigation water at South Mountain is estimated at 81,928 Kwh and the greenhouse gas emitted by the generation of that power is 53.25 tons CO_{2e} per year. Pumps operating at WTPs, moving water internally between processes and back-flushing will move 6,805,000 m^3/yr and at the landfill leachate treatment plant, 14,000 m^3/yr. for an estimated total power use of 18,930 Kwh and the greenhouse gas emitted by the generation of that power is 12.3 tons CO_{2e} per year.

347. Total greenhouse gas emissions from power use are therefore estimated at 65.55 tons CO_{2e} per year.

348. **Emissions from Wetlands.** Wetlands treating wastewater have been studied for greenhouse gas emissions in the literature, but little data exists on natural or non-wastewater based wetlands. An indication of gas emissions from wetlands can be found in studies in Europe with similar seasonal variations to Qinghai. A year-round study of a wetland in Czechoslovakia measured CO_2 and CH_4 emissions and recorded the following results:

Winter minimum emissions:	4 mg/m^2/hr CO_2 and 0 mg/m^2/hr CH_4.
Summer maximum emissions:	300 mg/m^2/hr CO_2 and 93 mg/m^2/hr CH_4.

349. Taking average yearly figures for these emissions (over a 280 day yearly frost-free period), the following total yearly emissions are obtained: 1.02 kg/m^2/year CO_2 and 0.312 kg/m^2/year CH_4. The wetland component of the Yizhou Wetland project is 10.88 ha (excluding forest belts and education areas). Indicative yearly emissions are therefore 108 tons CO_2 and 33.95 tons CH_4. This provides an indicative total yearly emission for the Yizhou Wetland of 820 tons CO_{2e}.

350. **Emissions from Landfill.** Potential emissions from the landfill have been calculated using the Commonwealth of Australia 2014 National Greenhouse and Energy Reporting (NGER) solid waste emissions calculator Version 1.91. Inputs included an assumed legacy landfill size of 500,000 tons in 2010, and the population and waste generation projections in the FSR. The calculator used the climatic and waste characteristics of a Dry Temperate region. With no recycling, the emissions calculated for the landfill are shown in Table V.16.

Table V.16: GHG from Landfill – No Recycling

Year	Waste generated (t)	Total emissions (CO_2-e) (t)	Legacy emissions (CO_2-e) (t)	Non-legacy emissions (CO2-e) (t)
2012	500000*	0	0	0
2013	40000	13,204	13,204	0
2014	42000	13,627	12,571	1,056
2015	44100	14,084	11,969	2,115
2016	46150	14,576	11,398	3,178
2017	48457	15,100	10,855	4,245
2018	50879	15,662	10,340	5,322
2019	53423	16,517	9,850	6,667
2020	56094	17,414	9,385	8,028
2021	58899	18,353	8,943	9,409
2022	61844	19,336	8,523	10,813
2023	64936	20,367	8,124	12,243
2024	68183	21,447	7,745	13,702
2025	70228	22,579	7,384	15,195
2026	72335	23,724	7,042	16,682
2027	74505	24,881	6,716	18,165
2028	76740	26,053	6,406	19,647
2029	79042	27,241	6,111	21,130
2030	80623	28,446	5,831	22,616
2031	82236	29,646	5,564	24,082
2032	83880	30,841	5,310	25,531
2033	85558	32,032	5,069	26,963
2034	87269	33,222	4,839	28,382
2035	89015	34,410	4,621	29,790
2036	90795	35,599	4,413	31,186
2037	92611	36,790	4,215	32,575
2038	94463	37,982	4,026	33,956
2039	96352	39,179	3,847	35,332
2040	98279	40,380	3,676	36,704
2041	100245	41,586	3,513	38,073
2042	102250	42,799	3,358	39,441
2043	104295	44,020	3,211	40,809
2044	106381	45,249	3,070	42,179
2045	108508	46,488	2,936	43,552
2046	110679	47,737	2,808	44,929

* assumed size of existing landfill (“legacy waste”).

351. At the commencement of subproject operation in 2018, the GHG emissions for the landfill will be 15,662 tons CO_{2e}/year, rising to 22,579 tons CO_{2e}/year in 2025 and 28,446 tons CO_2e /year in 2030. This gives an average yearly emission for the first seven years of 19,000 CO_2e /year.

352. **Mitigation and Offsets.** Measures to reduce greenhouse gas emissions are available in the short-term for the emitting activities. The offsetting effect of the project tree planting will also, over time, reduce the net greenhouse gas emissions to zero.

353. ***Power Usage.*** Adoption of variable frequency drive (VFD) controllers for all pumps (in WTPs, landfill leachate treatment and irrigation pumping stations) can achieve up to 20% energy savings. The PRC is a leader in this technology. Power consumption is responsible a

very low proportion of the GHG emissions of the project (65.55 t/yr). With the installation of VFD controllers on pumps in all project facilities, energy saving of 15-20% can be expected. This will reduce the greenhouse gas emissions to 55.72 t/yr CO_{2e}.

354. ***Landfill.*** The landfill emissions can be mitigated through the maximization of recycling. With maximum recycling, the amount of waste entering the landfill is significantly reduced (by up to 25%), and the GHG emissions are similarly reduced. This is shown in Table V.17.

Table V.17: GHG from Landfill – Maximum Recycling

Year	Waste generated (t)	Total emissions (CO_2-e) (t)	Legacy emissions (CO_2-e) (t)	Non-legacy emissions (CO2-e) (t)
2012	500000	0	0	0
2013	40000	13,204	13,204	0
2014	42000	13,627	12,571	1,056
2015	44100	14,084	11,969	2,115
2016	46150	14,576	11,398	3,178
2017	48457	15,100	10,855	4,245
2018	38159	15,662	10,340	5,322
2019	40067	16,117	9,850	6,267
2020	42071	16,613	9,385	7,228
2021	44174	17,149	8,943	8,206
2022	46383	17,728	8,523	9,204
2023	48702	18,349	8,124	10,225
2024	51137	19,016	7,745	11,271
2025	52671	19,728	7,384	12,344
2026	54251	20,456	7,042	13,414
2027	55879	21,200	6,716	14,485
2028	57555	21,962	6,406	15,556
2029	59282	22,741	6,111	16,630
2030	60467	23,539	5,831	17,708
2031	61677	24,337	5,564	18,773
2032	62910	25,137	5,310	19,827
2033	64169	25,939	5,069	20,870
2034	65452	26,744	4,839	21,905
2035	66761	27,553	4,621	22,932
2036	68096	28,366	4,413	23,953
2037	69458	29,184	4,215	24,969
2038	70847	30,007	4,026	25,980
2039	72264	30,836	3,847	26,989
2040	73710	31,672	3,676	27,996
2041	75184	32,515	3,513	29,002
2042	76687	33,366	3,358	30,008
2043	78221	34,226	3,211	31,015
2044	79786	35,095	3,070	32,025
2045	81381	35,973	2,936	33,037
2046	83009	36,861	2,808	34,053

* assumed size of existing landfill (“legacy waste”).

355. At the commencement of subproject operation in 2018, the GHG emissions for the landfill with maximum recycling are unchanged because of the strong contribution from the legacy landfill. However by 2025 the emissions are only 19,728 tons/year, and 23,539 tons/year in 2030 (13% and 17% lower respectively). This gives an average yearly emission for the first seven years of 17,500 CO_2e /year.

356. ***Offsets through Carbon Sequestration.*** The large scale tree-planting and general landscaping under the project will provide large areas of growing woody plants, which will sequester and store CO_2 as carbon in their biomass for their lifetime. A proportion will continue to be stored as timber products derived from strategic and planned harvesting of trees in the future (with a harvest-and-replacement management plan in place to ensure that the core functions of erosion control, windbreak and habitat provision are maintained). The FSR has nominated the carbon sequestration rates for the greening-related components of the project (Table V.18).

Table V.18: Indicative Carbon Sequestration Rates from project Forest Plantations

Plantation	Area of Tree planting	Tree Planting density used	Trees (no.)	Carbon Sequestration	
				Tons/day	Tons/yr
Ping'an Riverside Greenbelt	71.2 ha	Actual numbers	48000	32	8,960
Yizhou Wetland	-	-	-	9	2,520
Ping'an Mountain Edge Greenbelt	104.7 ha	600 trees/ha	62820	47.1	13,188
South Mountain Landscaping	663 ha	600 trees/ha	397800	311	87,080
Totals			508620	399.1	111,748

357. **Net estimated GHG emissions.** Without the above energy savings and direct emission reductions described above, the estimated gross GHG emissions from the project are 19,886 t/yr CO_{2e}. With the energy savings and direct emission reductions described above, the estimated net GHG emissions from the project will be 18,376 t/yr CO_{2e}. These levels of emission are below the significant level of GHG generation as defined by the ADB SPS, which is 100,000 t/yr CO_{2e}. When the carbon sequestration provided by the greenbelt and shelterbelt plantings under the forest is added, there will be greenhouse gas emissions reduction under the project.

H. Adaptation to Climate Change

358. The initial climate risk screening for the project, as part of the rapid environmental assessment by ADB was that the climate change risk for the project was medium. Consequently the ADB commissioned a Climate Risk and Vulnerability Assessment (CRVA) which was submitted in August 2015[18].

359. The **CRVA** study has assessed climate change risks and vulnerabilities at two levels. One is at regional level to confirm the effectiveness of the provincial urban development strategy in raising resilience and to assess the vulnerability of the Integrated Water Management Plan for the Huangshui River Basin (IWMPHRB). The other is at Haidong city level to assess the vulnerability of the designs of proposed project components.

360. The assessments of this study were based on climate change scenarios constructed from climate projections of AR5 global climate models. Because the timeframe of those plans are up to 2030 only, the climate change scenarios were then constructed with GCM projections from 2020 to 2040. Hydrological models, including ArcSWAT and HEC-HMS, were used in simulating climate change impact on the river flow volumes and flood levels of the Huangshui River,

[18] Heping Zuo and Wei Ye 2015, Climate Risk and Vulnerability Assessment (CRVA) for TA 8846-PRC: Qinghai Haidong Urban-Rural Eco Development Project. The summary of the CRVA is presented in Attachment 3. The full CRVA is available upon request.

Regional water resource changes were also assessed based on the modelling outcomes for the Huangshui River in combination with spatial water balance analysis.

361. The assessment found that regional water resources in Qinghai Provinces will not change significantly in total volumes in 2030, but seasonal and annual variability will increase. Hydrological modelling results have shown that river flow volumes will decline slightly under the low climate change scenario but will increase under medium and high scenarios. The mixed change signals are interaction results between projected rising temperature and increased precipitation across regional Qinghai Province. However, there will be increased climate risks due to increased seasonal and annual variability in precipitation and hence river flow volumes. Shrinking glacier areas caused by rising temperature is also posing risks to the river headwaters. Effective adaptation measures are required to address those risks and vulnerabilities.

362. The CRVA concluded that the provincial headwater protection strategy has shown positive results with improved water quality and river flow volumes in the headwater protection areas. However, the headwater protection programs have so far largely relying on the central government funding support, and Qinghai province will have difficulty in sustaining the headwater and other ecosystem protection programs. Economic development in the Xining-Lanzhou corridor will increase the provincial capacity in sustainably implementing the headwater protection strategy and programs and increase resilience to climate risks. The CRAV assessment results confirmed the provincial strategies in this area.

363. One of them, the Integrated Water Management Plan for the Huangshui River Basin (IWMPHRB), is an important step forward for effective management of the water resources of the basin. The plan sets up ecological flows to secure about 50% of river flows from the Huangshui and Datong rivers to the Yellow River. However the CRVA noted that the ecological flow volume of the Datong River may not be guaranteed in dry years if the divertible water limit is reached by the upstream diversion projects endorsed by the plan, and this will be exacerbated by future increased climate variability. The CRVA recommends the setting up of a coordination body to establish priorities and more flexible diversion volumes to build the resilience of the river systems.

364. Package CS4 – climate-resilient water resources management planning support is included in the project capacity building program. Consulting services will assist the HMG to review and climate-proof the Haidong City Master Plan (2013-2020), and initiate the establishment of a provincial-level Huangshui River coordination body (under the leadership of provincial Department of Water Resources with representatives from Haidong and Xining) to address Huangshui water resources management issues at watershed level.

365. Project-specific climate change adaptation measures have been recommended by the CRVA to be incorporated in component designs. However, the whole of the project in conjunction with Qinghai's planning policies for the Huangshui basin contributes to climate adaptation on a regional scale. This is through five major initiatives:

- Limiting urban development along the Haidong corridor will protect the fragile landscapes of the hills and slopes, allowing them to regenerate natural cover and provide improving watershed values for the Huangshui Basin;
- Urban greening, a major part of the project, will address the problem of balancing the competing land use needs of urban development, agriculture and ecosystem services within a tightly constrained corridor. Urban greening will mitigate the effects of urban

"heat islands", increase amenity and reduce power consumption for domestic climate control;

- The promotion of wastewater reuse is of critical importance in water-scarce environments in northwest PRC. The reuse of wastewater takes pressure off potable water services and exploiting limited natural water resources for irrigation;
- Water conservation saving and water conservation techniques in the design of irrigation systems and the close matching of seasonal water demand with supply and the use of drought tolerant plant species will also alleviate pressure on regional water resources; and
- The diversification of water sources will allow better and more conservation oriented management of regional water resources through the separation of potable and agricultural water streams and will provide more options for supply for future climatic conditions.

366. Design-specific adaptation measures addressing potential climate change risks have been incorporated into component designs. These are summarized in Table V.19 below, with estimations of the costs. Adaptation safety margins for embankments and landfill interception drains and leachate pond, as well as the capacity building component on climate change are all direct responses to CRVA recommendations.

Table V.19: Adaptation Design Adjustments for Project Components

Subcomponents with climate proofing	**Total Costs of sub-components**	**Contribution to Climate Adaptation (%)**	**Climate Adaptation Costs (million USD)**	***Notes***
Flood protection works	67	0.5%	0.34	*50% of embankments will be increased in height by 5-20cm to accommodate projected increase in flood volumes (CRVA recommendation, see Table V.20 below).*
Water Reclamation	4.2	100.0%	4.20	*Water reclamation was promoted by the project team at project concept stage as important measure to increase climate resilience of irrigation systems.*
Mountain Forest	19.5	10.0%	1.95	*Mountain forest will limit urban sprawl on fragile hills and reduce soil erosion from wind and water, which is likely to increase as a result of projected increased intensity of storms.*
Water Supply	12.9	20.0%	2.58	*Sanhe WTP will be used as secondary source and back-up water supply for Ping'an urban district, increasing resilience to water shortages that are projected to increase in future.*
Landfill	7.6	2.0%	0.15	*Stormwater interception drainage and leachate holding tank capacities increased by 10% and 20%, respectively (CRVA recommendation).*
Capacity Development	2.2	10.0%	0.22	*Capacity building component includes sub-module on climate adaptation (CRVA recommendation).*
Total			***9.44***	

Table V.20: Climate proofing of flood protection works at various river cross-sections

	1-in-30 years design flow without climate change		1-in-30 years design with climate change (i.e. 8% increased flow)			Climate vulnerability of section	
Sct. No	Flow Q (m^3/s)	Embankment crest elevation (A)	Flow Q (m3/s)	Water Level (B)	(B) plus freeboard of 0.70m (C)	Gap between (A) and (C)	Embankment height adjustment (cm)
1	715	2161.65	772	2160.75	2161.45	0.2	
2	780	2158.26	843	2157.59	2158.29	-0.03	3
3	780	2151.17	843	2150.57	2151.27	-0.1	10
4	780	2144.29	843	2143.22	2143.92	0.37	
5	780	2139.01	843	2138.42	2139.12	-0.11	11
6	780	2135.27	843	2134.59	2135.29	-0.02	2
7	780	2128.79	843	2127.94	2128.64	0.15	
8	780	2124.86	843	2124.31	2125.01	-0.15	15
9	780	2118.37	843	2117.73	2118.43	-0.06	6
10	780	2113.64	843	2113.14	2113.84	-0.2	20
11	780	2107.59	843	2106.95	2107.65	-0.06	6
12	810	2103.05	875	2102.33	2103.03	0.02	
13	810	2098.89	875	2098.21	2098.91	-0.02	2
14	810	2095.93	875	2095.36	2096.06	-0.13	13
15	810	2090.94	875	2090.22	2090.92	0.02	
16	810	2084.45	875	2083.67	2084.37	0.08	
17	810	2082.45	875	2081.83	2082.53	-0.08	8
18	810	2079.84	875	2079.14	2079.84	0	0
19	810	2076.93	875	2076.24	2076.94	-0.01	1
20	810	2072.62	875	2072	2072.7	-0.08	8
21	849	2066.29	917	2065.43	2066.13	0.16	
22	849	2052.51	917	2051.81	2052.51	0	0
23	849	2047.16	917	2046.42	2047.12	0.04	
24	849	2043.14	917	2042.32	2043.02	0.12	
25	849	2037.6	917	2037	2037.7	-0.1	10
26	862	2032.82	931	2032.23	2032.93	-0.11	11
27	862	2029.43	931	2028.16	2028.86	0.57	
28	862	2025.73	931	2025.16	2025.86	-0.13	13
29	862	2023.73	931	2022.1	2022.8	0.93	
30	862	2015.21	931	2014.37	2015.07	0.14	
31	862	2008.86	931	2008.07	2008.77	0.09	
32	887	2005.79	958	2005.16	2005.86	-0.07	7
33	887	2003.7	958	2002.89	2003.59	0.11	
34	887	2001.58	958	2000.78	2001.48	0.1	
35	887	1998.95	958	1998.08	1998.78	0.17	
36	887	1997.87	958	1997.19	1997.89	-0.02	2
37	887	1996.3	958	1995.36	1996.06	0.24	
38	887	1991.32	958	1990.54	1991.24	0.08	
39	950	1983.55	1026	1982.9	1983.6	-0.05	5
40	950	1978.95	1026	1978.11	1978.81	0.14	

	1-in-30 years design flow without climate change		1-in-30 years design with climate change (i.e. 8% increased flow)			Climate vulnerability of section	
Sct. No	Flow Q (m^3/s)	Embankment crest elevation (A)	Flow Q (m3/s)	Water Level (B)	(B) plus freeboard of 0.70m (C)	Gap between (A) and (C)	Embankment height adjustment (cm)
41	950	1976.53	1026	1975.74	1976.44	0.09	
42	950	1972	1026	1971.32	1972.02	-0.02	2
43	950	1970.45	1026	1969.78	1970.48	-0.03	3
44	1091	1965.9	1178	1964.97	1965.67	0.23	
45	1091	1959.6	1178	1959.01	1959.71	-0.11	11
46	1091	1954.43	1178	1953.6	1954.3	0.13	
47	1091	1950.31	1178	1949.35	1950.05	0.26	
48	1091	1941.92	1178	1941.24	1941.94	-0.02	2
49	1091	1936.41	1178	1935.33	1936.03	0.38	
50	1091	1930.65	1178	1929.59	1930.29	0.36	
51	1091	1926.31	1178	1925.7	1926.4	-0.09	9
52	1091	1923.34	1178	1922.3	1923	0.34	
53	1091	1915.21	1178	1914.38	1915.08	0.13	
54	1091	1911.74	1178	1911.06	1911.76	-0.02	2
55	1091	1900.87	1178	1900.2	1900.9	-0.03	3
56	1091	1898.24	1178	1897.5	1898.2	0.04	
57	1091	1889.55	1178	1888.82	1889.52	0.03	
58	1091	1887.06	1178	1886.36	1887.06	0	0
59	1091	1882.46	1178	1881.66	1882.36	0.1	
60	1091	1878.84	1178	1877.95	1878.65	0.19	
61	1091	1873.92	1178	1873.32	1874.02	-0.1	10
62	1091	1869.29	1178	1868.3	1869	0.29	
63	1091	1861.81	1178	1861.06	1861.76	0.05	
64	1091	1860.6	1178	1859.92	1860.62	-0.02	2
65	1091	1856.53	1178	1854.93	1855.63	0.9	

Number of sections needing climate-proofing	31
Average increase needed (cm)	7.4
Maximum increase needed (cm)	20.0

367. Cost-neutral adaptation measures incorporated into the project include the use of drought tolerant tree and shrub species for core planting areas in mountain edge shelterbelts and the calculation of leachate production from the landfill with a 10% safety margin.

I. Associated Facilities

368. There will be several associated and/or linked facilities, including the reservoirs for the water supply component, the existing landfill for the solid waste component and the existing WWTP for the reuse of treated wastewater discharge. For all, the minimum requirement for due diligence has been that the facilities are operating under appropriate environmental approvals.

Table V.21: Approval of Associated Facilities

District	Associated Facility	EIA approval	Approval date	Approval agency	Compliance History	Remarks
Ping'an	Ping'an WWTP	Yes	2008/11/21	Qinghai Provincial EPD	Effluent and influent quantity and quality for 2014-2015 complies.	Associated facility of Output 3: Rural Water Supply and urban solid waste infrastructure constructed.
	Fatai Reservoir	No	-	-	Water balance analyses for the reservoirs demonstrating sustainability of operations and supply	Associated facility of Output 3. Facility built in 1979. No EIA required at that time
	Fatai Water Source Protection Area	No	-	-	-	Associated facility of Output 3. Facility built for irrigation water supply. No requirement for water source protection zones
	Wenzukou Reservoir	Yes	2011/7/05	Qinghai Provincial EPD	Water balance analyses for the reservoirs demonstrating sustainability of operations and supply	Associated facility of Output 3.
	Wenzukou Water Source Protection Area	Yes				Associated facility of Output 3.
Ledu	Ledu Landfill stages 1 and 2	Yes	2005/3/25	Qinghai Provincial EPD	Environmental Completion Acceptance 2009	Associated facility of Output 3: Rural Water Supply and urban solid waste infrastructure constructed.

Source: PPTA team and Haidong EPB

369. Additional due diligence of associated facilities has been undertaken through advice from the EPB on the compliance record of the Ping'an WWTP operation (effluent and influent quantity and quality for 2014-2015). These results show that the discharge complies with Class1A standard. This performance level will need to be maintained and monitored and this is included as a project assurance.

370. Due diligence on the sustainable operation of the Wenkuzhou and Fatai reservoirs has focused on the seasonal water balance analyses of the reservoirs. Water balance analyses for the reservoirs have been received and critically assessed (see section V. E.3). They demonstrate the sustainability of operations and supply. The Fatai reservoir is, and the Wenkzhou reservoir will be, connected to the Ping'an flash flood monitoring and early monitoring system that is operated by the Ping'an Water Affairs Bureau.

371. *Ping'an County Drinking Water Resource Protection Zoning Technical Report* prepared in 2009 set out the protection zoning for Wenzukou and Baishengou drinking water resources. According to the document, Class I protection zone for Wenzukou Reservoir is the whole water body, land area is the area below elevation 2,800m on the side of reservoir water intake. Class II protection zone only has land area which include all upstream watershed (outside of Class I protection zone land area). Figure below shows the Class I and Class II protection zones for Wenzukou Reservoir.

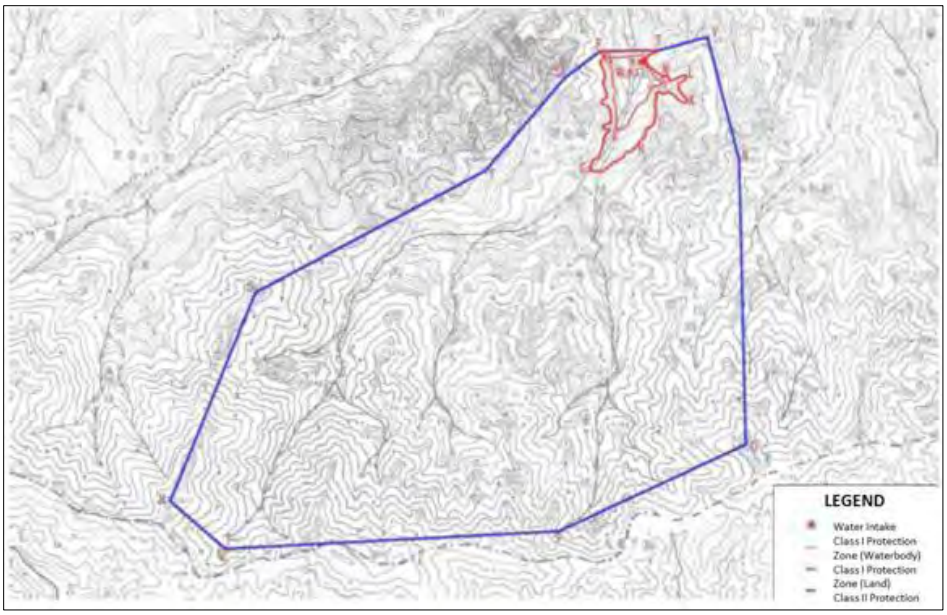


Figure V.6: Wenzukou Reservoir Water Resource Protection Zoning Map

372. The Class I zone is a Prohibited Zone, closest to the water source, and unauthorized personnel will be forbidden from entering within 100m of the water intakes. The Class II zone is a Protection Zone adjoining the Prohibited Zone and prohibits new buildings or construction projects which may drain pollutants to the water body. In this zone, existing developments must reduce and manage their pollutants discharge. The protection zones have been appropriately delineated and, if properly enforced, will provide suitable protection of the water quality.

373. Fatai reservoir was originally commissioned for irrigation and no water source protection was required. A water protection zone for this reservoir will be developed according to the Technical Specification for Protection Zone of Drinking Water Source (HJ/T 338-2007). This will be required as a loan assurance. The due diligence has confirmed absence of settlement or agricultural and other production activities within 100m from the reservoir water intakes.

J. Induced and cumulative impacts and benefits

374. Cumulative impacts and benefits relate to the extent of infrastructure to be constructed along the Huangshui River in Ping'an and Ledu districts. The project, when combined with existing embankments, will result in flood risk of the two districts reduced from a <1 in 10 year to 1 in 30 year recurrence interval. The project will directly improve the living conditions of a large number of residents: an estimated 205,000 people will be protected from flooding up to 1:30 flood recurrence interval. Future city development will be on the landward side of the river embankments, to protect and maintain the river corridor as an environmental and recreational asset for the cities. The improved and expanded sanitary landfill will service the solid waste management needs of 100,000 people in Ledu and the rural water supply component will provide new piped water to 18 villages (12,000 people).

375. A concern that was assessed is that increasing embankments and containment of the river channel could increase flow velocities and/or volumes downstream, presenting risks to downstream communities. Hydrological impacts downstream (including consideration of predicted increases in rainfall and/or flood intensity) have been modeled in the FSR or CRVA. The natural geographic conditions immediately downstream of the project (steep-sided valleys with no riverbank settlements for 17 km) and only small riverside settlements and limited agriculture until river reaches in Gansu limit the magnitude of any impacts (Figure V.19).

Increasing government awareness and activity for land use planning, water resources management, and increased flood storage capacity at the Yizhou wetland and other natural floodplains along the various river sections will offset the potential impacts of altered flows.

Figure V.7: Area immediately downstream of Project showing location of Laoya Gorge

VI. ANALYSIS OF ALTERNATIVES

A. No Project Alternative

375. The no project alternative would be to not support Haidong Municipal Government's efforts to provide a livable environment for an increasing population while also balancing the competing land use needs of urban development, agriculture and ecosystem services within a tightly constrained river corridor.

376. Without completion of the flood management system, lives and property will be put at risk. Without the urban greening embodied in the greenbelt, shelterbelt and wetland developments urban forms will dominate the river valley, decreasing the amenity and increasing power consumption for domestic climate control. Mountain edge erosion will continue with dust storms affecting the quality of life in urban areas.

377. Without the project, water resources will not be closely managed or matched with demand, with continued pressure on water resources in a water-scarce area of the PRC. Allocation of water to target communities will not be assured. Without the landfill component, poor design and management at the landfill will erode local environmental values, with special threats to the quality of groundwater and soil resources.

B. Alternatives Considered

1. Flood Protection and River Rehabilitation Component

378. The FSR did not formulate alternative designs for the spatial layout of proposed flood protection and river management components. It concluded that the flood modeling and land assets needing protection dictated the optimum configuration. However, it has focused on the different types of structures for embankments and river bank erosion protection works. These are considered below.

379. **Embankment Structural Types.** The FSR has considered three alternative structural types for the river embankment wall revetments. The advantages and disadvantages for the three types of proposed retaining walls are shown in Table VI.1.

Table VI.2: Comparison of revetment alternatives

Comparison factor	Green retaining wall	Grouted rubble retaining wall	Reinforced concrete retaining wall
Structure performance	Fair	Good	Excellent
Landscape effect	Good	Fair	Poor
Ecological effect	Good	Fair	Poor
Direct cost	Low	Medium	High
Construction condition	Best practice technology, complicated treatment of backfill earth	Mature technology, mass of stone materials, skilled workers	Mature technology, convenient construction

380. The "green retaining wall" type of construction will best achieve the objectives of the component, which are to combine river bank scour protection works, flood protection levees and habitat provision.

381. **Embankment Elements.** The green retaining wall type of embankment can employ a range of structural elements. The main ones are: metal and rock gabions; green dam eco-bags; embedded landscape wall; and planter box retaining wall. These are illustrated at Figures VI.1 to Figure VI.4.

Figure VI.1: Metal gabion retaining wall

Figure VI.2: Green Dam eco-bags retaining wall

Figure VI.3: Embedded landscaped retaining wall

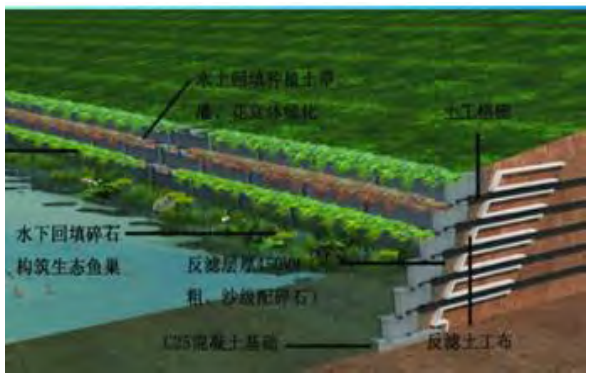


Figure VI.4: Box type green concrete retaining wall

382. From these four types of ecological retaining wall assessed in the FSR, the gabion type has been selected because of its ease of construction, ready availability of gabion-sized rocks from river blockage removal activities, and because of their stability in low height structures (retaining wall heights in the project area are not more than 4m).

383. **Embankment Design.** The third major consideration of alternative designs for riverbank embankments is for design configuration – how the chosen elements are arranged. Six types of revetment structures that combine river bank scour protection works, flood protection levees and habitat provision have been designed. They are illustrated in Figure VI.5 to Figure VI.10.

384. The design best suited to the local riverbank conditions will be used. The selection for the Ping'an and Ledu rural river reaches, with their emphasis on greening and riverside habitat, will be from designs VI.5 to VI.8. For the Ledu urban area, where the stabilization and protection of the built environment is added to the selection criteria, the designs will be either VI.9 or VI.10.

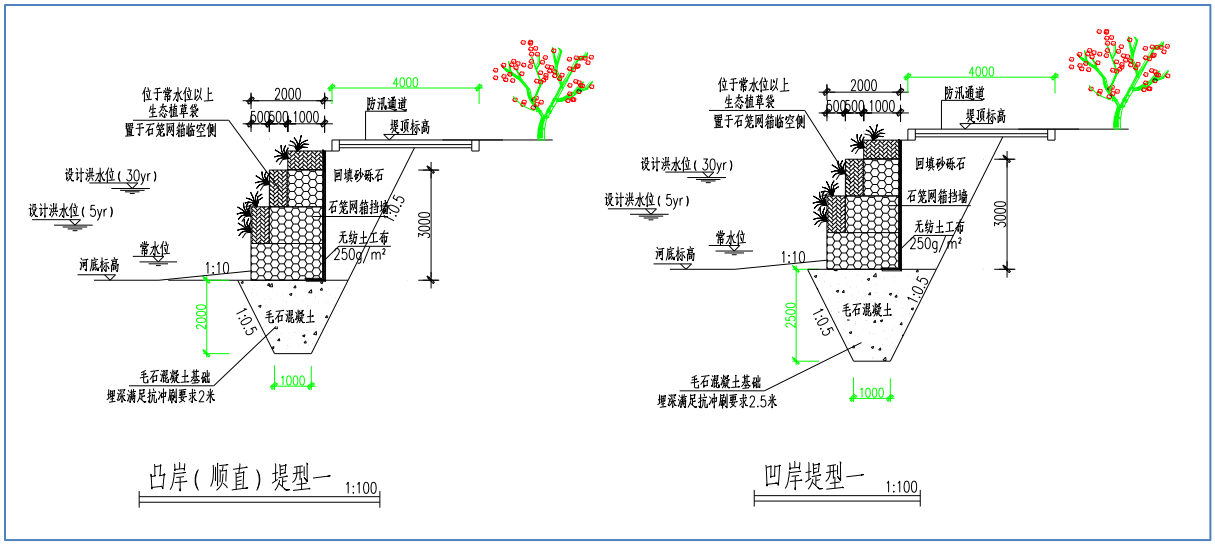


Figure VI.5: Type-A Revetment Structure

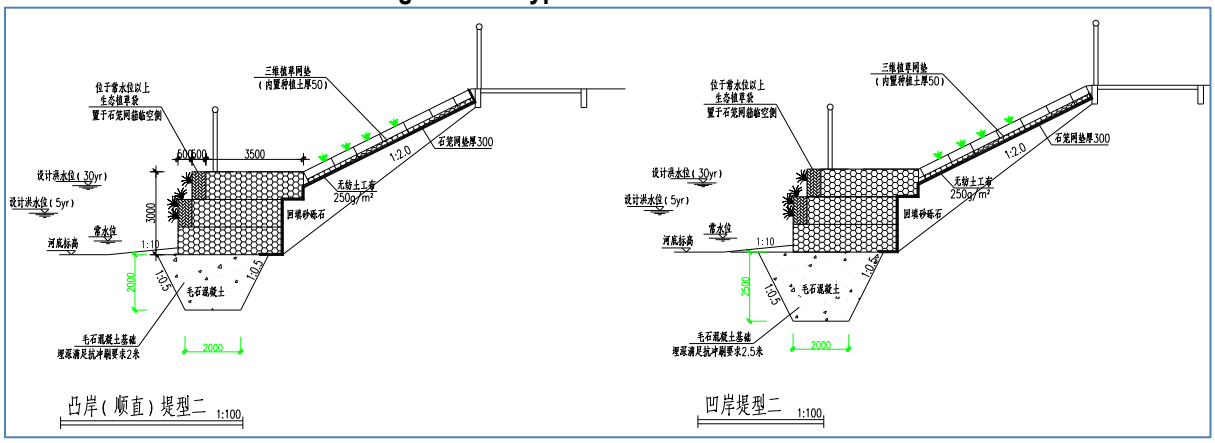


Figure VI.6: Type-B Revetment Structure

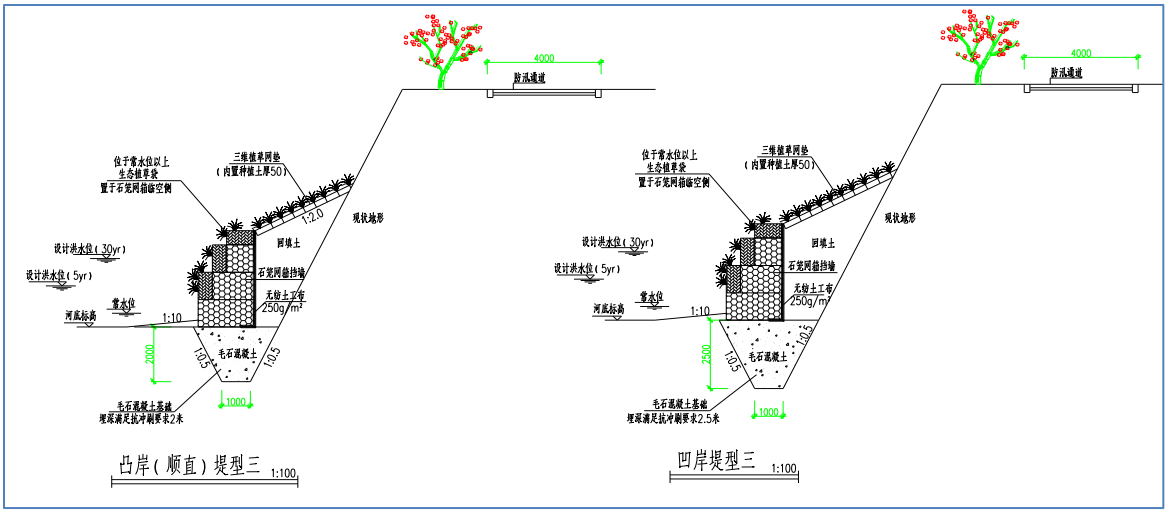


Figure VI.7: Type-C Revetment Structure

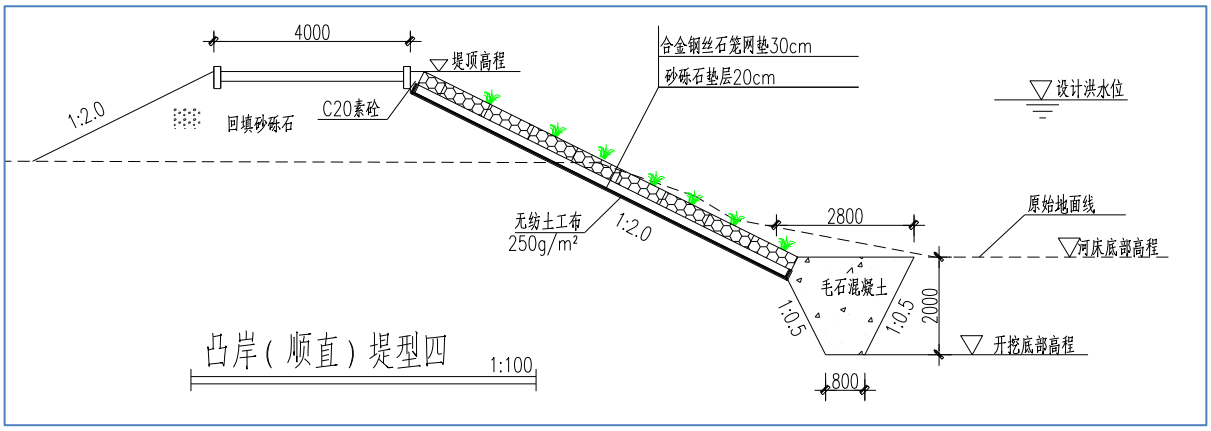


Figure VI.8: Type-D Revetment Structure

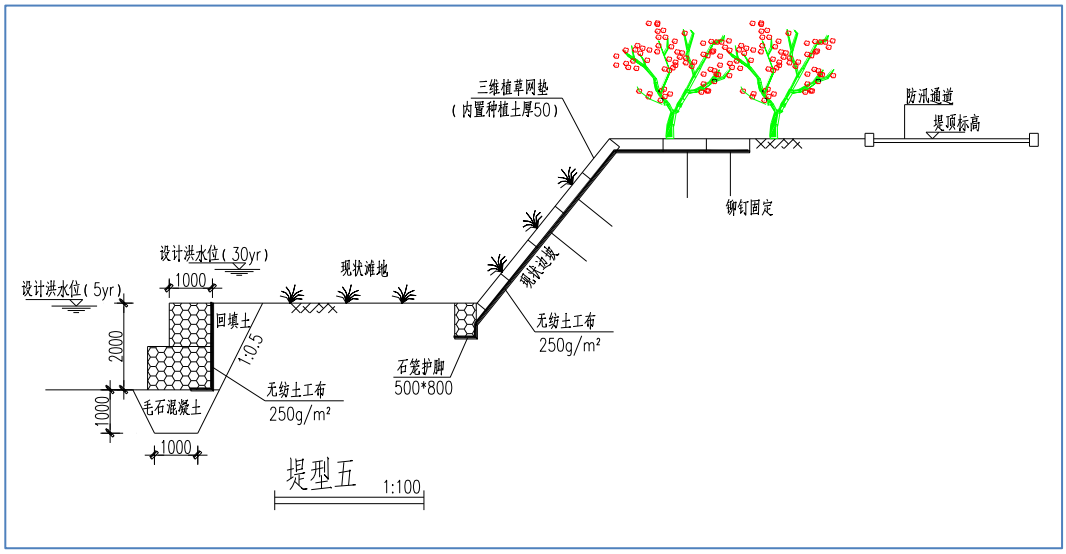


Figure VI.9: Type E Revetment Structure

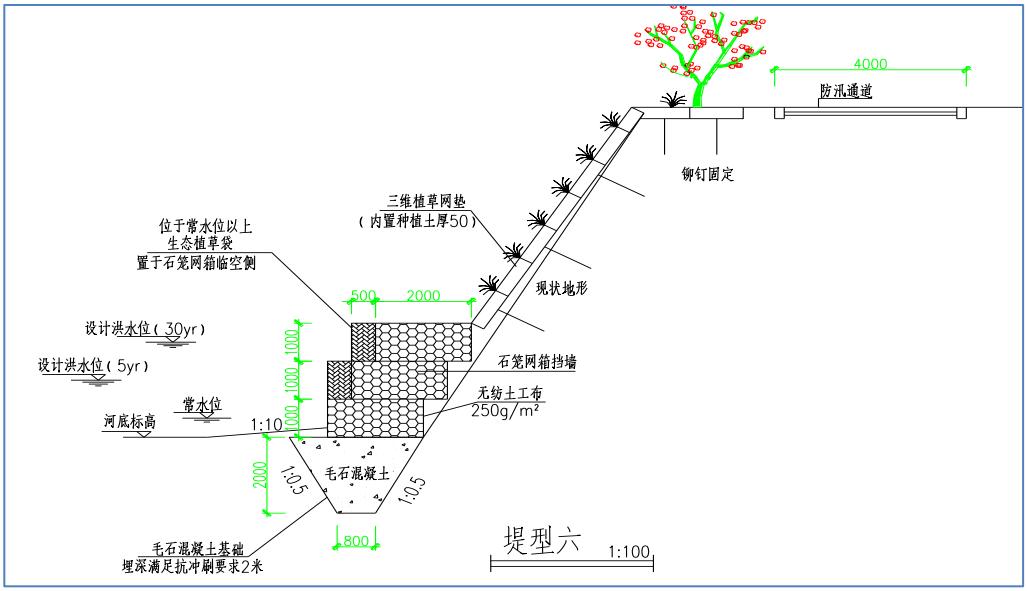


Figure VI.10: Type F Revetment Structure

2. Greenbelts and Wetlands Components

385. Development of the Riverside Greenbelts is part of long term planning by Haidong Government. The re-vegetation of the project's riverside greenbelts and Yizhou Wetland Park will then extend the total Riverside Greenbelt to a length of 35 km in Ping'an District. The FSR details one alternative option, of increasing the width of the New Urban and Main Urban Riverside Greenbelts to wider than 50m. Although this alternative would increase the total vegetated area, with potential environmental and scenic benefits, the increase in costs and demand for irrigation water would reduce the overall lengths of the greenbelts established. The LDI also identified difficulties in acquiring a wider strip of land. Therefore the FSR did not recommend this alternative.

386. The Yizhou Wetland Park area has been subject to two previous Wetland Park development proposals under the Pingan Yizhou National Wetland Park (2014-2020) Master Plan and the Feasibility Study Report on Yizhou Wetland Park Engineering 2015.

387. **Pingan Yizhou National Wetland Park (2014-2020) Master Plan.** The National Wetland Park was proposed for the area from Liuwan Bridge in the west to Zhangjiazhai Bridge in the east, with the north boundary being the embankment of Huangshui River and extending 100 m to the south of the southern embankment giving a total area of 141 ha. The peer review of the Draft Master Plan was undertaken in late 2014, for State Forestry Administration. The Plan was not approved to progress to national pre-appraisal because the data on the wetland in the draft master plan were considered insufficient and much of the wetland biodiversity was considered to have already been lost and too difficult to restore on such a big scale.

388. **Feasibility Study Report on Yizhou Wetland Park Engineering 2015.** This study developed concepts for 5 areas of the Huangshui River in Haidong, one of which included the area now proposed for Yizhou Park. The design concept was for a parkland in the Yizhou area covering 277 ha. This concept plan addressed some of the difficulties of the previous plan by focusing on recreational tourism and featuring a strong element of water treatment. The concept area was divided into a western area (Fishing Wetland Park) and an eastern area (Moonlight

Park). The Moonlight Park area was proposed to cover most of the eastern area in the current Yizhou Wetland Park proposal, and comprised a core "Wetland District" and the "Leisure Agricultural Region". In addition to sourcing water from the Huangshui River, the design concept included a proposal to divert part of the water flow from the Haidong City Channel.

389. This concept plan was progressively scaled down to reduce land acquisition costs. The first draft FSR was for a concept plan covering 86 ha only. The acquisition costs of this were estimated at 339 million RMB. It was concluded during the PPTA that this cost was prohibitive and the preferred option in the latest FSR is for a 20 ha development. This concept plan retains the water treatment function as a linear wetland with minimal recreation and parkland components.

3. Greenbelt and Shelterbelt Irrigation

390. Commonly used irrigation systems include conventional irrigation, sprinkling irrigation system and micro-irrigation system. Conventional irrigation consumes relatively large amount of water and is inefficient; it is not recommended for areas with water scarcity like Haidong. The FSR compared sprinkler irrigation and micro-irrigation, as shown in Table VI.2.

Table VI.2: Alternatives for Water-saving Irrigation

	Sprinkling Irrigation	Micro-irrigation
Advantages	- High water use efficiency - Ease of O&M, save labor - High land use efficiency - Increase production - Wide application, suitable for all terrains	- Ease of O&M, save labor - Save energy consumption - Even distribution of water - Increase production - Suitable for all terrains
Disadvantages	- Affected by wind condition - Large evaporation - May lead to low moisture content in soil	- Small sprayer, tendency to clog; periodic maintenance is needed
Water Use Efficiency	-80%	-95%
Working Pressure	200-400 kPa, maximum @ 500 kPa	20-150 kPa
Ease of Construction	Easy	Easy
Ease of O&M	Convenient	Convenient
Cost	High	Relatively low

kPa = kilopascal, O&M = operation and maintenance

391. Since the sprinkling system requires relatively high working pressure and needs additional pumping, whereas micro-irrigation merely utilizes gravity for irrigation, the operation cost of the sprinkling system will be higher. Micro-irrigation directly delivers water to the tree roots, which avoids evaporation during spraying and ensures better water use efficiency. Therefore, after consideration of the dry and windy nature of the project location, the FSR recommended the use of micro-irrigation for this project component.

4. Water Supply Component - Treatment

392. The raw water quality data for the two reservoirs show that the source water for this component has good water quality, with most of the parameters meeting the Standard for Potable Water Quality (GB 5749-2006). The only parameters that exceed the standard are turbidity and coliforms. Therefore, the FSR recommended a water treatment process that includes coagulation, sedimentation, filtration and disinfection. The FSR compared several alternatives of each treatment process.

393. **Coagulation (mixing and flocculation).** Good mixing reduces the dosage amount of flocculants and improves the coagulation effect. Commonly used mixing methods are mechanical mixing and static mixing. Table VI.3 lists the comparison between two common mixing methods. Due to the small capacity of Wenzukou Reservoir WTP and Fatai Reservoir WTP, the FSR recommended static mixing rather than mechanical mixing. Two parallel tube static mixers were recommended; when the flow is low, only one will be used and the other one will be placed on standby. Based on the larger influent to Sanhe Town WTP and larger flow variation, the FSR recommended mechanical mixing for Sanhe Town WTP.

Table VI.3: Alternatives for Mixing Design

Alternatives	Advantages	Disadvantages
Mechanical Mixing	- Good mixing effect - Not affected by flow amount	- Requires space
Static Mixing	- Save space - Good mixing effect	- Affected by flow amount; low flow reduces mixing

394. Mechanical and hydraulic flocculation are currently the most frequently used in the PRC. Hydraulic flocculation includes grid flocculation and folded-plate flocculation. Table VI.4 below lists the comparison of the three alternatives. Based on the comparison, the FSR recommended grid flocculation for Wenzukou and Fatai WTPs due to their small capacity. Mechanical flocculation was recommended in the FSR for Sanhe Town WTP.

Table VI.4: Alternatives of Flocculation Design

Alternatives	Advantages	Disadvantages
Mechanical Flocculation	- Adapt to different flow, water quality and temperature - Low chemical addition - Low energy consumption	- Require more O&M - Higher cost - Require immediate maintenance for any malfunction
Grid Flocculation (Hydraulic Flocculation)	- Less flocculation retention time - Less complicated configuration - Good flocculation effect	- More sensitive to flow change - Need frequent cleaning
Folded-Plate Flocculation (Hydraulic Flocculation)	- Less flocculation retention time - Higher treatment capacity per basin	- More sensitive to flow change - More complicated configuration

395. **Sedimentation.** The alternatives for sedimentation in the FSR are summarized in Table VI.5. All WTPs are below the capacity at which horizontal flow sedimentation is optimized. Based on the small capacity and limited space of Wenzukou and Fatai Reservoir WTPs, the FSR recommended the inclined-tube sedimentation basin for the two small WTPs. For Sanhe Town WTP inclined-tube sedimentation does not have a sludge return feature and is not recommended. Machine mixing sedimentation requires relatively easy maintenance. Its cost is relatively low, with a relatively good sedimentation effect for low temperature and low turbidity water; so the FSR has recommended a machinery mixing sedimentation basin for Sanhe Town WTP.

Table VI.5: Alternatives of Sedimentation Design

Alternatives	Advantages	Disadvantages
Horizontal Flow Sedimentation	- Less complicated configuration - Easy to manage - Adapted to high loading	- Require more space - Long retention time
Inclined Tube Sedimentation	- High sedimentation efficiency - Require less space, only 1/3 of the space required for Horizontal Flow sedimentation basin for same flow	- Less applicable for water quality change - High O&M cost - Difficult configuration for sludge removal
Machinery Mixing Sedimentation	- Adapted to flow and water quality variance - Stable sedimentation effect - Widely used in the PRC - Experience good effect on treating low temperature and turbidity water	- More complicated configuration
ACTIFLO Sedimentation19	- Quickly adapt to different flow and water quality - Stable effluent water quality	- High cost - Need constant addition of micro-gravel - High O&M cost
Sludge Flocculation Sedimentation (DENSADEG High Density Sedimentation)	- Good flocculation effect - Fast sedimentation - Good effluent water quality - Adapted to flow variance - High loading - Saves space	- More devices - High cost - Requires more for chemical addition - Complex O&M

396. **Filtration.** Currently there are several different filtration methods widely used in the PRC, among which double valve filter, Siphon filter and valveless filter are most applicable for small WTPs. The FSR has recommended valveless filter for all three WTPs due to its ease of operation and maintenance.

[19] Gravel Flocculation High Efficient Sedimentation, invented by Velia Water Group

Table VI.6: Alternatives of Filtration Design

Alternatives	Advantages	Disadvantages	Application
Normal Filter	Widely used nationwide, good operation experience	- Footprint ≤ 100 m2 for each filter tank - More valves to operate - Need full set of washing equipment	Medium to large size WTPs
Siphon Filter	- Low cost - No large valve - No wash pump - Easier to operate	- Effluent water quality is not as good as V-shape filter - Require more backwash	Medium size WTPs
Valveless Filter	- No valve, easy to operate - Automatic wash, easy to manage	- Require more backwash - Filter not visible during operation	Small size WTPs

397. **Disinfection.** The FSR compared chlorination, ozone, UV and bleach for disinfection alternatives (Table VI.7). Since the project is located in a mountainous area, with long transport distance and relatively low local capability for operation and management, the FSR recommended combining UV disinfection with bleach for all 3 WTPs due to their ease of use and transport.

Table VI.7: Alternatives of Disinfection Design

Alternatives	Chemical	Advantages	Disadvantages
Chlorination	Chlorine, Chloramine	- Low cost - Good disinfection effect	- Toxic - Corrosive - Hazardous material, raise safety concern
	Chlorine Dioxide	- Better disinfection effect than Chlorine	- More toxic than Chlorine - More volatile - Explosive, difficult for storage - Hazardous material
	Sodium Hypochlorite	- Strong disinfection - Safer to use and store	- Concentrated solution is considered hazardous and highly corrosive - More costly
Ozone		- Excellent disinfection effect - Cause less THMs and HAA byproducts	- Unstable - Requires better operator skill - Escaped gas may cause air pollution
UV		- No byproducts - 99.99% removal for E. coli, bacteria, Giardia. Lamblia and Cryptosporidium - Low O&M cost	- Discontinuous disinfection - High cost
Bleach	CaOCl2	- 30% effective chlorine - Safe to use	- Sensitive to light, heat and moisture - Need to be diluted into solution before use

$CaOCl_2$ = calcium hypochlorite, HAA = haloacetic acid, O&M = operation and maintenance, THM = trihalomethane, UV = ultraviolet

398. **Sludge Treatment.** The FSR proposed two design alternatives for sludge treatment, as shown in Figure VI.11. Alternative 1 directly returns the filtration basin backwash to the sedimentation basin; this increases the load on the sedimentation basin. Alternative 2 uses a backwash storage tank which can be used in between to reduce the load on the sedimentation

basin. However, Alternative 2 causes increased flow into condenser, and a larger sized condenser is required. The FSR recommended Alternative 1 for all three WTPs in this project.

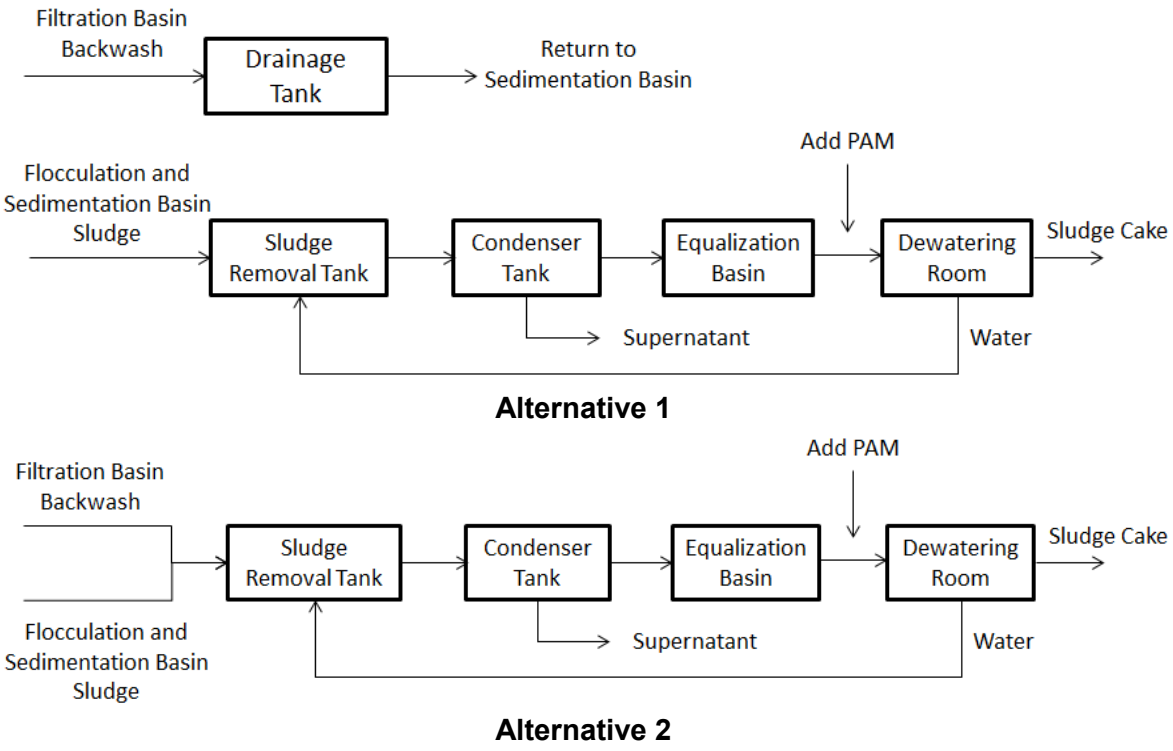


Figure VI.11: Alternatives of Sludge Treatment

399. **Sludge Dewatering.** Sludge dewatering options considered include natural drying bed dewatering and mechanical drying bed dewatering. The advantages of using natural drying bed include low capital cost and low O&M cost; the disadvantages include large footprint and adverse impact on the surrounding environment. Commonly used mechanical dewatering equipment includes plate and frame filter, centrifugal dewatering and belt filter. Comparison of the three alternatives is shown in Table VI.8. Considering the small capacity and available land for Wenzukou and Fatai Reservoir WTPs, the FSR recommended natural drying bed to dewater the sludge. For Sanhe Town WTP, the FSR proposes centrifugal dewatering as it requires less space, and it is highly automatic and relatively easy for O&M.

Table VI.8: Alternatives of Dewatering Design

Alternatives	Advantages	Disadvantages
Natural Drying Bed	- Low cost - Low O&M cost	- Require relatively larger space - Adverse environmental impact
Belt Filter	- Less noise - Less power consumption - Low cost	- More chemical consumption - Dewatered sludge contains 15-20% solid content - Require more O&M - Require more backwash - Open configuration, poor hygienic condition
Centrifugal Dewatering	- Require less space - Dewatered sludge contains 20-25% solid content - Light weight - Enclosed configuration, better hygienic condition - Less backwash - Low O&M cost	- More noise - More power consumption - More capital cost
Plate and Frame Filter	- Dewatered sludge contains 30-45% solid content - Less noise - Less power consumption - Low O&M cost	- Require more space - Higher weight sludge - Open configuration, poor hygienic condition - More backwash - High capital cost

5. Landfill Component

400. The FSR considered a comparative assessment of different types of waste dam, lining structure and leachate treatment technologies and processes. The comparative criteria for the waste dam and lining structure were solely engineering and cost based. There was no environmental advantage or disadvantage associated with the alternatives. However the leachate treatment process is sensitive to a number of environmental factors.

401. **Leachate Treatment Process.** The FSR considered three processes including (i) two-stage DTRO (Disc tube reverse osmosis); (ii) UASB+SBR+CMF+RO (up flow anaerobic sludge blanket + sequencing batch reactor + continuous microfiltration membrane element + reverse osmosis); and (iii) and MBR+NF/RO (membrane bioreactor + reverse osmosis). The results are summarized in Table VI.9 below.

Table VI.9: Leachate Treatment Process Comparison

		Two-stage DTRO	UASB+SBR+CMF+RO	MBR+NF/RO
Technical Feasibility	Technology	Advanced	Advanced	Advanced
	Reliability	Reliable	Reliable	Reliable
	Equipment needs	Simple	Complex	Fairly complex
	Applications	Many successful domestic applications	Many successful domestic applications	Many successful domestic applications

		Two-stage DTRO	UASB+SBR+CMF+RO	MBR+NF/RO
Operation management	Operational stability	Stable at early stage. Output decreases sharply at later stage	Stable	Stable
	Operation	More complex	Complex	More complex
	Maintenance	More complex	Complex	More complex
Cost	Capital cost	Very high	High	High
	Operation cost,	High	Very high	Very high
Environment	Land requirement	Small	Large	Large
	Climate condition	Operational temperature is 5-35°C	Operational temperature is 25-35°C. Might not be effective at lower temperature.	Operational temperature is 25-35°C. Might not be effective at lower temperature.
	Continuous operation	On/Off anytime.	2-3 months start-up period. Needs continuous operation	2-3 months start-up period. Needs continuous operation

403. Located in Qinghai where temperature is very low in winter, with low annual precipitation and high evaporation, the landfill leachate treatment plant will work best using a two-stage DTRO process. This process is also suitable for the local leachate characteristics, which is low volume with significant seasonal variance.

VII. PUBLIC CONSULTATION, PARTICIPATION AND INFORMATION DISCLOSURE

A. Legislative Framework for Public Consultation and Information Disclosure

404. Meaningful participation and consultation in the evaluation of project planning, feasibility study, design and implementation is an important environment safeguards requirement. It can directly reflect the public's perceptions of environmental quality in the project's area of influence.

405. Relevant provisions in the *Environmental Protection Law* of PRC and the *Regulations on the Administration of Construction Project Environmental Protection* (Order of the State Council, No. 253) require that the "Environmental Impact Report formulated by the construction unit shall be in accordance with relevant laws to solicit the opinions of units concerned and inhabitants of project construction site". In January 2011, the MEP circulated the draft *Technical Guidelines for Environmental Impact Assessment: Public Participation* for public commenting, which specifies the requirements of information disclosure and stakeholder opinion survey. Since 2012, MEP also requires that abstracts of EIRs should be posted on the websites of local EPBs during the approval process (MEP Order No. [2012]51).

406. ADB's Safeguard Policy Statement requires meaningful participation, consultation and information disclosure. The consultation processes for this project follow both the PRC and ADB requirements.

407. Information disclosure and public consultation have been conducted during preparation of the domestic EIR and TEIAs in compliance with PRC regulatory framework, and this project IEE in compliance with ADB's Safeguard Policy Statement (2009). Information disclosure and consultation included disclosure on the internet, community posting, a questionnaire survey, and discussion forums attended by affected people and other concerned stakeholders. It also included a comprehensive socio-economic survey. Consultation and information dissemination activities are presented below.

B. Information Disclosure

408. Information disclosure of project information and related environmental issues was undertaken in two stages in line with PRC regulatory framework.

409. The first public announcement of the project via district government websites, and posters on public display, occurred from October 2015 to January 2016. Disclosed information included (i) name and overview of the project; (ii) name and contact of the construction unit; (iii) name and contact information of the EIA institutes; (iv) EIA work procedures and major work contents; (v) the major proceedings to collect public opinions; and (vi) the way for the public to deliver and submit opinions. The first round disclosure was designed to solicit public comments and suggestions on the project and on the terms of reference for the domestic EIA.

410. The second public announcement was conducted prior to the submission of the domestic EIA documents to HEPB. Information included: (i) overview of the project; (ii) overview of the anticipated environmental impacts; (iii) summary of key mitigation measures; (iv) summary of key conclusions drawn in the EIA documents; (v) the major proceedings to collect public opinions; and (vi) the way for the public to deliver and submit opinions.

411. The announcement period was 10 working days for each disclosure stage. No objection to the project was received. Figure VII.1 shows one example of web-posting (for the water reuse subcomponent). Figure VII.2 shows an example of a poster for Ledu landfill expansion

subcomponent put up in potentially affected communities.

http://www.pinganhb.gov.cn/dh/xxgk/zwgk/201601/t20160105_384795.html

Figure VII.1: Information Disclosure by Posting on Ping'an HCEPB website

Figure VII.2: Information Disclosure by Community Posting

C. Socio-economic survey

412. A socio-economic survey was undertaken during project preparation. A detailed questionnaire survey was conducted in October 2015, including 250 households in 18 affected villages and communities. In addition, 30 focus group discussions were held with 200 persons including women, poor, ethnic minorities and elders to seek feedback on various components of the project. Several key informant interviews and stakeholders workshops were also held with various government bureaus to inform and consult regarding the project design and management. E.g. 73 in-depth interviews were conducted in 18 affected villages/communities, including 37 women (accounting for 50.7%), to assess peoples' attitudes to and suggestions on project design and implementation. The detailed findings of the socio-economic survey are presented in the PPTA Final Report, but key findings are highlighted here.

Table VII.1: Basic Information of the Socio-Economic Survey Samples

District	Township	Sample size	Male		Female	
			N	%	N	%
Ping'an	Ping'an Town	54	27	50.00	27	50.00
	Sanhe Town	58	28	48.28	30	51.72
	Shihuiyao Xiang	38	21	55.26	17	44.74
Ledu	Gaodian Town	15	8	53.33	7	46.67
	Gaomiao Town	11	5	45.45	6	54.55
	Hongshui Town	14	7	50.00	7	50.00
	Nianbo Town	47	25	53.19	22	46.81
	Yurun Town	13	7	53.85	6	46.15
		250	128	51.20	122	48.80

413. 30% of women and 70% of men were aware of the Project prior to the consultation process. It can be seen that women's awareness of the Project is lower than men's, and it is further learned that the female respondents who are aware of the Project mostly knew little about the Project. The vast majority of people supports the Project and expects it to be put it into operation as soon as possible to truly benefit local residents.

414. Consulted people have identified the main pollution sources of the Huangshui River as agricultural runoff, domestic waste discharge, and soil erosion. People expect that the Project will improve flood discharge capacity, ensure the safety of the embankments and local residents, reduce flood losses and waterborne diseases, and improve the living quality of people. Women also expect specific facilities be provided along river works, such as streetlamps, green belts and warning signs.

415. Consulted people expect that the landfill expansion works will improve the living environment and public health, reduce mosquitoes and flies, prevent outbreak of diseases, and facilitate resource recycling to some extent. To the question "your suggestion on the improvement of local MSW disposal", 69% and 62.5% of men and women chose "improving the MSW collection and transport system" respectively, and 18.8% and 14.6% of the women chose "expanding the landfill" and "building a new landfill" respectively, showing that women strongly expect improved MSW service coverage and quality.

416. The proposed water supply works enjoy very strong support. Only 28% of the respondents are satisfied with current water supply, and 39.7% think it necessary to improve water supply. Especially women are looking forward to improved water supply services, and expect the waterworks to secure their water supply and protect their health. Poor women expressed concern over potential water tariff increases.

417. Tibetans, as the only ethnic minority group in the direct area of influence, were consulted separately. All were of view that the Project will improve their living environment and promote their development, and all supported the Project. Minority residents expect the waterworks to improve local water supply and water quality, thereby reducing waterborne diseases. Since the waterworks will involve land acquisition, minority residents expect reasonable compensation be provided, and jobs made available to them. They expressed the need to respect local Tibetan customs during construction. In order that minority residents benefit from the Project in a culturally adaptive manner, an ethnic minority development plan (EMDP) has been prepared. The EMDP defines, amongst others, the following key protection measures to address Tibetan (and other EM) customs: Construction should be conducted in stages to avoid minority religious activities or festival (i.e., no construction allowed within 500 meters of any mosques during Friday prayer times, or during Muslim Corban, Kaizhai festivals).

418. It is estimated that the Project will generate 1,050 jobs (315 skilled and 735 unskilled) in total, in which 460 (66 skilled and 394 unskilled, including catering, retail, equipment maintenance, road cleaning, landscaping, etc.) are suitable for women and will be first made available to women, such as catering, retail, maintenance, cleaning and landscaping. In addition, 40% of these jobs will be first made available to the poor, minority residents and other vulnerable groups to increase their income.

D. EIA Questionnaire Surveys

419. In the framework of the domestic environment impact assessments and in compliance with PRC EIA requirements, the EIA institutes conducted questionnaire surveys in all project areas. These surveys were independent from the socio-economic survey, but confirmed main perceptions and priorities of project beneficiaries and potentially affected people.

420. A questionnaire survey for the Yizhou wetland subcomponent was conducted by Xining Institute of Environment Science on 7 January 2016. It surveyed potentially affected persons, including villagers from Mayi Village and Xiaoxi Village, and staff from Ping'an WWTP. 15 questionnaires were distributed and 15 were returned. The major concerns expressed by potentially affected people included dust (20%), construction noise (38%) and construction waste (22%) during construction. Major concerns during operation were solid waste (46%) and noise (32%). All respondents (100%) were supportive of the project if all mitigation measures proposed are implemented properly.

421. A questionnaire survey for the Ledu Landfill Expansion subcomponent was conducted by Anhui Siwei Environmental Engineering Company on 1-2 February 2016. A total of 100 questionnaires were distributed to affected persons in Shuimowan Village, Qilidian Village and Taomajia Village, and 99 were returned. The survey results are summarized in Table VII.3.

Table VII.2: Respondents of Questionnaire Survey for the Ledu Landfill Expansion Subcomponent

	Occupation				Education				Age			Gender	
	Farmer	Worker	Company employer	others	Primary School	Secondary School	High School	College degree or above	<35	35-50	>50	Male	Female
Number of respondents	68	22	7	2	11	56	24	8	27	60	12	58	41
Percentage (%)	69	22	7	2	11	57	24	8	27	61	12	59	41

Table VII.3: Questionnaire Results for the Ledu Landfill Expansion Subcomponent

No.	Question			
1	What do you consider as the major issue of solid waste disposal in Ledu?	Options	No. of respondents	Percentage%
		Ecological impact	3	3
		Odor	45	46
		Noise	15	15
		Wastewater	35	35
		Soil erosion	1	1
2	Do you agree with the site selection for the expansion of Ledu landfill site?	Agree	97	98
		Disagree	1	1
		Unknown	1	1
3	What do you consider as the major impacts during construction?	Ecological impact	37	38
		Waste gas	14	14
		Noise	10	10
		Wastewater	13	13

		Soil erosion	25	25
4	What do you consider as the major impacts during operation?	Ecological impact	10	10
		Odor	45	46
		Noise	5	5
		Wastewater	30	30
		Soil erosion	9	9
5	What do you consider as the major issue of the existing Ledu Landfill site?	Odor and flies	82	83
		Poor management	15	15
		Impact on landscape	2	2
6	Do you think this project will improve environment and promote ecological civilization of Ledu?	Yes	97	98
		No	2	2
		Unknown	1	1
7	What is your attitude towards this project?	Support	99	100
		Not support	0	0
		Don't mind	0	0
8	After closure, what do you think the landfill site could be used for?	Reclamation	50	51
		Greening	46	46
		Recreation	3	3

Source: Draft domestic EIA report for Ledu Landfill site extension (April 2016)

422. All respondents (100%) were supportive to the sub-component, and 98% agreed with the proposed site selection for expansion, while one respondent disagreed. Total of 98% consulted APs believe this subcomponent will help improve the local environment. Total of 83% consulted APs consider odor emissions and flies as the major issues of the existing landfill site, and 46% of the respondents think odor will be the major concerns during operation.

E. EIA Discussion Forum

423. Two separate discussion forums were conducted in Ledu District and Ping'an District on 15th March 2016. The forums were facilitated by the EIA institutes and the PPTA national environmental consultant, and involved a total of 68 local stakeholders from the IAs, interested government departments, including Water Affairs Bureau, Forestry Bureau, Transportation Bureau, DRC, Housing and Construction Bureau, EPB, Land Resources Bureau, Ledu District Government Office, Civil Affairs Bureau and township directors, and village representatives. . The PMO representative introduced the project scope. The two EIA institutes explained the EIA process conducted for the various components, and informed on the findings of the domestic EIA studies, highlighting potential environmental impacts and proposed mitigation measures. The PPTA national environmental consultant explained main components of the EMP and proposed project-specific grievance redress mechanism (GRM).

424. No specific comment or concern was raised by the forum participants in Ping'an District. All participants fully supported the project. Villagers from Qilidian Village in Ledu District pointed out that odor from landfill operation was significant, especially during spring and summer. In addition, villagers expressed their concern that storm water runoff originating from the landfill site was polluted during the rainy season. The Ledu EPB officer also mentioned that complaints were received in the past that related to the landfill operation. The EIA institute explained that the project will strengthen landfill management and monitoring, and confirmed that a fully covered leachate collection and treatment facility would be installed.

Ping'an

Ledu

Figure VII.3: Discussion Forums in 15 March 2016

425. During the discussion forums, 47 questionnaires were distributed and collected to supplement the first round public consultation. All respondents (100%) showed support to the project. Specific comments from the questionnaire survey included: (i) management of Ledu landfill site should be improved during operation; (ii) solid waste management along the Huangshui riverside should be strengthened; (iii) the EPB should monitor air quality surrounding the landfill site regularly; (iv) the upstream of Fatai reservoir should be protected to ensure water quality for the water supply subcomponent. The relevant IAs and the consultants confirmed that (i) a water source protection zone at both reservoirs will be established to ensure reliable water supply; and (ii) capacity building activities on landfill operation and monitoring is covered in Output 4 of the project.

F. Future Information Disclosure and Public Consultation Program

426. **Consultation.** Meaningful consultation to safeguard the environment and local residents will continue throughout construction and operation phases. The PMO and the IAs will be responsible for organizing the public consultations, with the support of the loan implementation environmental consultant (LIEC). Civil works contractors will be required to frequently communicate and consult with the communities in the project area of influence, especially those near the project areas. Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractor, construction supervision company, IA, PMO), and the project level Grievance Redress Mechanism (GRM). Consultation will focus on public complaints about public nuisances from construction and operation activities, such as water quality, noise, asphalt fume nuisance, dust, odor, traffic disturbance.

Table VII.4: Environment Consultation and Communication Plan

Organizer	Format	Frequency	Subject	Attendees
Construction Stage				
PMO, IAs, LIEC	Public consultation & site visits	Once each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents in project areas
PMO, LIEC	Expert workshop	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinion	Experts of various sectors, District EPBs, HEPB
PMO, LIEC	Public opinion	Once at MTR stage	Public satisfaction with EMP	Residents in project areas

Organizer	Format	Frequency	Subject	Attendees
	survey		implementation	
Operational Stage				
PMO, IAs, LIEC	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents in project areas
LIEC, PMO	Public satisfaction survey	Once at PCR stage	Public satisfaction with EMP implementation. Comments and suggestions	Residents in project areas
EPB = Environmental Protection Bureau, PMO = Project management office, LIEC = Loan implementation environment consultant; MTR = midterm review; PCR = project completion review.				

427. **Disclosure.** The project's environmental information will be disclosed by the Haidong Municipal EPB and ADB as follows:

a. Abstracts of the domestic EIA report (for the Ledu landfill extension) and the EIA Tables (in Chinese) were disclosed on the local governments' websites before approval by the Haidong Municipal EPB; copies of the domestic assessments are available on request in the PMO;
b. The project IEE will be disclosed on the project website at www.adb.org;
c. All environmental monitoring reports during project implementation will be available at www.adb.org;
d. Environmental acceptance inspection reports will be disclosed on the website of the Haidong Municipal EPB.

376. **Community involvement.** Under the EMDP, six Community Environment Supervision and Education team (CEST) will be established as pilot for three years to (a) develop and implement public awareness and education programs on environment management, forest protection and maintenance, SW recycling and water saving to promote changes of public behavior.

VIII. CONCLUSION

427. This initial environmental examination (IEE) including environmental management plan (EMP) was prepared in compliance with ADB's Safeguard Policy Statement (2009). The IEE incorporates findings of the domestic feasibility studies, domestic environmental impact assessments (EIAs), and soil erosion protection plans (SEPPs) prepared by licensed domestic design institutes[20], and topical studies conducted in the framework of the PPTA (including biodiversity and habitat survey along the Huangshui river, a comprehensive climate risk and vulnerability assessment, water resources assessments, and others). The domestic safeguards documents were prepared in compliance with the PRC Law on Environmental Impact Assessment (2003), the Technical Guidelines for Environmental Impact Assessment (HJ/T2-93) and other relevant PRC regulations and guidelines. All domestic EIAs and SEPPs have been approved by the Haidong environment protection and water resources management authorities. The IEE concludes that the project will have significant environment benefits, and that adverse environmental impacts will not be unprecedented and be of temporary nature. The IEE's findings have been incorporated in the EMP as mitigation and management measures to be implemented during the project. They will form part of the contractual obligations with IAs and contractors for construction and with operating units for operation of components. The IEE confirms project classification of category B for environmental safeguards. Major findings are presented below.

Environmental benefits

428. The project components will have quantifiable and non-quantifiable benefits, including avoided flood damage, increased forest cover and landscaping to maintain soil and water resources balance, ecotourism and environmental education, improved irrigation and avoided water scarcity, sustainable rural and urban water supplies, improved sanitation and cleaner environment and reduced health risks.

429. The **river rehabilitation and riverside greenbelt** sub-components will provide protection against floods up to a minimum 30-year return period for an estimated 380 ha. Soil erosion will be reduced based on soil conservation at a yearly rate of 30 tons per ha for the greenbelt areas of 71.2 ha, totaling 2,136 tons/year.

430. The **Yizhou wetland** sub-component will provide regulating services (including flood water storage, water treatment, micro-climate regulation), supporting services (biodiversity maintenance by providing resting, nesting, feeding and breeding habitats for wildlife), and cultural services (including research, education and recreation). The water treatment function of the wetland will reduce emissions of TP by 0.648 tons, TN by 4.86 tons, COD by 23.43 tons and ammonia by 2.025 tons annually.

431. The **soil erosion control and water reclamation** sub-component will result in soil and water conservation benefits by increasing the mountain border protection forest coverage, and by increasing the water storage capacity of mountain land. The mountain edge shelterbelt will reduce soil erosion from those localities by 3,141 tons per year and the South Mountain planted forest by 19,890 tons/yr. The reuse of treated wastewater will provide a new irrigation source, diversifying the city's water resources. The South Mountain forest will also help control urban sprawl.

[20] All domestic EIAs were approved by the Haidong Environment Protection Bureau (HEPB) in April 2016.

432. The **rural water supply** sub-component will increase water security for communities in the Qijiachuan valley for both domestic use and livestock. It will enable users to increase consumption levels, with health benefits from improved hygiene and livelihood benefits.

433. The **urban solid waste infrastructure sub-component** will increase landfill disposal capacity and result in environmental protection that prevents threats to public health. The project will correct poor design and management at the landfill to stop the decline in local environmental values, with special threats to the quality of groundwater and soil resources.

Environmental Impacts and Mitigation Measures

434. **Land and vegetation affected by the project.** Total loss of remnant natural vegetation is low. This is because only 17% of the affected length of the left bank and 11% of the right bank of the Huangshui River has any form of natural regrowth or wetland. The least disturbed parts of this land cover represent “modified habitat”. Marginal modified habitat is also provided by the fringing riverbank trees which border much of the riverside agriculture. Disturbed vegetation and waste ground, both characterized by scattered regrowth trees, weeds and grasses, will mainly be impacted. Land take for the WTPs at Sanhe, Wenzukou and Fatai and pipelines between them will be 10 ha, mostly agricultural and waste land. The reforestation and shelterbelts occur on currently degraded or denuded lands and will result in net increases in naturally vegetated areas.

435. **Anticipated impacts and mitigation measures during construction.** Potential impacts during construction have been identified in the consolidated project IEE. Impact assessment for all project activities covered the following issues: (i) earthworks; (ii) soil erosion; (iii) dust and gaseous air pollution; (iv) noise; (v) construction wastewater; (vi) loss of terrestrial and aquatic habitat; (vii) risk of introducing invasive species; (viii) impacts from pipe-laying; (ix) temporary traffic management; (x) hazardous and polluting materials; and (xi) worker and community health and safety. For each, the severity of potential impact has been assessed in relation to the baseline environment and sensitive receptors which might be adversely affected. The main findings of the IEE are that construction will cause no loss of valuable ecology or physical cultural resources, and that construction dust, noise, erosion and local disruption to traffic and communities will be temporary and can be successfully managed. No terrestrial or aquatic species recorded in PPTA surveys or the domestic environmental assessments is on the PRC local or provincial lists for protected species, nor are they species of concern in IUCN lists. Avoidance of construction related impact through design and site management and mitigation measures through construction management have been identified for each impact and these are listed in the project EMP for the attention of contractors and the IAs. In all cases, where the EMP requirements are strictly followed, construction impacts will be kept at acceptable levels.

436. **Anticipated impacts and mitigation measures during operation**. The operation of flood protection embankments along the Huangshui River will make use of design alternatives to promote the reestablishment of riverside habitats. Downstream afflux effects of flood protection works have been modelled and are minimal. The natural geographic conditions immediately downstream of the project (steep-sided valleys with no riverbank settlements for 17 km) and only small riverside settlements and limited agriculture until river reaches in Gansu Province limit the magnitude of any impact. A comprehensive flood warning and emergency plan will complete the flood protection system. Potential operational impacts arise from the risks of unsustainable water use for the range of irrigation applications (riverside greenbelts and mountain shelterbelts) and for the water supply components in the Qijiachuan valley. Water balances have been established to demonstrate sustainability for irrigation, and strict water allocations in the reservoir regulation plans will ensure water supply for target communities. A water safety plan for each water treatment plant will reinforce these outcomes. Additional

operational safeguards at the water supply WTPs focus on the safe handling of the necessary corrosive chemicals and assurances that the legislative protections given to water sources in PRC are in place and are being enforced. Landfill design, separation buffer and operational control will minimize impacts to environment and communities. The critical safeguard for the landfill site is the functioning of the leachate treatment system, methane control, and proper site management of the tip face. The leachate TP will be designed to contain leachate for periods of plant malfunction or maintenance. A methane collection system and monitoring system will be part of the detailed design. Control of noise, dust, odor, erosion and local transportation impacts are also parts of the management. The monitoring of water quality of treated wastewater from Ping'an WWTP is also required to ensure continued reuse as irrigation water.

437. **Climate risk, climate adaptation.** The project's classification as medium climate risk is confirmed. A climate risk and vulnerability assessment (CRVA) was conducted at two levels: (i) at regional level to assess the vulnerability of the Integrated Water Management Plan for the Huangshui River Basin (IWMPHRB); and (ii) at Haidong city level to assess the vulnerability of the designs of proposed project components, and the water resource management elements of the Haidong City Master Plan (HCMP). The CRVA found that (i) total water resources in Qinghai Province will not change significantly in future, but seasonal and annual variability are likely to increase; (ii) climate risks along Huangshui River are likely to increase due to increased seasonal and annual variability in precipitation and hence river flow volumes. Key recommendations of the CRVA were incorporated in the component design, including (i) increased embankment heights to accommodate projected average increase in flood flows resulting from climate change (8%); (ii) provision of alternative water supply source for the Ping'an urban district to reduce increasing water security risk; and (iii) increased capacity of drainage and leachate collection system at landfill site. A capacity development sub-module for climate-resilient urban development planning and regional water resources management has been included to component 4 of the project. The sub-module will be coordinated and provided by climate change and water resources management specialists. They will, amongst others, help the HMG reviewing and climate-proofing the HCMP, and assess the feasibility to establish a provincial-level Huangshui River coordination body to address Huangshui water resources management issues at watershed level.

438. **Greenhouse gas emissions.** The project will generate greenhouse gas (GHG) emissions in a number of ways, including use of fossil fuels and electricity for machinery and vehicles, emissions from constructed wetlands and emissions from landfill decomposition. The project construction phase is unlikely to produce large GHG emissions because existing construction equipment will be used and diverted to the current project (and therefore unlikely to result in large new GHG emissions in the context of existing city developments). The main generation of GHGs from the project will be from the operation of the wetland and landfill components. The indirect generation of GHG from power consumption for operational machinery (mainly pumps) will be a minor contribution. By the fifth full year of operations wetland and landfill will generate 51,000 and 20,000 t/yr CO_{2e} respectively, before emission savings measures are taken into consideration. At the same time, the large areas of greenbelt and shelterbelt plantations established by the project will significantly offset these emission levels through carbon sequestration. It is estimated that by year 10 after project commissioning cumulative carbon storage will be 35,000 t CO_{2e} (increasing to 220,000 t CO_{2e} at year 20) with a long term sequestration rate of 22,000 t/yr CO_{2e}. Aggregated CO_{2e} emissions are estimated at 16,000 t/yr CO_{2e} during project operation.

Environmental management plan (EMP)

439. The responsibilities for environmental management and supervision during the various stages of implementation of the project are defined in the EMP. The EMP will be implemented in all phases of the project—design, pre-construction, construction, and operation. The EMP

defines: (i) objectives; (ii) roles and responsibilities; (iii) mitigation measures; (iv) inspection, monitoring, and reporting arrangements; (v) training and institutional strengthening; (vi) GRM; and (vii) future public consultation. The EMP will be updated at the end of the detailed design, and included as a separate annex in all bidding and contract documents. The contractors will be made aware (through the PMO and the tendering agency) of their obligations to implement the EMP and to budget EMP implementation costs in their proposals. HMG (through the PMO) and the five implementing agencies will assume overall responsibility for implementing, supervising, monitoring and reporting on the EMP.

440. **Monitoring.** Environment safeguards monitoring obligations are defined in the EMP and include (i) project readiness monitoring, to be conducted by the PMO-ES and LIEC; (ii) internal monitoring, to be conducted by the CSCs and contractors; (iii) external environment monitoring, to be conducted by the Haidong EMS (contracted by the IAs); (iv) EMP compliance monitoring during project implementation and the first year of project operation (or up to the date as further to be agreed with the ADB mission), to be conducted by the PMO-ES and LIEC; and (iv) regular monitoring by O&M units during operation of the project facilities under their responsibility.

441. **Capacity building, institutional strengthening.** The capacity of the PMO, the IAs, contractors and construction supervision companies to implement the EMP, as well as the capacity of the O&M unit to manage project facilities, will be strengthened through capacity building and training activities defined under project component 4 (Capacity building). The PMO and the IAs will assign qualified environmental engineers to coordinate and monitor EMP implementation. These will be supported by environment management and sector specialists contracted by the PMO.

442. **Consultation, Grievance Redress Mechanism.** Information disclosure and public consultation have been conducted during preparation of the domestic EIR and TEIAs in compliance with PRC regulatory framework, and this project IEE in compliance with ADB's Safeguard Policy Statement (2009). Information disclosure and consultation included disclosure on the internet, community posting, a questionnaire survey, and discussion forums attended by affected people and other concerned stakeholders. The vast majority of people supports the Project and expects it to be put it into operation as soon as possible to truly benefit local residents. People expect that the Project will improve flood discharge capacity, ensure the safety of the embankments and local residents, reduce flood losses and waterborne diseases, and improve the living quality of people. Especially the proposed water supply works enjoy very strong support, with over 70% of respondents expressing their discontent with current water supply services. With regard to environmental impacts, the major concerns expressed by potentially affected people included dust (20%), construction noise (38%) and construction waste (22%) during construction. Major concerns during operation were solid waste (46%) and noise (32%). All respondents (100%) were supportive of the project if all mitigation measures proposed are implemented properly.

443. A plan for public consultation during construction and the initial phase of project operation has been developed and included in the EMP. The PMO and the IAs will be responsible for organizing the public consultations, with the support of the loan implementation environmental consultant (LIEC). Eye-catching public notice boards will be set at each work site to provide information on the purpose of the project activity, the duration of disturbance, the responsible entities on-site (contractor, construction supervision company, IA, PMO), and the project level Grievance Redress Mechanism (GRM).

Conclusion

444. It is concluded that full and effective implementation of the safeguard measures described in this EIA will combine to minimize adverse environmental impacts of the project, and

contribute to the project achieving its goal. The EMP and legal assurances to be defined in the project and loan agreement will ensure that these measures are implemented in an appropriate institutional framework and are supported through comprehensive training, monitoring and reporting arrangements. The IEE concludes that the Project is feasible from an environmental safeguards point of view.

ATTACHMENT 1. ENVIRONMENTAL MANAGEMENT PLAN

ENVIRONMENTAL MANAGEMENT PLAN FOR THE QINGHAI HAIDONG URBAN-RURAL ECO DEVELOPMENT PROJECT

Prepared by the Haidong City Government for the Asian Development Bank

Table of Contents

A. Introduction

1. This Environmental Management Plan (EMP) is for the Qinghai Haidong Urban-Rural Eco Development Project. It summarizes the potential project environmental impacts and defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. It also defines the institutional arrangements and mechanisms, roles and responsibilities of different institutions, and costs for EMP implementation. The EMP seeks to avoid, reduce, and/or mitigate adverse impacts and risks. The EMP is based on the findings of the Initial Environmental Examination (IEE) and domestic environmental assessment reports.

2. The IEE and EMP have been disclosed on the ADB public website (www.adb.org) since 15 June 2016 and are also included in the Project Administration Manual (PAM). The EMP will be included as a separate annex in all bidding and contract documents. The contractors will be informed of their obligations to implement the EMP, and to provide for EMP implementation costs in their bids for project works.

3. The EMP includes a monitoring program. Monitoring results will be used to evaluate: (i) the extent and severity of actual environmental impacts against the predicted impacts; (ii) the performance of the environmental protection measures and compliance with relevant laws and regulations; (iii) trends of impacts; and (iv) overall effectiveness of the EMP.

4. The EMP also defines (i) reporting requirements (Section E); (ii) EMP-related training requirements (Section F); (iii) the project level grievance redress mechanism (GRM) and public consultation requirements during project implementation (Section G); and (vi) cost estimates for EMP implementation (Section H).

B. Institutional Arrangements and Responsibilities for EMP Implementation

5. The agencies involved in the project and their responsibilities for the environmental management of the project are set out in Table A1.1.

Table A1.1: Institutional Responsibilities for EMP implementation

Agency	Environmental Management Roles and Responsibilities
Executing Agency (EA): Haidong City Government (HCG)	• Coordination with District governments • Provide overall guidance, coordination, supervision, and management for the project preparation and implementation • Responsible for providing counterpart funds
PLG (Project Leading Group): Headed by the Deputy Mayor of Haidong City and includes representatives from relevant government departments	• Provide policy guidance during implementation; and facilitate interagency coordination and coordinate with other involved parties.
Haidong project management office (PMO): With Haidong City Finance Bureau (HCFB)	• Provide oversight and daily management of the project preparation and implementation; • Assign PMO environment specialist (PMO-ES) and PMO social officer; • Direct project preparation and implementation activities; • Engage project implementation consultants, including loan implementation environment consultant (LIEC), and other relevant specialists; • Update the EMP after detailed design and ensure its effective

Agency	Environmental Management Roles and Responsibilities
	implementation; • Arrange field visits to contractors prior to their site specific EMP preparation; • Review and approve site-EMPs developed by contractors, supervise their environmental activities and compliance with the site-EMP; • Establish and coordinate GRM; • Coordinate training and capacity development activities; • Establish PPMS to monitor project progress, including regular monitoring of physical and financial progress, and safeguards compliance; • Prepare and submit (a) annual project progress reports, (b) annual environmental safeguard monitoring progress reports, (c) annual audit reports, (d) annual consolidated project financial statement, and (e) mid-term and project completion reports to ADB and HCG with assistance from the project implementation consultant; • Ensure project implementation compliance with loan agreement and project agreement;
Implementing Agencies (IAs): a. Ledu Housing, Planning, and Construction Bureau b. Ledu Water Affairs Bureau c. Ping'an Housing, Planning and Construction Bureau d. Ping'an Forestry Resource Bureau e. Ping'an Water Affairs Bureau.	• Implement project components in their jurisdiction, including finance and administration, technical and procurement matters, monitoring and evaluation, and safeguard compliance; • Coordinate with the PMO for project management and implementation; • Appoint one environment specialist as EMP coordinator; • Incorporate EMP into bidding documents; • Supervise and monitor EMP implementation and semi-annual reporting to the PMO (with support of LIEC); • Contract local EMS to conduct environmental monitoring; • Contract construction supervision company (CSC) for construction supervision and quality control; • Coordinate commissioning of completed facilities, including environmental and safety acceptance audits, as needed.
Project Facility Operators (PFOs):	• With the implementing agencies, commission the constructed facilities; • Operate and maintain completed facilities, including environmental management, monitoring, and reporting responsibilities

ADB = Asian Development Bank, EMP = environmental management plan, EMS = environmental monitoring stations, GRM = grievance redress mechanism, LIEC = loan implementation environment consultant, PMO = project management office

6. The entities with direct and daily responsibilities under the EMP are the PMO and its Environment Specialist (PMO-ES); the IAs and their Environment Specialist (IA-ES); the local Environmental Monitoring Station (EMS); the Loan Implementation Consultants (LIC) including the Loan Implementation Environment Consultant (LIEC); contractors; and the Construction Supervision Companies hired by the IAs.

7. **PMO, PMO Environment Specialist (PMO-ES).** The PMO has established the position of a PMO Environment Officer to coordinate EMP implementation. The terms of reference for this position are in **Annex A**. The PMO, through the PMO Environment Specialist (PMO-ES) and

in coordination with the Loan Implementation Environmental Consultant (LIEC, see below), will do the following.

(i) Update the EMP after detailed design and ensure its effective implementation;

(ii) Ensure that the five implementing agencies (see below) understand their roles for EMP implementation and allocate adequate budgets;

(iii) Prepare selection criteria for the project bidding procedures to ensure the EMP is included in tenders by the PMO and bids by applicants. These criteria will include clear directions for bidders on how to include actions and budgets for the EMP in their bids, enabling fair and transparent comparison between bids;

(iv) Review tenders for conformance with selection criteria for EMP implementation;

(v) With the assistance of a contracted Tendering Agency, prepare clauses to be included in the contractual terms and conditions for contractors to ensure full and effective implementation of the EMP;

(vi) Prior to first civil works, and regularly thereafter, assess project readiness of PMO, IAs and contractors based on indicators defined in Section D;

(vii) Arrange field visits to contractors prior to their site specific EMP preparation;

(viii) Review and approve site-EMPs developed by contractors, supervise their environmental activities and compliance with the site-EMP;

(ix) Monitor the progress of all agencies for EMP implementation;

(x) Implement and coordinate the Grievance Redress Mechanism (Section G);

(xi) Prepare and submit annual environmental monitoring reports (EMR), as well as environment appendixes to Midterm Report and Project Completion Report to ADB;

8. **Implementing Agencies (IAs).** The five IAs will implement project components, administer and monitor contractors and suppliers, and be responsible for construction supervision and quality control at each subproject site. Implementing departments within the bureaus have been set up, including administration, engineering, safeguards, planning and financing and information management divisions. These departments worked with the PPTA consultants and design institutes during loan processing and will work with the PMO and Loan Implementation Consultant during loan implementation. Each IA has assigned an Environment Specialist (IA-ES) to work with their PMO counterpart.

9. **Environmental Monitoring Station (EMS).** In Haidong, the EMS of the City Environment Protection Bureau (EPB) will be contracted by the IAs to implement the external environmental monitoring program described in this EMP (Section E). The PMO-ES will supervise this monitoring. The EMS will report to the local EPB and the PMO.

10. **Loan Implementation Environment Consultant (LIEC).** LIEC will be hired under the loan implementation consultancy services. The LIEC will be international national environmental specialists. The terms of reference for the LIEC are in **Annex B**. The LIEC is essential to completion of environmental pre-construction activities and should be recruited as soon as possible after loan effectiveness. The LIEC will assist the PMO-ES with the following:

- Assist the PMO and IAs to integrate the EMP mitigation and management measures into construction contracts and arrangements;

- Ensure that relevant sections of the project EMP are incorporated in the construction contract documents;
- Assist the PMO to establish and publicize the grievance redress mechanism (GRM);
- Develop procedures to (i) monitor and report on the EMP implementation progress; and (ii) record and collate complaints and resolution under the GRM;
- Provide support and training to PMO, IAs, CSCs and contractors on the specific requirements of the EMP as required;
- Assess the environmental readiness of project components prior to first civil works, and regularly thereafter, based on indicators defined in Section D;
- Conduct regular EMP compliance assessments, undertake site visits, identify any environment-related implementation issues, and propose necessary responses in corrective action plans;
- Assist PMO to prepare annual environmental monitoring progress reports for submission to ADB;

11. The loan implementation consultancy services will also include water and wastewater specialists, river ecology/hydrology specialists, and ecology experts. In addition, separate contracts will be awarded to consulting firms specialised in municipal waste management (including landfill O&M); wetland O&M; forest management (including irrigation); and climate adaptation. The specialists will assist in the detailed design, construction and initial operation of project facilities components and TORs for the positions are defined in the Project Administration Manual (PAM).

12. **Construction Contractors, Construction Supervision Companies (CSC)**. Construction contractors, CSCs contracted by the AIs will be responsible for the daily inspection, monitoring, and evaluation of the implementation of mitigation measures. Construction contractors will be responsible for implementing the mitigation measures during construction under supervision of the IA-ES and the PMO-ES. In their bids, contractors will be required to respond to the environmental management requirements defined in the EMP. Each contractor will be required to develop site-specific EMPs and will assign a person responsible for environment, health and safety (Onsite environment engineer, OEE). After project completion, environmental management responsibilities will be handed over to Project Facility Operators (PFOs). During the operational phase, the IAs and the Haidong EPB will supervise the environmental management and implementation of mitigation measures by the subproject PFOs. The cost of mitigation measures in this phase will be borne by the relevant OEs, which have been identified for each project component.

C. Summary of Potential Impacts and Mitigation Measures

13. Potential environmental issues and impacts during the project pre-construction, construction and operation phases, and corresponding mitigation measures, are summarized in Table A1.2. These measures were developed jointly by the PMO, local design institute (LDI), EIA Institute and PPTA team during the project preparation phase. The domestic EIA provided a list and costs for mitigation and environmental measures, and these have been adapted to the more detailed itemization included in Table A1.2. The costs total for mitigation and management measures have been derived by the PPTA team and approved by the PMO.

Table A1.2: Summary of Potential Impacts and Mitigation Measures

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
Pre-construction						
1.1 Design stage	Detailed design (embankments, landscaping, WTPs and landfill)	i. Finalize detailed designs for all infrastructure. ii. Include habitat features for aquatic and riverside flora, fauna and wetland birds in the design of embankments and landscaping iii. Include all agreed climate change adaptation design measures in final design, including: • Height increase adjustment to selected embankments of an average of 8cm to accommodate projected increase in flood volumes • Stormwater interception drainage increased by 10% • Use of drought tolerant species as core areas of mountain edge shelterbelts	IAs, LDI	PMO	Included in LDI contract	Included in LDI contract
			Wetland and riparian experts, various LIC experts (CS01)	PMO	included in CS01 contract	included in CS01 contract
	Water demand/supply for South Mountain to match sustainable WWTP discharge	Confirm short-term seasonal discharge rate of treated wastewater from Ping'an WWTP and define, through water demand calculations, the optimum area of landscaping which can be irrigated.	IA, LDI, Afforestation and wastewater specialists of LIC	PMO	Included in LDI contract and CS01 contract	-
	Confirm seasonal water availability for irrigation	For mountain edge shelterbelts, undertake seasonal water balances to ensure that there is sustainable water supply, taking into account the CRVA finding of future water scarcity.	IA, LDI, Afforestation specialist of LIC	PMO	Included in LDI contract and CS01	-
	Ledu Landfill Zones 1&2 due diligence (groundwater contamination risk)	Detection and analysis of groundwater quality under and immediately downstream is needed to complete due diligence of Ledu Landfill Zones 1&2. The monitoring plan at Table A1.4 requires sampling in June-September to establish baseline groundwater quality. Groundwater quality will be used to design remedial actions for zones 1 & 2, if needed. Remedial actions will be implemented during the initial stages of the development of zones 3 and 4 of the landfill.	IA, LDI	PMO	-	Included in LDI contract
	Water Safety Plan	For the Fatai, Wenkuzhou and Sanhe WTPs, prepare a Water Safety Plan in compliance with WHO guidelines to ensure water quality at all stages of conveyancing and distribution.	IA, LDI	PMO, LIEC	-	60
	Resettlement Plans (RP)	Update RPs for each project output to required ADB and PRC standards. i. Establish a resettlement office comprising local government officials to manage the resettlement process.	PMO, IAs	External Resettlement Monitor	Included in the RP (financed by	Included in the RP (financed by

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		ii. Conduct community consultation programs and ensure information is disseminated about entitlement based on the Land Administration Law. iii. Ensure that all relocation and resettlement activities are completed before construction starts on any subproject.		CS02)	HCG)	HCG)
1.2 Implementation Support	Establish implementation support positions	Contract a Loan Implementation Environmental Consultant (LIEC), wetland and river ecology specialists, and various sectorial specialists (water and wastewater, solid waste)	PMO	ADB	Included in loan cost (CS01)	Included in loan cost (CS01)
		Contract a Tendering Agency to ensure that the provisions of this EMP are included in bidding documents.	PMO	ADB	10	10
		Contract Environmental Monitoring Station for external monitoring of construction and operations.	IAs	LIEC, PMO	660 (see Table A1.4 for breakdown)	330 (see Table A1.4 for breakdown)
	Establish environmental staff positions at different levels of supervision	i. Appoint PMO Environment Specialist (PMO-ES) ii. Appoint IA Environment Specialists (IA-ES) in the five IAs	PMO, IAs	PMO, LIEC	PMO and IA in-kind support	PMO and IA in-kind support
1.3 Construction Preparation Stage	Update EMP	Review EMP to assess if the current mitigation measures need to be updated due to any changes in the final engineering design. For changes in project locations, sites, or other changes that may cause new or greater environmental impacts or involve additional affected people: the PMO will conduct additional environmental assessment and public consultation. The revised environmental assessment reports will be submitted to the PMO, EPB and ADB for approval and disclosure.	PMO-ES, IAs-ES, LIEC	PMO, ADB,	PMO in-kind support, included in loan cost (CS01)	PMO in-kind support, included in loan cost (CS01)
	Contract documents	i. Prepare and include clauses referencing this EMP in the terms of reference for bidders for construction contracts. ii. Prepare environmental contract clauses for contractors, especially the EMP and monitoring plan.	IAs with LDI and Tendering Agency	PMO-ES, LIEC	LDI contract	LDI contract
	Grievance Redress Mechanism (GRM)	i. Implement the GRM described in this EMP. ii. Establish complaints recording procedures within PMO. iii. Publicize GRM at all construction sites.	PMO-ES, LIEC	ADB, PMO	15	5
	Construction site planning	i. Prepare Site-specific EMP (SEMP), including health and safety plan (See IEE-Section VI.D.1). ii. Assign onsite environment engineer, OEE iii. IAs and PMO review and approve each SEMSP	Contractors	IAs-ES, PMO-ES	Included in construction contracts	Included in construction contracts
	Environmental Protection Training	Provide training on implementation of this EMP to all relevant agencies, especially the IAs and contractors (see Table A1.7 for details). Includes training in GRM and environmental protection and monitoring.	LIEC, PMO-ES, Haidong EPB	PMO, ADB	42	42

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
Construction Phase						
2.1 Water	Domestic wastewater from construction sites	Contractor to provide portable toilets at construction sites. Toilets to be emptied regularly and sewage transported to WWTP.	Contractors	CSC, IAs, PMO	60	20
	Construction wastewater (washing aggregates, pouring / curing concrete, machinery repairs) is managed	Site planning, management and safeguards (in the SEMP to include: i. Interception of all construction wastewater and site runoff water ii. Sediment from construction wastewater and site runoff water to be separated in sedimentation traps before discharge of water iii. Sediment to be disposed at landfill iv. Site runoff water containing hazardous and harmful materials (see below) to be treated separately from site runoff.	Contractors	CSC, IAs, PMO	200	120
	Handling of hazardous and harmful materials	Site planning, management and safeguards (in the SEMP) to include: i. Storage facilities for fuels, oil, and other hazardous materials within secured areas on impermeable surfaces, and provided with bunds and cleanup installations; ii. Fuel supplier is properly licensed and follows the proper protocol for transferring fuel, and complies with JT 3145-88 (Transportation, Loading and Unloading of Dangerous or Harmful Goods). iii. Vehicles and equipment are properly parked in designated areas to prevent contamination of soil and surface water. iv. Vehicle, machinery, and equipment maintenance and refueling are carried out so that spilled materials do not seep into the soil or into water bodies. v. Fuel storage and refilling areas are located at least 300 m from stormwater drains, Huangshui River and its tributaries. vi. Oil traps for service areas, and parking areas.	Contractors	CSC, IAs, PMO	140	70
2.2 Air	Generation of dust by construction activities	i. Transport containers and vehicles carrying soil, sand or other fine materials to and from the sites must be covered. ii. Materials storage and stockpile sites are covered or sprayed with water. iii. Water is sprayed on bare earth surfaces at construction sites and access roads twice daily. iv. All roads and tracks used by vehicles of the contractors or any subcontractors or supplier are kept clean and clear of all dust, mud, or extraneous materials dropped by vehicles.	Contractors	CSC, IAs, EMS	200	100
	Air emission from vehicles and equipment	i. Equipment and machinery is maintained to a high standard to ensure efficient running and fuel-burning. ii. Avoid leaving machinery running or trucks and other vehicles idling when not in use; iii. A regular inspection and certification system for equipment and machinery is	Contractors	CSC, IAs, EMS	15	10

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		initiated.				
2.3 Noise and Vibration	Noise from vehicles and construction machinery	i. Noise levels from equipment and machinery conform to PRC standard GB12523-2011. ii. Install portable noise shields near sensitive receptors listed in Table V.10 of the IEE. iii. When work is planned near sensitive receptors, residents will be notified by the IA and/or contractors and any site-specific concerns or working arrangements addressed. iv. Prohibit noise-generating construction work between 2000 and 0600 hours. v. Avoid minority religious activities or festivals (i.e., no construction allowed within 500 meters of any mosques during Friday prayer times, or during Muslim Corban, Kaizhai festivals). vi. If construction noise needs to continue into the night, the contractor must first consult with the PMO, IA, and local communities and obtain their agreement.	Contractors	IAs, PMO, EMS	90	30
2.4 Soil Quality	River blockage removal	Rocks, rubble and sand from slides into river will be reused as fill in embankments and greenbelt landscaping.	Contractors	CSC, IAs	Included in construction contracts	Included in construction contracts
	Wetland excavations	The soil excavated from wetland ponds and channels at the Yizhou Wetland shall only be reused on-site if it complies with Class II of Soil Environmental Quality Standard (GB15618-1995), which is the equivalent soil quality for the adjoining agricultural lands.	Contractors, IA	PMO, EMS	Included in monitoring costs (Table A1.4)	-
2.5 Soil erosion and stability	Erosion from construction sites	i. Construct interception ditches and drains to prevent runoff entering construction sites, and to divert runoff from sites to existing drainage. ii. Limit construction and material handling during periods of rains and high winds. iii. Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are going on. iv. All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites. v. Preserve existing vegetation where no construction activity is planned.	Contractors	CSC, IAs	Included in construction contracts	Included in construction contracts
	Shelterbelt establishment	On sloping lands, all preparation for plantations must be conducted according to technical specifications of soil and water conservation for sloping land set in *Soil and Water Conservation Law of PRC* (2010). In particular, soil tillage on terraces must be carried out along contours, keeping any existing vegetation between contour terraces to prevent soil erosion.	IAs, contractors	PMO	Included in construction contracts	-
	Refurbishment of existing landfill	i. Protection of spoil and old garbage stockpiling during excavation. Excavated old garbage will be deposited on a prepared clay bed and compacted, underlying soil placed on top, with clean topsoil cover. No stockpile will exceed 1 in 3 slope and will be protected by interception drains;	Contractors	CSC, IA, PMO	-	Included in construction contracts

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		ii. Geotextile or hessian matting will be laid and pegged over exposed slopes				
2.6 Solid waste	Domestic waste from construction site	i. Provide appropriate waste storage containers; ii. Trash collection bins are regularly sprayed with pesticides to reduce flies; iii. Wastes are stored away from water bodies and regularly hauled to a suitable landfill or designated dumping site.	Contractors	CSC, IAs, PMO	30	20
	Construction wastes causing adverse impacts on surrounding environments.	Construction wastes that cannot be reused will be regularly transported off-site for disposal, and not allowed to accumulate on site over long periods.	Contractors	CSC, IAs, PMO	Included in construction contracts	Included in construction contracts
2.7 Flora and Fauna	Habitat retention	Loss of existing native trees and shrubs in embankment construction will be replaced by the same species in landscaping and in habitat re-establishment in embankments. To minimize impacts on existing riverside habitats and wetlands: i. prohibit construction activities or use of noise-intensive machinery during bird migration season (end of March to end of April; mid-September to end of October); ii. prohibit construction activities at night; iii. avoid water pollution from construction spoils and oil leakage; iv. locate construction camp at least 500-m away from wetlands; v. awareness building and training of construction workers. In all cases, the taking or harming of any wildlife by construction workers will be strictly prohibited. At the construction site of the Sanhe WTP, ensure a buffer zone along creek to protect vegetation along banks.	Contractors, IAs	PMO, wetland and river ecology specialists of LIC	Included in construction contracts, CS01	Included in construction contracts, CS01
	Invasive species	Prohibit the use of any plant species classified in the PRC as weeds, as defined by the China National Invasive Plant Database (http://www.agripests.cn; 229 species) and by the Ministry of Environment Protection and Chinese Academy of Sciences (19 species).	LDI, IAs, contractors	PMO, LIEC	-	-
2.8 Social and Cultural	Traffic management – all components	A traffic control and operation plan must be prepared by the contractor in consultation with the local traffic management authority prior to any construction. The plan will include: i. Selection of haulage routes to reduce disturbance to regular traffic. ii. Trucks hauling construction material and waste to be fully covered. iii. Divert or limit construction traffic at peak traffic hours.	Contractors	CSC, PMO, local traffic police	Included in construction contracts	Included in construction contracts
	Work camp health and hygiene	i. Ensure awareness of communicable diseases for the construction work forces and nearby communities ii. Ensure construction sites, canteens, food, water and food handling, and toilets, are maintained under hygienic conditions	Contractors	CSC, IAs	10	10

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		iii. Construction site operations comply with PRC State Administration of Worker Safety Laws and Regulations.				
	Community safety (all sites)	i. At all times during construction, safe and convenient passage must be given for community vehicles, and pedestrians to and from side roads. ii. Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warnings. iii. At the end of each day, all sites and equipment will be made secure (through fencing and/or lock-down of equipment) to prevent public access.	Contractors	CSC, IAs	20	10
	Construction site safety (all sites)	i. To the furthest extent possible, protect all persons and nearby property from construction accidents. ii. Comply with all national and local safety requirements and any other measures necessary to avoid accidents. iii. Provide protective equipment and clothing (goggles, gloves, respirators, dust masks, hard hats, steel-toed boots) for construction workers and enforce their use. iv. Ensure sites and machinery are sealed or closed at night and off-limits to the general public. v. For residents next to construction (especially loud noise), ensure residents are aware of the duration and nature of works, potential hazards, and offer to provide ear plugs/dust masks/other basic safety equipment. vi. During heavy rains / emergencies, suspend all work.	Contractors	CSC, IAs	10	10
	Construction site safety (pipe-laying)	Trenches will be dug, pipes laid, and the trenches closed, in the same operation. This will ensure that open trenches are not left over an extended period to pose a safety risk or to erode and cave-in.	Contractors	CSC, IA	Included in construction contracts	-
	Cultural, physical and natural heritage protection	If a cultural artefact is unearthed, stop work and immediately report the matter to the IAs, PMO and local Cultural Relics Preservation Bureau for guidance on next steps.	Contractors	CSC, IAs, PMO	Included in construction costs	Included in construction costs
2.9 Unexpected environmental impacts		If unexpected environmental impacts occur during project construction phase, immediately inform the PMO; assess the impacts; and update the EMP	IA	PMO, LIEC	Included in construction costs	Included in construction costs
Operation Phase						
Component 1: Integrated flood plain management infrastructure for Huangshui River						
3.1 Flora and fauna	Manage the built habitats – landscaped embankments and constructed wetlands	i. Maintain the landscaping – watering, weeding, stabilizing, survival and growth of planted trees, shrubs and herbs, with replacement and corrective action as necessary. ii. Provide security and surveillance to guard against misuse, theft and littering. iii. Regularly remove litter and transport to landfill.	O&M Unit	IA, PMO	Management-included in operating costs. Monitoring- see	Management-included in operating costs. Monitoring- see

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		iv. The operating and maintenance units will provide monthly monitoring reports to the IAs and PMO on the survival and growth of planted trees, shrubs and herbs, with replacement and corrective actions as necessary. v. Establish a wetland management and monitoring system, including a wetland operations manual (supported by CS6) which will include a comprehensive biodiversity and habitat survey/monitoring program and the regulation of water flows in the wetland especially in the summer to control eutrophication and algal blooms.			Table A1.4	Table A1.4
	Plantation forest management	Shelterbelt forests will require intensive management during the establishment phase and silvicultural management later The project's capacity building and training will address proper fertilizer and pesticide use.	O&M Unit	IA, PMO	Management-included in operating costs. Monitoring- see Table A1.4	Management-included in operating costs. Monitoring- see Table A1.4
3.2 Emergency preparedness and response	Flood warning and emergency system	Review flood emergency preparedness and response system for the project area, and identify improvement opportunities.	IA, CS01 consultant	PMO, ADB	Included in project costs, CS01	Included in project costs, CS01
Output 2: Haidong Urban Catchment Soil Erosion Control Measures						
3.3 Water	Wastewater discharged without meeting relevant standard for irrigation	i. Install wastewater quality monitoring devices for real-time monitoring at Ping'an WWTP ii. Establish real-time monitoring framework	WWTP O&M Units	IA, PMO	Included in design and operating costs	
Output 3: Rural Water Supply and Urban Solid Waste Infrastructure						
Water Supply Component						
3.4 Water	Water source protection	Protection measures for the watershed of Fatai reservoir will be formally delineated for water source protection zones and the zones enforced for both Wenkuzou and Fatai. These comprise: (i) a Prohibited Zone (Grade I Zone), closest to the water source; and (ii) a Protection Zone (Grade II Zone), adjoining the Prohibited Zone.	Haidong WRB	Haidong City Government	Ongoing city government role	
3.5 Health and safety	Health and safety of WTP operating staff	i. Compulsory use of safety equipment and clothing as necessary, including shoes or boots with non-slip soles, protective and chemical resistant clothing, safety goggles; ii. Wearing of respiratory mask in the sludge dewatering and de-odor workshops and when moving and transporting sludge; iii. Posting and briefing on safety instructions for the storage, transport, handling or pouring of chemicals, and entry into confined spaces	WTP O&M Unit	IA, PMO	Included in operating costs	-
	Hazardous materials handling	i. The chlorination room and chemical storage area will be equipped with automatic alarms, which will be triggered by chlorine dioxide leakage. ii. The duty room will be equipped with gas masks, oxygen breathing apparatus	Landfill O&M Unit	IA, PMO	Included in operating costs	-

Item	Environmental Issues and Impacts	Mitigation Measure	Who Implements	Who Supervises	Cost (CNY x10^3) and Fund Source	
					Ping'an	Ledu
		and other rescue materials iii..An emergency response plan will be developed and implemented.				
Solid Waste Component						
3.6 Water	Groundwater quality (landfill)	To ensure that leachate is not penetrating into the groundwater, a monitoring program will be implemented (see details in the EMP). Continuous groundwater monitoring will be carried out during operation. Leachate holding tanks will be designed for 2 weeks' storage of leachate in the event of plant malfunction. In the event of longer malfunctions, the collected leachate will be back-pumped onto the landfill to obtain leachate volume reduction and leachate fixing.	O&M Unit	IA, PMO	-	Included in monitoring costs (Table A1.4) Included in design and operating costs
3.7 Air	Noise (landfill)	i. Scheduling working hours and transportation routes for garbage collection and disposal, avoiding urban traffic peak period and sensitive location; ii. Selecting low noise equipment and vehicles in the acquisition of machines and vehicles; and iii. Installing sound insulation at pumps and pumping stations.	O&M Unit	IA, PMO	-	Included in design and operating costs
	Fugitive garbage (landfill)	i. All haulage vehicles will be covered, and progressively enclosed as the fleet is modernized. ii. Retaining fences will be erected around the landfill site to prevent the waste from spreading during windy or rainy season.	O&M Unit	IA, PMO	-	Included in design and operating costs
	Landfill gas (CH_4)	i. Collection of methane gas from decomposing garbage will be channeled through a specially constructed gas collection system comprising gas transmitting gabions, collecting pipes and gas flaring chimneys. ii. Regular monitoring of surface concentrations of CH_4 will ensure that below 2m height above landfill work surface, the concentration of methane should not exceed 0.1%.	O&M Unit	IA, PMO	-	Included in design and operating costs
3.8 Health and safety	Odors and pests (landfill)	i. To reduce the breeding of flies, mosquitoes, rats and other vermin, and to prevent odor and wind-borne dispersal of garbage, ii. Compaction and earth covering of the active tip face or landfill cell will be undertaken daily. iii. Periodic spraying with approved pesticide will further control the breeding of flies and mosquitoes and iv. Regular rat trapping programs will be undertaken.	Landfill O&M Unit	IA, PMO	-	Included in operating costs
All Components						
3.9 Unexpected environmental impacts	All areas	If unexpected environmental impacts occur during project operations, immediately inform the PMO; assess the impacts; and update the EMP	All O&M Units	IAs, PMO	Included in operational costs	Included in operational costs

Sources: PPTA Team; Project IEE. ADB = Asian Development Bank, LDI =local design institute, EIA = Environmental Impact Assessment, EPB = Environment Protection Bureau, IA = Implementing Agency, HCG = Haidong City Government, LIEC = Loan Implementation Environmental Consultant, O&M = Operation and

maintenance, PMO = Project Management Office, RP = Resettlement Plan, SEMP = Site Environmental Management Plan, WTP = water treatment plant.

D. Project Readiness Assessment

14. Before construction, the LIEC and PMO-ES will assess each IA's readiness in terms of environmental management based on a set of indicators (Table A1.3) and report it to ADB and the PMO. This assessment will demonstrate that environmental commitments are being carried out and environmental management systems are in place before construction starts, or suggest corrective actions to ensure that all requirements are met. The assessment will be repeated at regular intervals to account for new works contracts, and documented in the annual environment monitoring reports to ADB.

Table A1.3: Project Readiness Assessment Indicators

Indicator	Criteria	Assessment
Environmental Supervision in place	LIEC is in place. Wetland and River Ecology Specialists contracted as part of LIC	Yes No
	Qualified EMS contracted by the IAs	Yes No
	Environment specialists assigned by PMO (PMO-ES) and IAs (IA-ES)	Yes No
Compliance with loan covenants and assurances	The borrower complies with loan covenants related to project design and environmental management planning	Yes No
Public involvement effectiveness	Meaningful consultation completed, construction activities publicized at construction sites	Yes No
	GRM established with entry points publicized	Yes No
Contracts with environmental safeguards	Bidding documents and contracts incorporating the environmental activities and safeguards listed as loan assurances	Yes No
Site construction planning (environmental)	Site Environmental Management Plan prepared for each work site by the contractors and cleared by the IAs	Yes No
EMP financial support	EMP budget established, and required funds set aside for EMP implementation by each IA	Yes No

EMS = Environment Monitoring Station, IA = Implementing Agency, LIC = Loan Implementation Consultant, LIEC = Loan Implementation Environment Consultant, PMO = Project Management Office.

E. Monitoring Requirements

15. Three types of project monitoring will be conducted under the EMP:

(i) Internal monitoring to be conducted by the contractors and the Construction Supervision Companies (CSCs);

(ii) External monitoring, to be conducted by the Haidong EMS, contracted by the IAs;

(iii) EMP compliance monitoring, to be conducted by the LIEC on behalf of the PMO.

16. Internal environmental monitoring includes the monitoring of air quality and noise at all construction sites as well as the quality of discharged construction wastewater, and erosion control. It also includes daily inspection and internal compliance assessment with the approved site-EMP of contractors. During operations, internal monitoring will cover the growth and survival of greenbelts, shelterbelt and wetland vegetation and the amount of habitat they provide through

fauna inventories; quality of treated wastewater from the WWTP going to irrigation; and dust, noise and rubbish containment, and site security at the landfill.

17. External monitoring covers many of the same parameters and is a verification of the internal monitoring. It also measures effects at sensitive receptors including the monitoring of noise and dust at construction sites, or surface and groundwater downstream of the landfill.

18. EMP compliance monitoring is the systematic evaluation of the overall progress of the entire EMP – see Para. 15.

19. Table A1.4 shows the environmental monitoring program designed for this project, defining the scope, location, parameter, duration and frequency, and responsible agencies, for monitoring during the construction and operational stages. Monitoring needs were identified in the environmental assessment and also reflect the requirements of national regulatory standards. Monitoring costs are estimates based on the experience of the PPTA team and PMO from other projects elsewhere in the PRC. ADB will oversee project compliance on the basis of the annual environmental monitoring reports provided by the PMO and site visits as required.

20. The results of the environmental monitoring will be compared with relevant PRC performance standards as defined in Table A1.5. Non-compliance with these standards will be highlighted in the monitoring reports. Monitoring results will be submitted to the PMO and then reported by the PMO to ADB in annual environmental monitoring reports (prepared with the support of the LIEC – Table A1.6).

Table A1.4: Environmental Monitoring Program for Project Duration

Item	Parameter	Monitoring Location	Monitoring Frequency and Duration	Who Implements	Who Supervises	Cost CNYx10^3
Pre-construction						
Soil	pH, TP, TN, Zn, Cu, Pb, Hg, As, Cd, pesticide residues	Sampling of areas proposed for excavation at Yizhou wetland	One sample per site analyzed before construction commences	IAs	PMO	50 (all Ping'an)
Ground-water	pH, COD, BOD, NH_3-N, TN, TP, E.coli, total turbidity, sulfate, chloride, Hg, Pb, Fl, Fe, Mn, Cu, Zn.	2 groundwater monitoring wells at 30m and 50 m north of leachate tank at Ledu landfill. The monitoring well shall be 30 m deep at least.	Once before detailed design is finalized for risk assessment of leakage and to establish baseline and inform remediation work for zones 1 & 2.	IA	PMO, EPB	60 (all Ledu)
Construction Stage						
Internal monitoring						
Dust and noise	TSP, L_{Aeq}	At each construction site boundary	One 24-hr continuous sampling period each week, during construction activity	CSC and contractor	IA, PMO	Included in construction cost (allow 50: 30 Ping'an

Item	Parameter	Monitoring Location	Monitoring Frequency and Duration	Who Implements	Who Supervises	Cost CNYx10^3
						and 20 Ledu)
Surface water quality	SS, petroleum products	Construction wastewater released from construction sites	Once day per week during construction activity	CSC and contractor	IA, PMO	Included in construction cost (allow 50: 30 Ping'an and 20 Ledu)
External monitoring						
Dust and noise	TSP, L_{Aeq}	At nearest sensitive receptor for each construction site; at construction site boundary	1 day (24-hr continuous sampling) per month during construction activity	EMS	PMO	360 (260 Ping'an 100 Ledu)
Surface water quality	SS, petroleum products	Selected points 200 m downstream of active riverbank constructions	2 times per week at each site during construction activity.	EMS	PMO	180 (90 Ping'an 90 Ledu)
Operational Stage						
Internal monitoring						
Dust, noise and odor	Visual inspection for dust in household areas. L_{Aeq} measure for noise and NH_3 and H_2S for odor.	At nearest sensitive receivers from landfill site.	1 day per month for first 3 years of operation.	Landfill O&M Unit	PMO, EPB	Included in O&M budget for landfill
Waste water quality	pH, COD, BOD, NH_3-N, TN, TP, E.coli,	Both influent and effluent discharge (to irrigation) of Ping'an WWTP	Continuous routine monitoring	WWTP O&M Unit	PMO EPB	Included in plant's O&M budget for WWTP
Embankment strength	Inspection of structural integrity by engineers	All riverside embankments	Monthly between June and September for first 3 years of operation	Ping'an and Ledu River Water Course Management Stations	PMO	Included in O&M budget
Built habitat quality	Re-vegetation of riverbank revetments. % cover of grasses, sedges and shrubs.	All riverside embankments	Semi-annually for first 3 years of operation.	O&M Units	PMO, EPB	Included in O&M budget

Item	Parameter	Monitoring Location	Monitoring Frequency and Duration	Who Implements	Who Supervises	Cost CNYx10^3
	Survival of greenbelt and shelterbelt plantings. % survival and replacement	All riverside greenbelts, mountain edge shelterbelts and South Mountain forest.	Semi-annually for first 3 years of operation.	O&M Unit	PMO, EPB	Included in O&M budget
Wetland habitats	Inventory of aquatic and fringing plants; Records of bird sightings and populations.	Yizhou wetland areas	Semi-annually for first 3 years of operation.	O&M Unit	PMO, EPB	Included in O&M budget
Wetland water quality	pH, DO, COD, BOD, NH_3-N, TN, TP, E.coli	Intake and outflow points of Yizhou wetland	Monthly for first 3 years of operation.	O&M Unit	PMO, EPB	Included in O&M budget
Surface water quality	pH, DO, COD, BOD, NH_3-N, TN, TP, E.coli	In Fatai and Wenkuzhou reservoirs at a point 50 m from water intake, 2 m depth.	Monthly for first 3 years of operation.	O&M Unit	PMO, EPB	Included in O&M budget
Drinking water quality	pH, DO, COD, BOD_5, N-NH_3, TP, TN, Cu, Zn, Fl, Se, Ar, Hg, Cd, Cr, Pb, SO_3, faecal coliforms, SO_4, Cl, Fe, Mn	At water outlet points at Fatai, Wenkuzhou and Sanhe WTPs	2 days per week. Ongoing monitoring.	WTP operators	PMO, EPB	Included in O&M budget
Ground-water	pH, COD, BOD, NH_3-N, TN, TP, E.coli	2 groundwater monitoring wells at 30m and 50 m north of leachate tank at Ledu landfill. The monitoring well shall be 30 m deep at least.	Monthly	Landfill operator	PMO, EPB	Included in O&M budget
Treated leachate	COD, BOD_5, NH_3-N, SS, pH.	At leachate treatment plant outlet.	Monthly	Landfill operator	PMO, EPB	Included in O&M budget
Methane emission	CH_4 level (<0.1%)	At point 1 m above the ground at the northern edge of the landfill and 200m downslope northeast of landfill.	Monthly	Landfill operator	PMO, EPB	Included in O&M budget

Item	Parameter	Monitoring Location	Monitoring Frequency and Duration	Who Implements	Who Supervises	Cost CNYx10^3
External monitoring						
Noise, dust and odor	TSP, L_{Aeq} and odor detection scale	At nearest sensitive receivers from landfill site.	2 days per month until PCR stage	EMS	PMO, EPB	120 (all Ledu)
Ground water quality	pH, COD, BOD, NH_3-N, TN, TP, E.coli, total turbidity, sulfate, chloride, Hg, Pb, Fl, Fe, Mn, Cu, Zn.	A permanent monitoring well sunk 200m downstream of landfill plus the 2 groundwater monitoring wells at 30m and 50 m north of leachate tank used for internal monitoring.	Monthly for 12 consecutive months. Monitoring can cease when 100% compliance is achieved 3 consecutive times at the same site	EMS	PMO, EPB	60 (all Ledu)
Surface water quality	pH, DO, COD，BOD, NH_3-N, TN, TP, E.coli	In Fatai and Wenkuzhou reservoirs at a point 50 m from water intake, 2 m depth.	Quarterly until PCR stage	EMS	PMO, EPB	90 (all Pin'an)
Drinking water quality	pH, DO, COD, BOD_5, N-NH_3, TP, TN, Cu, Zn, Fl, Se, Ar, Hg, Cd, Cr, Pb, SO_3, faecal coliforms, SO_4, Cl, Fe, Mn	At water outlet points at Fatai, Wenkuzhou and Sanhe WTPs		EMS	PMO, EPB	180 (all Ping'an)
Total estimated cost:						**1,200**

BOD = biological oxygen demand, COD = chemical oxygen demand, EMS = Environmental Monitoring Station; EPB = Environment protection Bureau; O&M = Operation and Maintenance; PMO = Project Management Office; IA = Implementing Agency, WTP = water treatment plant

Table A1.5: Monitoring Indicators and Applicable PRC Standards

Phase	Indicator	Standard
Preconstruction	Soil quality	Environmental Quality Standard for Soils (GB 15618-1995).
Construction	Dust and noise at construction site boundary	Construction Site Noise Limits (GB12523—1990) Emission Standard of Environmental Noise for Boundary of Construction Site (GB 12523-2011)
	Dust and noise at sensitive receptors	Ambient Air Quality Standard (GB 3095-1996) Environmental Quality of Noise Standard (GB3096-2008)
	Surface water quality	Surface Water Ambient Quality Standard (GB3838—2002)
Operation	Odor	Classification of Temporary Odor Intensity
	Noise at landfill and WTPs	Emission Standard for Industrial Enterprises Noise at Boundary (GB 12348-2008)
	Wastewater discharge from WWTP	Discharge Standard for Municipal Wastewater (CJ3082-1999)
	Surface water quality	Surface Water Ambient Quality Standard (GB3838—2002)

Phase	Indicator	Standard
	Drinking Water	National Drinking Water Quality Standard (GB 5749-2006)
	Built habitats (embankments, shelterbelts and wetlands)	Survival rate of planted vegetation >75% Comparison against baseline fauna species present (IEE)

21. **EMP compliance monitoring.** Evaluation of the compliance with the EMP will be undertaken regularly by the PMO-ES and the LIEC. The PMO-ES and the LIEC will report EMP implementation progress and compliance along with information on project implementation, environmental performance of the contractors, and environmental compliance through quarterly project progress reports and annual environmental monitoring reports (Table A.6). The LIEC will support the PMO-ES in developing the annual environmental monitoring reports (EMR). The reports will identify any environment related implementation issues and necessary corrective actions, and reflect these in a corrective action plan. Operation and performance of the project GRM, environmental institutional strengthening and training, and compliance with all covenants under the project will also be included in the report.

F. Environmental Safeguards Reporting Requirements

22. **Environmental safeguards reporting**. Environmental monitoring and inspection activities and findings shall be documented for purposes of reporting, recording, verifying, referring on and evaluating the environmental performance of the Project. The documentation shall also be used as basis in correcting and enhancing further environmental mitigation and monitoring. Annual Environmental monitoring reports (EMRs) will be reviewed and cleared by ADB and disclosed on the ADB website. Environment safeguards reporting requirements are defined below.

(i) **Monthly internal progress reports by the Contractors** during construction, submitted to the IAs. These monthly reports will include; (i) physical construction progress; (ii) mitigation measures implemented; (iii) grievances received, resolved, closed and/or directed to other mechanisms; (iv) emergencies responded to; (v) internal monitoring conducted by CSCs, and (vi) corrective actions taken.

(ii) **Quarterly progress reports by IAs.** The quarterly reports by the IAs to the PMO will include a separate section on EMP implementation progress and performance.

(iii) **Semi-annual environmental impact monitoring reports by Haidong EMS** to report on the results of external environmental monitoring as specified in the EMP. The reports will include the analysis results and assessment of compliance/non-compliance with PRC and international standards.

(iv) **Annual environment monitoring reports (EMRs) by the PMO** to be submitted to the EA and ADB to comply with environmental agreement in the loan and PRC Law on EIA. The annual EMRs will not only report on the progress and results of environmental monitoring and compliance of EMP implementation but will also briefly: (i) assess the effectiveness of instituted measures; (ii) point out violation/s, if any; (iii) assess/recommend corrective actions; and (iv) cite any coordination made for corrective actions and, if applicable, certifications for having instituted them effectively. It shall also feature possible innovative mitigation measures applied by the Contractor, Operator or affected residents themselves, and other lessons learned in EMP implementation. These will be useful in adjusting the EMP to adapt to real

ground situations. Proposed adjustments/enhancement of the EMP must have prior ADB approval.

(v) **Environmental acceptance reporting.** Following the PRC Regulation on Project Completion Environmental Audit (MEP, 2001), within three months after the completion of all project components[1], an environmental acceptance report for each shall be prepared by a licensed environmental monitoring institute. The report will be reviewed and approved by the Haidong City EPB and reported to ADB (Table A1.6). The environmental acceptance reports of the component completions will indicate the timing, extent, effectiveness of completed mitigation and of maintenance, and the needs for additional mitigation measures and monitoring during operations.

Table A1.6: Reporting Plan

Reports	From	To	Frequency
Pre-construction Phase			
Project Readiness	LIEC, PMO	ADB	1st EMR
Construction Phase			
Construction Implementation	Contractor, CSC	IAs	Monthly
Project progress reports	IAs	PMO	Quarterly
Environmental monitoring progress	EMS	EPB, PMO, IAs	Semi-annual
Environment progress and monitoring reports (EMR)	PMO	ADB	Annual
Environmental acceptance	Licensed acceptance institute	EPB	Once; within 3 months of completion of physical works
Operational Phase			
Environmental monitoring progress (until PCR is issued	EMS	EPB, PMO, IAs	Semi-annually
Environment progress and monitoring reports (EMR)	PMO	ADB	Annually
EMP implementation completion	PMO, LIEC	ADB	At PCR stage
ADB = Asian Development Bank; EPB = Environment Protection Bureau; EMS = Environmental Monitoring Station; LIEC = Loan Implementation Environment consultant; PMO = Project Management Office			

G. Training

23. The capacity of the PMO and IAs and their Environment and Social Specialists to implement this EMP will be strengthened through training. Initially the training will be in formal workshops, then will continue with on the job training by the LIEC and other specialists hired under the consulting services. The formal training will cover EMP implementation, supervision, and reporting, and the Grievance Redress Mechanism (Table A1.7). Training will be facilitated by the LIEC with the support of other experts under the loan implementation consultant services.

24. Consultant services packages under the Capacity Building component of the project will provide the specialist input to the training. Training costs listed here represent that part of the CS packages that are directly applied to achieving full implementation of the EMP provisions. Attendees from the IAs will be staff from their environmental units and supervising engineers.

[1] Except Ping'an riverside greenbelt and mountain edge shelterbelt, which is Category C under MEP 2015 guidelines for project classification.

Training of WTP and landfill operation and maintenance unit supervisors in environmental safeguards, and occupational safety will be undertaken by a contracted specialists.

Table A1.7: Training Program

Training	Attendees	Contents	Times	Total Days	No. trainees	Cost (CNY / person / day)	Total CNY
EMP implementation Part of CS1 Package	PMO, IAs, contractors	EMP roles and responsibilities, monitoring, supervision, reporting procedures, review of experience (after 12 months)	Once prior to, and once after, the first year of project implementation	4	16	600	40,000
Grievance Redress Mechanism Part of CS1 Package	PMO, IAs, contractors	Roles and responsibilities, Procedures	Once prior to, and once after, the first year of project implementation	2	16	600	20,000
Environmental protection and monitoring Part of CS1 Package	PMO, IAs, EPB	Pollution control on construction sites (air, noise, waste water, solid waste)	Once (during project implementation)	2	20	600	24,000
WTP operation safeguards Part of CS1 Package	WTP O&M supervisors	Operation of treatment processes, environmental safeguards and safety (disinfection operation)	Once (before plant commissioning)	2	10	600	12,000
Landfill operation safeguards Part of CS5 Package	Landfill O&M supervisors	Daily operation of site, environmental safeguards and security. Operation of leachate treatment plant. Use of pesticides.	Once (before commissioning)	2	10	600	12,000
Training in wetland and forest management Part of CS6 Package	Staff of O & M agency for wetland.	Training in management of wetland ecological processes and habitat protection.	Prior to Project implementation	2	5	600	6,000
	Staff of O & M agency for wetland.	Training in management of insects and diseases within the context of the creation and maintenance of valuable wetland ecosystems. Safe pesticide use as part of integrated pest management.	Prior to Project implementation	2	5	600	6,000
	Staff of O & M agency for shelterbelt and landscaping.	Training in forest management including fertilizing and insect and pest control. Safe pesticide use as part of integrated pest management.	Prior to Project implementation	2	5	600	6,000

Training	Attendees	Contents	Times	Total Days	No. trainees	Cost (CNY / person / day)	Total CNY
						Total estimated cost:	121,000

H. Grievance Redress Mechanism, Consultation

25. A Grievance Redress Mechanism (GRM) has been established as part of the project EMP to receive and manage any public environmental and/or social issues which may arise due to the Project. The PMO will ensure that potentially affected communities are informed about the GRM at an early stage of the project. During the project preparation phase, the IAs, PMO and Haidong City EPB personnel received training on the GRM from the PPTA team.

26. The PMO is the lead agency responsible for overall management, implementation, and reporting of the GRM. The PMO-ES coordinates the GRM and: (i) instructs the IAs and contractors on their responsibilities in the GRM; (ii) establishes a simple registry system, to document and track grievances received (including forms to record complaints and how they have been resolved); and (iii) reports on progress of the GRM in the annual environmental monitoring and progress reports (EMR) to ADB.

27. Each IA will assign a member of staff, who is responsible for implementation of the GRM and other relevant aspects of the EMP. This will be the IA-ES. Tasks include keeping a record of complaints. At least two months before construction commences, these contacts will be publicized at each construction site and forwarded to local village committees to ensure that entry points to the GRM are well known.

28. **GRM readiness procedures prior to start of construction**. To be successful and reduce the likelihood of public concerns, the following measures will be implemented before any construction:

1) On-site procedures: (i) all contractors and CSC staff will be briefed by the PMO-ES and IA-ES on the GRM. Contractors and workers will be instructed to be courteous to local residents and, in the event they are approached by the general public with an issue, to immediately halt their work and report the issue to the foreman; (ii) at least one sign will be erected at each construction site providing the public with updated project information (the purpose of the project activity, the duration of disturbance, the responsible entities on-site), the GRM process, and contact names and details for the GRM entry points.

2) Non-project agencies: Prior to project construction, the PMO-ES will notify all relevant agencies about the project and GRM, so that if these agencies receive complaints, they know to contact the PMO-ES and follow up as necessary. This will include, but not be limited to, the Haidong EPB, and local police.

29. The procedure and timeframe for the GRM is shown in Figure A1.1 and is as follows.

Stage 1 (maximum 10 working days): Affected persons can submit a written or oral complaint to the contractor, CSC or IA. Complaints received by any other institutions will be referred back to the IA for action. The IA will notify the PMO-ES of the complaint within two days. The PMO-ES will enter the complaint in the Complaints Register.

The contractor, in consultation with the IA, attempts to resolve the issue directly with the affected person. Within five working days of receiving the complaint, the agency will provide clear advice to the affected person on the proposed corrective action and by when it will be taken. The corrective action will be implemented not later than 10 working days from receipt of the complaint. The PMO-ES will enter the resolution in the Complaints Register.

If quick corrective action is not possible, or the IA is unsure how to proceed, or the complainant is not satisfied by the initial corrective action, then the complaint will be referred to the PMO-ES for Stage 2.

Stage 2 (maximum 5 working days): For complaints not resolved in Stage 1, Stage 2 is initiated. The PMO-ES, contractor, CSC and IA will meet with the affected person and together discuss the issue and identify possible solutions. At the meeting, a possible solution will be agreed upon. The contractor or IA, as appropriate, will implement the agreed solution and report the outcome to the PMO-ES.

Stage 3 (maximum 10 working days): If Stage 2 is unsuccessful (i.e. no solution can be identified or the affected person is not satisfied with the proposed solution) the PMO-ES will convene a multi-stakeholder meeting and involve the Project Leading Group to ensure that any needed inputs from other project agencies are coordinated. The workshop will identify a solution acceptable to all. The agreed solution will be implemented and a report on the outcome provided to the PMO and ADB.

The above steps relate to the construction phase where most complaints will be directed in the first instance to the contractor, CSC or IA. During initial operations, complaints will be received by the operations and maintenance (O&M) units of the facilities.

PMO will inform ADB of all complaints and actions under the GRM and include all relevant documents in its progress reports to ADB.

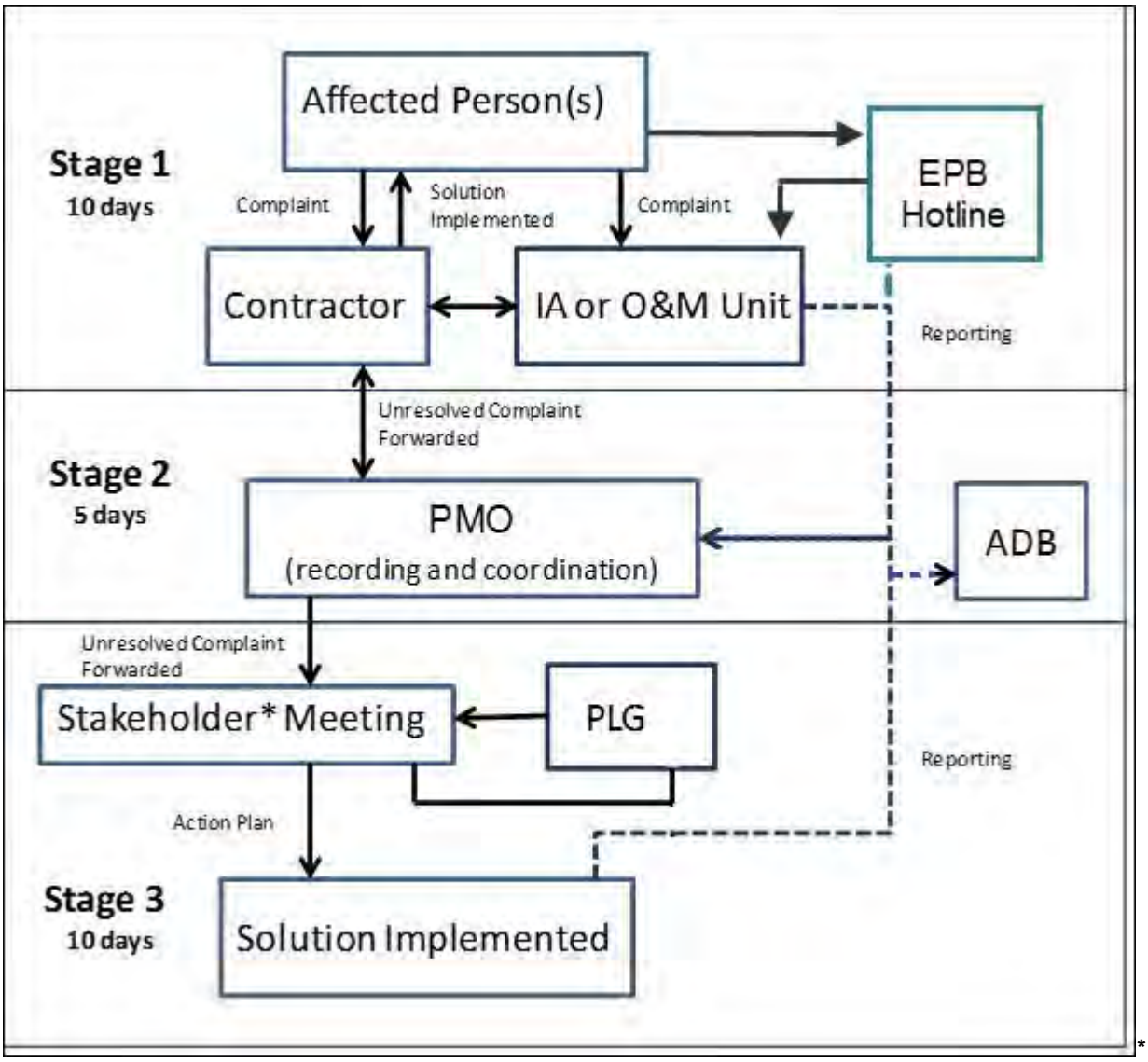
30. Any costs incurred to receive and document grievances will be paid by the PMO. The grievance procedures will remain valid throughout the duration of project construction and the first two years of project operation.

31. The tracking and documenting of grievance resolutions by the PMO will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) regular updating of the GRM database by the PMO-ES; (iii) processes for informing stakeholders about the status of a case; and (iv) a simple but effective filing system, so that data can be retrieved for reporting purposes, including reports to ADB.

32. If the above steps are unsuccessful, people adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make a good faith effort to solve their problems by working with the concerned ADB operations department (in this case, the ADB East Asia Department). Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.[2]

[2]See: www.adb.org/ accountability-mechanism

Figure A1.1: The Project Grievance Redress Mechanism



*Stakeholders involved will depend upon the nature of the complaint and will include as a minimum the affected person(s), PMO, IA (for the district), Haidong City EPB. Other stakeholder agencies relevant to particular concerns can be called upon to contribute through the PLG.

Note: AP = affected person, EPB = environmental protection bureau, O&M = operation and maintenance, PMO = project management office; IA = Implementing Agency.

33. **Consultation.** Meaningful consultation to safeguard the environment and local residents will continue throughout construction and operation phases. The PMO and the IAs will be responsible for organizing the public consultations, with the support of the loan implementation environmental consultant (LIEC). Civil works contractors will be required to frequently communicate and consult with the communities in the project area of influence, especially those near the project areas. Consultation will focus on public complaints about public nuisances from construction and operation activities, such as water quality, noise, asphalt fume nuisance, dust, odor, traffic disturbance.

Table A1.8: Environment Consultation and Communication Plan

Organizer	Format	Frequency	Subject	Attendees
Construction Phase				
PMO, IAs, LIEC	Public consultation & site visits	Once each year during construction	Adjusting of mitigation measures, if necessary; construction impact; comments and suggestions	Residents in project areas
PMO, LIEC	Expert workshop	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinion	Experts of various sectors, District EPBs, HEPB
PMO, LIEC	Public opinion survey	Once at MTR stage	Public satisfaction with EMP implementation	Residents in project areas
Operation Phase (until PRC)				
PMO, IAs, LIEC	Public consultation and site visits	Once in the first year	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Residents in project areas
LIEC, PMO	Public satisfaction survey	Once at PCR stage	Public satisfaction with EMP implementation. Comments and suggestions	Residents in project areas

I. Cost Estimates

34. This section provides an estimate of the cost of implementing the EMP. The cost comprises three categories: mitigation measures (Table A1.2); environmental monitoring (Table A1.4); and, training (Table A1.6). Refer to Tables A1.2, A1.4 and A1.6 for more details of each item. Costs are presented for the construction and operational phases of the project over five years. The costs do not include: (i) detailed design revisions and adjustments; (ii) facility operating costs (which include environmental safeguards); and (iii) the salaries of PMO environment staff. Costs for the mitigation measures are based on estimates in the domestic EIA and the experience of the PPTA team and PMO in other projects. Costs for the monitoring and training are estimates based on the experience of the PPTA team in similar projects and discussed with the PMO.

35. The total estimated cost of implementing the EMP is CNY 2.566 million over five years (Table A1.8). It is anticipated that about CNY 1.275 million (50%) will be paid through the construction contractors, CNY1.13 million (44%) paid through the IAs (mainly for external monitoring) and CNY 161,000 (6%) by the PMO. Total costs are small given the large scale of the project and when spread over five years.

Table A1.8. Estimated cost (CNY) of implementing the EMP over Five Years. See Tables A1.2, A1.4 and A1.7 for details of activities.

Item	Total cost 5 years	PMO	IAs Ping'an	IAs Ledu	Contractors Ping'an	Contractors Ledu
MITIGATION (EMP Table A1.2)						
PRE-CONSTRUCTION						
1.1 Water Safety Plan	60,000		60,000			
1.1 Tendering Agency	20,000	20,000				
1.3 GRM	20,000	20,000				
CONSTRUCTION						
2.1 Domestic wastewater	80,000				60,000	20,000
2.1 Construction wastewater	320,000				200,000	120,000
2.1 Handling materials	210,000				140,000	70,000
2.2 Dust management	300,000				200,000	100,000
2.2 Vehicle emissions	25,000				15,000	10,000
2.3 Noise and vibration	120,000				90,000	30,000
2.4 Domestic waste	50,000				30,000	20,000
2.8 Site hygiene	20,000				10,000	10,000
2.8 Community safety	30,000				20,000	10,000
2.8 Site safety	20,000				10,000	10,000
Sub-total	**1,275,000**	**40,000**	**60,000**	**0**	**775,000**	**400,000**
MONITORING (EMP Table A1.4)						
PRE-CONSTRUCTION						
Soil testing Yizhou wetland	50,000		50,000			
Groundwater testing at landfill	60,000			60,000		
CONSTRUCTION						
Internal monitoring						
Dust and noise	50,000				30,000	20,000
Water quality	50,000				30,000	20,000
External monitoring						
Dust and noise	360,000		260,000	100,000		
Water quality	180,000		90,000	90,000		
OPERATION						
External monitoring						
Noise, dust and odor (landfill)	120,000			120,000		
Groundwater (landfill)	60,000			60,000		
Water quality (reservoirs)	60,000		60,000			
Drinking water quality (WTPs)	180,000		180,000			
Sub-total	**1,170,000**	**0**	**640,000**	**430,000**	**60,000**	**40,000**
TRAINING (EMP Table A1.7)						
EMP implementation	40,000	40,000				
GRM	20,000	20,000				
Environmental monitoring	24,000	24,000				
WTP-safeguards	12,000	12,000				
Landfill - safeguards	12,000	12,000				
Wetland and forests env. management	18,000	18,000				
Sub-total	**121,000**	**121,000**	**0**	**0**	**0**	**0**
GRAND TOTAL CNY	**2,566,000**	**161,000**	**700,000**	**430,000**	**835,000**	**440,000**
Total USD (USD1=CNY6.1)	**420,656**	**26,393**	**114,754**	**70,492**	**136,885**	**72,131**
Proportion of total (%)	**100%**	**6.3**	**27.3**	**16.8**	**32.5**	**17.1**

GRM = Grievance Redress Mechanism; WTP = wastewater treatment plant.

ANNEX A. DRAFT TERMS OF REFERENCE FOR PMO ENVIRONMENT SPECIALIST (PMO-ES)

I. BACKGROUND

1. Development projects which are assisted by the Asian Development Bank (ADB) routinely require the establishment of a Project Management Office (PMO). The PMO is responsible for project implementation. Compliance with the Loan and Project Agreements includes implementation of an Environment Management Plan (EMP), which is prepared as part of the project environment impact assessment. The EMP is the critical guiding document to manage, monitor, and report upon potential project environmental impacts. Implementation of the EMP is a full-time task. For this reason, the PMO assigns a full-time officer for this role. These terms of reference describe the requirements for this officer.

II. SCOPE AND DURATION OF WORK

2. The officer will work on behalf of the PMO to implement the project EMP. The officer will report directly to the PMO. The position is for the entire project duration (five years).

III. QUALIFICATIONS

3. The officer will have: (i) an undergraduate degree or higher in environmental management or related field; (ii) at least five years of experience in environmental management, monitoring, and/or impact assessment; (iii) ability to communicate and work effectively with local communities, contractors, and government agencies; (iv) ability to analyze data and prepare technical reports; and (v) ideally, proficiency in spoken and written English.

IV. DETAILED TASKS

4. The PMO Environment Specialist will have a detailed understanding of the project EMP and supporting documents, including the domestic environmental reports, the project IEE, and project environmental assurances. The officer will have the following tasks.

(i) Assess whether the EMP requires updating due to any changes in project design which may have occurred after the EMP was prepared.

(ii) Distribute the Chinese language version of the EMP to all relevant agencies, including the implementing agencies, provincial and municipal agencies for environment protection. This should occur at least three months before construction begins.

(iii) Conduct meetings with agencies as necessary to ensure they understand their specific responsibilities described in the EMP.

(iv) Ensure that relevant mitigation, monitoring and reporting measures in the EMP are included in the bidding documents, contracts and relevant construction plans.

(v) Confirm that the Implementing Agencies (IAs) responsible for the internal environment monitoring described in the EMP understand their tasks and will implement the monitoring in a timely fashion.

(vi) At least two months before construction begins, establish and implement the project Grievance Redress Mechanism (GRM) described in the EMP. This will include: (a) prepare a simple table and budget identifying the type, number and cost of materials needed to inform local communities about the GRM and starting dates and scope of construction; (b) design, prepare and distribute these materials, and plan and conduct the community meetings; (c) prepare a form to record any public complaints; (d) prepare a summary table to record all complaints, including dates, issues, and how they were resolved; and (e) ensure that all relevant agencies, including contractors, understand their role in the GRM.

(vii) Prior to construction, ensure that IAs and their contractors have informed their personnel, including all construction workers, of the EMP requirements. This will include all mitigation measures relating to impacts to air, water, noise, soil, sensitive sites, ecological values, cultural values, worker and community health and safety, respectful behavior when communicating with local communities, and responding to and reporting any complaints.

(viii) During project construction, make regular site visits with LIEC to assess progress, meet with contractors and/or local communities, and assess compliance with the EMP.

(ix) Ensure that all relevant agencies submit required progress reports and information, including environmental monitoring and reports of any issues or grievances.

(x) Compile, review, and store environmental progress reports from the IAs, records of any grievances, and any other relevant issues. Maintain digital copies of all information. When necessary, enter data into summary tables in digital format (e.g. to transfer records of grievances from hard copy forms). Ensure that all information is stored in the PMO filing system, backed up, and can be easily retrieved.

(xi) Prepare annual environment progress reports for ADB.

(xii) Work closely with the PMO, IAs, loan implementation consultants, and other agencies and personnel as necessary to conduct these tasks.

V. REPORTING REQUIREMENTS

Annual environment monitoring reports, using the template provided by ADB or a domestic format reviewed and approved by ADB.

VI. LOGISTICAL SUPPORT PROVIDED BY PMO TO THE ENVIRONMENT OFFICER

(i) Provision of hard and soft copies of the project EMP, domestic and project environmental reports, feasibility study reports, loan and project agreements, maps, and other supporting materials as necessary to ensure the officer can implement the tasks.

(ii) Vehicle transport, office materials, and other logistical support as necessary for the officer to visit the project construction sites and local communities, arrange and conduct meetings, and prepare and distribute consultation materials.

(iii) Overall coordination, including review of the draft annual monitoring reports and final responsibility for submission of the monitoring reports to ADB.

ANNEX B. DRAFT TERMS OF REFERENCE FOR LOAN IMPLEMENTATION ENVIRONMENTAL CONSULTANT

I. BACKGROUND

1. Implementation of the Qinghai Haidong Urban-Rural Eco Development Project will be overseen and coordinated by a Project Management Office (PMO). The PMO will be assisted by a Loan Implementation Consultant team. The Loan Implementation Environmental Consultants (LIEC) will be a part of this team and will assist the PMO with implementation of the project Environmental Management Plan (EMP).

II. SCOPE AND DURATION OF WORK

2. This position could be a firm or two individuals (one international, 4 person-months; one national, 14 person-months) engaged by the PMO. It is not part of the PMO in-house environmental specialist or the implementing agencies. The specialists will report directly to the PMO. The positions are for the entire project duration (5 years). The LIEC should be recruited as soon as possible after loan affectiveness, as the first task is to confirm project environmental readiness (EMP Table A1.3).

III. QUALIFICATIONS

3. The specialists will have: (i) a Masters degree or higher in environmental management or related field; (ii) at least five years of experience in environmental management, monitoring, and/or impact assessment; (iii) familiarity with ADB project management requirements and national environmental management procedures; (iv) ability to communicate and work effectively with local communities, contractors, and government agencies; (v) ability to analyze data and prepare technical reports; and (vi) proficiency in spoken and written English.

IV. TASKS

Before construction

(i) Ensure project environmental readiness, including: (a) checklist in Table A1.3 of the EMP is achieved; (b) all contractor contracts include, and will comply with, the EMP; and (c) relevant sections of the EMP are incorporated in construction plans and contracts.
(ii) Assist the PMO to implement the GRM, including: (a) establish and publicize the GRM; and (b) collate and evaluate grievances received.
(iii) Develop procedures to: (a) monitor EMP implementation progress; (b) collate and evaluate data collected in the EMP environmental monitoring program; and (c) prepare and submit the annual environmental monitoring reports to ADB (to continue until Project Completion Report).
(iv) Undertake training of project agencies as required by the EMP training plan.
(v) Provide hands-on support and on-the-job training to the PMO, IAs and contractors on the specific requirements of the EMP as required.

During project implementation

(i) Undertake site visits to all IAs and project sites during subproject construction and operating phase.
(ii) Assist in the ongoing public consultation process as described in the project IEE (EMP Table A1.8).
(iii) Conduct EMP compliance assessments, identify any environment-related implementation issues, and propose necessary responses in corrective action plans.
(iv) Assist in training of project agencies as required by the EMP training plan (EMP Table A1.7).
(v) Assist PMO to prepare annual environmental monitoring progress reports for submission to ADB.

ANNEX C. DRAFT TERMS OF REFERENCE FOR IA ENVIRONMENT SPECIALISTS

I. BACKGROUND

Development projects which are assisted by the Asian Development Bank (ADB) require compliance with the Loan and Project Agreements. This includes implementation of an Environment Management Plan (EMP), which is prepared as part of the project environment impact assessment. The EMP is the critical guiding document to manage, monitor, and report upon potential project environmental impacts. Implementation of the EMP by each IA and their contractors requires the full time assignment of an Environmental Specialist within the construction management team of each IA. These terms of reference describe the requirements for this officer.

II. SCOPE AND DURATION OF WORK

The IA-ES will work with the PMO Environment Specialist, contractors and other relevant personal, to implement the EMP. The manager will report to IA construction manager. Duration will be for the project implementation period up to Project Completion Report stage.

III. QUALIFICATIONS

The IA-ES will have: (i) an undergraduate degree or higher in a relevant field; (ii) experience in environmental management, monitoring, and/or impact assessment; (iii) ability to communicate and work effectively with local communities, contractors, and government agencies; (iv) ability to analyze data and prepare technical reports; and (v) willingness and health to regularly visit the sub-project sites.

IV. DETAILED TASKS

Working closely with the PMO Environment Specialist, and contactors, the IA-ES will:

1. Develop a high level of familiarity with the EMP;
2. Assist the contractors to prepare Site Environmental Management Plans (SEMPs) for each major work location, which incorporates all relevant EMP provisions;
3. Assist the PMO-ES in setting up and publicizing the GRM at the local level;
4. Coordinate the receival of complaints and corrective responses at the local level for the GRM;
5. Undertake, coordinate and supervise internal monitoring as per EMP Table A1.7;
6. Receive and evaluate monthly reports of work performance from contractors;
7. Prepare environmental monitoring reports for quarterly submission to the PMO;
8. Attend training as required.

V. REPORTING REQUIREMENTS

Quarterly environmental reports to the PMO, using the template provided by ADB or a domestic format reviewed and approved by ADB.

Attachment 2: Contract Clauses Related to the Environment Management Plan (EMP)

The following contract clauses for safeguarding the environment during construction will be incorporated into all the tender documents.

General Environmental Clauses for all Bidding Documents and Contracts

Site specific environmental management plan (SEMP):

The contractor shall prepare a site-specific environmental management plan (SEMP) prior to the commencement of construction works, and shall submit the plan to the implementing agency (IA) and project management office (PMO) for review and approval. The plan shall include method statements on the implementation of pollution control and mitigation measures, adherence to energy-and resource-efficient construction practices, as well as an emergency spill contingency plan for containing and cleaning up accidental chemical spills on construction sites. The SEMP shall be updated as needed as and when environmental issues not covered by the plan arise.

Siting of construction facilities:

Locations of asphalt mixing stations and concrete batching plants shall be at least 300 m downwind of the nearest air quality and noise protection target.

Locations of borrow areas shall be at least 500 m from residential areas.

Borrow areas and spoil disposal sites with long, steep slopes, susceptible to erosion shall be avoided and shall include small level cut-off drains to break up and redirect runoff.

Access and haul roads shall be constructed at sufficient distances from residential areas, in particular, local schools, health clinics and hospitals.

Construction time:
There shall be no night time (between 22:00 and 06:00 hours) construction.

Protection of air quality

Provide dust masks to construction workers;

Build access and hauling roads at sufficient distances from residential areas, particular, from local schools and hospitals.

Assign haulage routes and schedules to avoid transport occurring in the central areas, traffic intensive areas or residential areas. For the areas with high-demand on environmental quality, transport should be arranged at night.

Spray water regularly on unpaved haul roads and access roads (at least once a day) to suppress dust; and erect hoarding around dusty activities.

Cover material stockpiles with dust shrouds or tarpaulin. For the earthwork management for backfill, measures will include surface press and periodical spraying and covering. The extra earth or dreg should be cleared from the project site in time to avoid long term stockpiling.

Minimize the storage time of construction and demolition wastes on site by regularly removing them off site.

Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of

dust emissions.

Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substance onto public roads.

Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use.

Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.

In periods of high wind, dust-generating operations shall not be permitted within 200 m of residential areas. Special precautions need to be applied in the vicinity of sensitive receptors such as schools, kindergartens and hospitals.

Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.

Protection of the acoustic environment

Noise levels from equipment and machinery shall conform to the PRC standard for Noise Limits for Construction Sites (GB12523-2011) and the WBG EHS Standards, and properly maintain machinery to minimize noise.

Equipment with high noise and high vibration shall not be used near village or township areas and only low noise machinery or the equipment with sound insulation is employed.

Temporary noise barriers or hoardings shall be installed around the equipment to shield residences when there are residences within 20 m of the noise source.

Regularly monitor noise levels at construction site boundaries. If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.

Provide the construction workers with suitable hearing protection (ear muffs) according to the worker health protection law of the PRC.

Control the speed of bulldozer, excavator, crusher and other transport vehicles travelling on site, adopt noise reduction measures on equipment, step up equipment repair and maintenance to keep them in good working condition.

Limit the speed of vehicles travelling on site (less than 8 km/h), forbid the use of horns unless absolutely necessary, minimize the use of whistles.

Maintain continual communication with the villages and communities near the construction sites, and avoid noisy construction activities during school examination periods.

Protection of water quality

Portable toilets and small package wastewater treatment plants shall be provided on construction sites for the workers and canteens; If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers.

Sedimentation tanks shall be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as polyacryl amide (PAM) will be used to facilitate sedimentation.

Construction machinery shall be repaired and washed at special repairing shops. No onsite machine repair and washing shall be allowed.

Storage facilities for fuels, oil, and other hazardous materials will be within secured areas on impermeable

surfaces, and provided with bunds and cleanup kits.

The contractors' fuel suppliers must be properly licensed, follow proper protocol for transferring fuel, and must be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88).

Material stockpiles will be protected against wind and runoff waters which might transport them to surface waters.

Spills shall be cleaned up according to PRC norms and codes within 24 hours of the occurrence, with contaminated soils and water treated according to PRC norms and codes. Records must be handed over without delay to the PMO and Haidong EPB.

All process wastewater and muddy runoff from construction sites and supernatant water from dredged sediment storage or disposal sites shall be treated to GB 8978-1996 Class I standard before discharging.

Protection of biological resources and wildlife

Preserve existing vegetation where no construction activity is planned.

Protect existing trees and grassland during construction; where a tree has to be removed or an area of grassland disturbed, replant trees and re-vegetate the area after construction

Remove trees or shrubs only as the last resort if they impinge directly on the permanent works or necessary temporary works

Construction workers are prohibited from capturing any wildlife in the project areas.

Solid waste management, earth works and soil erosion

Establish enclosed waste collection points on site, with separation of domestic waste and construction & demolition (C&D) waste.

Set up centralized domestic waste collection point and transport offsite for disposal regularly by sanitation department.

Maximize the reuse of earth cut materials and C&D waste for filling and foundations of other construction works specified by the municipal and planning departments, or transport in enclosed containers to designated C&D landfill site.

Confirm location of the borrow pit and temporary spoil storage and final disposal sites.

Develop borrow pit and spoil disposal site management and restoration plan, to be approved by responsible authority; obtain permit for the clearance of excavated earthworks

Construct intercepting ditches and drains to prevent runoff entering construction sites, and diverting runoff from sites to existing drainage.

Construct hoardings and sedimentation ponds to contain soil loss and runoff from the construction sites.

Limit construction and material handling during periods of rains and high winds

Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are going on.

Stockpiles shall be short-termed, placed in sheltered and guarded areas near the actual construction sites, covered with clean tarpaulins, and sprayed with water during dry and windy weather conditions.

All earthwork disturbance areas shall be stabilized with thatch cover within 30 days after earthworks have ceased at the sites.

Immediately restore, level and plant landscape on temporary occupied land upon completion of construction works.

Implement all soil erosion protection measures as defined in the soil and water conservation reports.

Occupational safety

A person responsible for environmental, health and safety during construction shall be appointed for the project.

Personal protective equipment (safety hats and shoes and high visibility vests) shall be provided to all construction workers.

Ear defenders for hearing protection shall be provided to workers operating and working near noisy power mechanical equipment.

Safety goggles and respiratory masks shall be provided to workers doing asphalt road paving and tunnel blasting.

Method statements shall be prepared and approvals obtained for hazardous activities such as blasting, tunnel works, excavation and working near water.

Food safety

Food hygiene in canteens on site shall be inspected and supervised regularly. Canteen workers must have valid health permits.

If food poisoning is discovered, effective control measures shall be implemented immediately to prevent it from spreading.

Disease prevention and health services

All contracted labor shall undergo a medical examination which shall form the basis of an (obligatory) health/accident insurance and welfare provisions to be included in the work contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged.

A person responsible for health and epidemic prevention and education and training on food hygiene and disease prevention shall be specified (by the IA and contractors) to raise the awareness of workers.

Induction and training by local health departments on prevention and management of communicable diseases shall be provided.

Social conflict prevention

The following shall be prioritized: (i) employ local people for works, (ii) ensure equal opportunities for women and men, (iii) pay equal wages for work of equal value, and to pay women's wages directly to them; and (iv) not employ child or forced labor.

Community health and safety

A traffic control and operation plan shall be prepared together with the local traffic police prior to any construction. The plan shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning in advance. Haulage routes and schedules shall be assigned to avoid transport occurring in the central areas, traffic intensive areas or residential areas.

Residents and businesses shall be informed in advance of the road improvement activities, given the dates and duration of expected disruption, dusty and noisy activities, and access to the grievance redress mechanism. Local communities shall be alerted of the time and location of hazardous activities such as blasting. Construction billboards, which include construction contents, schedule, responsible person and complaint hotline number, will be erected at each construction site.

Clear signs shall be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavations etc. and raising awareness on safety issues. Heavy machinery shall not be used at night, where possible, and all such equipment shall be returned to its overnight storage area/position before night. All sites shall be made secure, discouraging access by

members of the public through appropriate fencing, signage and/or security personnel, as appropriate.

Continual communication with the villages and communities along the road alignments shall be maintained and the grievance redress mechanism shall be accessible and effective.

Utility interruption

Contractors shall assess construction locations in advance and identify potential for disruption to services and risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities shall be subject to full compensation, at the full liability of the contractor who causes the problem.

If temporary disruption is unavoidable the contractor shall, in collaboration with relevant local authorities such as power company, water supply company and communication company, develop a plan to minimize the disruption and communicate the dates and duration in advance to affected persons.