Draft Environmental Impact Assessment

May 2017

People's Republic of China: Heilongjiang Green Urban and Economic Revitalization Project

Part 1

Prepared by the Heilongjiang Provincial Government for the Asian Development Bank.

Environmental Impact Assessment (DRAFT)

Project Number: PRC 49021-002
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CURRENCY EQUIVALENTS

(as of 18 May 2017, source: Bank of China)

Currency unit	-	Chinese Yuan (CNY)
CNY 1.00	=	$0.1452
$ 1.00	=	CNY 6.8866
CNY1.00		€ 0.1301
€1.00		CNY 7.6877

ABBREVIATIONS

ADB	-	Asian Development Bank
AQG	-	air quality guideline
BAC	-	biological activated carbon
BDS	-	business development services
BOD_5	-	5-day biochemical oxygen demand
C&D	-	construction and demolition
Cd	-	Cadmium
Cl-	-	Chlorides
CMIP5	-	coupled model intercomparison project 5
CNY	-	Chinese Yuan
CO	-	carbon monoxide
CO_2	-	carbon dioxide
CO_{2eq}	-	carbon dioxide equivalent
COD	-	chemical oxygen demand
CQS	-	consultants' qualification selection
CRVA	-	climate risk and vulnerability assessment
CSC	-	construction supervision company
CSO	-	combined sewer overflow
Cu	-	Copper
DEIA	-	domestic environmental impact assessment
EA	-	executing agency
EEM	-	external environmental monitor
EEP	-	ecological and environmental plan
EHS	-	environmental, health, and safety
EIA	-	environmental impact assessment
EIS	-	environmental impact statement
EIRF	-	environmental impact registration form
EIT	-	environmental impact table
EMP	-	environmental management plan
EMS	-	environmental monitoring station
EPB	-	Environmental Protection Bureau
EPL	-	environmental protection law
ES	-	Environmental Specialist
ESMS	-	environment and social management system
FIL	-	financial intermediary loan
FSR	-	feasibility study report
FYP	-	five-year plan
GDP	-	gross domestic product
GFA	-	gross floor area
GHG	-	greenhouse gas
GRM	-	grievance redress mechanism
H_2S	-	hydrogen sulphide
HADSDI	-	Heilongjiang Agricultural Development Survey and Design Institute
HDRC	-	Heilongjiang Development and Reform Commission

HEPB	-	Hegang Environmental Protection Bureau
HG	-	Hegang
HGV	-	heavy goods vehicle
HPG	-	Heilongjiang Provincial Government
HDPE	-	high density polyethylene
HXEPC	-	Heilongjiang Xingye Environmental Protection Company
I_{Mn}	-	permanganate index
IA	-	implementing agency
ICB	-	international competitive bidding
ICS	-	individual consultant system
IPCC AR5	-	intergovernmental panel on climate change fifth assessment report
ITS	-	intelligent transportation system
JEPB	-	Jixi environmental protection bureau
JX	-	Jixi
LDI	-	local design institutes
LED	-	light emitting diodes
LIEC	-	loan implementation environmental consultant
MEP	-	Ministry of Environmental Protection
MLS	-	minimum living standard
NCB	-	national competitive bidding
NH_3	-	Ammonia
NO_2	-	nitrogen dioxide
NO_x	-	nitrogen oxides
NMDIC	-	northeast municipal design institute of China
NMT	-	non-motorized transport
NRW	-	non-revenue water
O&M	-	operation and maintenance
PAA	-	poly-acryl amide
PAH	-	poly-aromatic hydrocarbons
PAM	-	project administration manual
PCCP	-	pre-stressed concrete cylinder pipe
PE	-	Polyethylene
PIU	-	project implementation unit
PLG	-	project leading group
$PM_{2.5}$	-	particulate matter with diameter $\leqslant$ 2.5 μm
PM_{10}	-	particulate matter with diameter $\leqslant$ 10 μm
PME	-	powered mechanical equipment
PMO	-	project management office
PPTA	-	project preparation technical assistance
PRC	-	People's Republic of China
PSA	-	poverty and social assessment
PVC	-	polyvinyl chloride
QEPB	-	Qitaihe Environmental Protection Bureau
QH	-	Qitaihe
QCBS	-	quality cum cost basis
REA	-	rapid environmental assessment
SCADA	-	supervisory control and data acquisition
SEPB	-	Shuangyashan Environmental Protection Bureau
SEDZ	-	Shuangyashan Economic Development Zone
SEPP	-	soil erosion protection plans
SME	-	small- and medium-sized enterprise
SMEFP	-	small- and medium-sized enterprise financial plan
SO_2	-	sulfur dioxide

SPS	-	safeguard policy statement
SS	-	suspended sediments
SY	-	Shuangyashan
TN	-	total nitrogen
TP	-	total phosphorus
TSP	-	total suspended particulate
UV	-	Ultraviolet
VAI	-	value added index
VOC	-	volatile organic compound
WBG	-	World Bank Group
WDC	-	water and drainage company
WHO	-	World Health Organization
WTP	-	water treatment plant
WWTP	-	wastewater treatment plant
Zn	-	Zinc

WEIGHTS AND MEASURES

dB	-	decibel
℃	-	degree centigrade
cm	-	centimeter
gm	-	gram
ha	-	hectare
km	-	kilometer
Km/h	-	kilometer per hour
km^2	-	square kilometer
Kwh	-	kilowatt hour
L	-	liter
m	-	meter
m/s	-	meter per second
m^2	-	square meter
m^3	-	cubic meter
m^3/d	-	cubic meter per day
mg/kg	-	milligram per kilogram
mg/L	-	milligram per liter
mm	-	millimeter
pcu	-	passenger car unit
pcu/d	-	passenger car unit per day

NOTE

In this report, "$" refers to US dollars and € refers to euro unless otherwise stated.

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I. EXECUTIVE SUMMARY

A. Introduction

1. The Heilongjiang Provincial Government (HPG), People's Republic of China (PRC), has requested the Asian Development Bank (ADB) to provide investment and technical assistance support for the Heilongjiang Green Urban and Economic Revitalization Project (the project). The project is focused on four cities in the east of the province: Hegang, Jixi, Qitaihe and Shuangyashan (the four cities) that are currently heavily dependent on coal industries. HPG is the executing agency (EA) to plan and implement the project. Each of the four cities has set up a project leading group (PLG) and project management office (PMO). The project will help the HPG improve water and environmental management in the four cities, facilitate future sustainable development, and enhance climate resilience. The project has been developed with reference to the approved Thirteenth Five-year Plans (2016–2020) (FYP) of Heilongjiang Province and the Transformation Development Planning of Coal Cities in Heilongjiang Province (2014–2020), as well as the Thirteenth Five-year Economic and Social Development Plan and City Master Plans (2010-–2020 or 2013–-2030, depending on the city) of the four cities. Under ADB's Safeguard Policy Statement (SPS, 2009) the project is classified as Category A for environment, requiring preparation of an environmental impact assessment (EIA).

2. This EIA has been prepared in accordance with SPS requirements. It is based on information from: (i) nine domestic environmental impact statements (EIS) and 22 domestic environmental impact tables (EIT) prepared by the Heilongjiang Agricultural Development Survey and Design Institute, Heilongjiang Xingye Environmental Protection Company, Heilongjiang Heida Environmental Protection Technology Company, Hebei Qizheng Environmental Science and Technology Company, Zhongye Energy Conservation and Environmental Protection Company, and Heilongjiang Yipu Environmental Protection Technology Company; (ii) a feasibility study report (FSR) prepared by North China Municipal Design Institute and Northeast Municipal Design Institute of China; and (iii) Site visits conducted between August 2016 and April 2017; and environmental, social, climate risk and vulnerability and economic assessments prepared by a consultant team for the project preparatory technical assistance (PPTA), in cooperation with provincial and local governments.

B. Background

3. The four cities covered by this project are located in the eastern part of Heilongjiang province, covering the most northeastern part of the PRC. The four cities have a combined area of 66,155 km^2, accounting for 14.6% of the total area of the province.

4. The East Heilongjiang sub-region including the four cities have been an important coal base for the entire PRC, delivering a cumulative total of more than 3.2 billion tons of coal to industry and power stations throughout the country. However, Heilongjiang province and the project cities face economic decline and population loss due to severe price cuts of coal and reduced revenue from coal mining dependent industries induced by changes in the PRC's energy and climate policies. Urban poverty has become serious as a consequence of declining wages combined with poor and unsanitary living conditions caused by a lack of proper urban infrastructure and services.

5. There is an urgent need to revitalize and transform the economy of the four cities towards a sustainable non-coal future through (i) strategic planning for non-coal industries and key investments that facilitate private investments in non-coal jobs; (ii) environmental cleanup and remediation of impacts from mining (although not supporting mining itself); (iii) developing urban infrastructure, services, and environmental improvements to help attract and retain modern companies and qualified workers; and (iv) capacity development to plan and implement a strengthened sub-region as an inclusive, competitive, and green East

Heilongjiang Smart City Cluster with educated and skilled workers.

C. Project Components

6. The project incorporates a number of special innovations including strategic planning for economic diversification from coal to non-coal industries; mining remediation management planning and pilot programs; city cluster economic cooperation and higher education and technical training partnerships development; smart city cluster information and communications technology applications including a shared platform for branding and marketing of East Heilongjiang, industrial land and job markets, and supply-chain partnerships; and sub-regional labor force planning and technical and vocational education and training plan development. The expected project impacts are a revitalized economy of East Heilongjiang sub-region with non-coal industries in the four cities; improved East Heilongjiang smart city cluster cooperation; and improved living environment, safety, and public health in the four cities. The indicative project outcome is improved enabling environment for non-coal economic and industrial transformation. The project has five outputs, described in the following sections, and summarized in **Table ES-1**.

- **Output 1: Sustainable SME investment and access to finance in project cities improved.** A SMEFP will be established using the FIL modality to mobilize domestic financing offering three types of financial products: (i) cofinancing of SME investments with the cities taking the subordinated debt position, (ii) first loss cash collateral facility to mobilize commercial guarantees and facilitate access to commercial financing for investments and longer-term working capital of up to 3 years, and (iii) entrusted loan facility exclusively for high priority projects for local governments. The FIL will be strategically combined with BDS (output 5).

- **Output 2: Key infrastructure and SME facilities in non-coal industrial parks in project cities constructed.** Key infrastructure and facilities will be constructed and operational, including (i) roads with a length of 18.4 kilometers (km) with advanced safety features, and associated utility pipes; (ii) industrial wastewater treatment plants with combined capacity of 26,000 cubic meters per day (m^3/d); and (iii) multifunctional facilities for SMEs and startup offices, training, and business services with a total area of 56,000 square meters (m^2).

- **Output 3: Remediation and environmental cleanup from mining impacts in project cities improved.** Mining remediation strategies will be developed, investment plans will be prepared, and pilot demonstration projects for replication will be implemented in all project cities: (i) Hegang: open pit mine (52.6 hectares [ha]) will be remediated, reclaimed, and reused as park and for light industry; (ii) Jixi: mining area and wasterock dumpsite will be remediated and afforested (89.7 ha) and a subsidence[1] monitoring center will be built and operated; and (iii) Qitaihe and Shuangyashan: wasterock dumpsites and subsidence areas (21.7 ha and 24.7 ha, respectively) will be remediated and reused as green open space and agricultural land.

- **Output 4: Integrated urban infrastructure and services in project cities improved.** This output will enhance urban livability and attractiveness by improved, spatially integrated infrastructure and services: (i) Hegang: Focus is on river rehabilitation, improvements in drainage, sustainable urban and public transport, urban greening, and district heating; (ii) Jixi: Focus is on integrated improvements to core area of Hengshan District and West Jixi including river rehabilitation; and urban roads, water supply, and wastewater management and drainage system improvements; (iii) Qitaihe: Focus is on water supply, wastewater system, and public transport; and (iv) Shuangyashan: Focus is on sustainable urban transport constructing key missing road

[1] Subsidence is lateral or vertical ground movement and failure, caused by the man-made underground coal mines.

links, and on improvements to the water supply, sewer, and drainage management systems.

- **Output 5: Inclusive capacity in business development services and integrated project planning and management developed.** This output will support project management, monitoring, and evaluation. Capacity development will include training, study tours, policy dialogue, and stakeholder consultation on (i) project planning and management, procurement, and financial management; (ii) BDS capacity development to SMEs and local SME bureaus; (iii) labor force assessment, and technical and vocational education and training; (iv) smart city cluster cooperation; (v) mining remediation planning and implementation; (vi) flood risk management, sponge city planning,[2] and urban climate resilience; (vii) water, wastewater, and drainage management system design, construction, management, operation, and tariff reform; and (viii) sustainable urban transport, road and traffic safety, and public transport management.

  Consulting services to be financed by the loan include six packages: (i) CS1: Consulting Services for Project Management and Implementation Support and Capacity Development and Training (international firm); (ii) CS2: Business Development Services Capacity Development to SMEs Consulting Services; (iii) CS3: external social and resettlement monitoring services (national institute); (iv) CS4: External environment monitoring services (national institute); (ii) CS5: project implementation startup support (individual national consultants) (v) CS6: Consulting services for non-revenue water (NRW) reduction piloting in Qitaihe (national institute).

Table ES-1: Project Summary

No.	Component	Project Description	Primary Benefits
Output 1 - Sustainable SME investment and access to finance in project cities improved			
1.1	SMEFP will be established using FIL modality	(i) Co-financing of SME investments with the cities taking the subordinated debt position. (ii) Guarantee support to SMEs to access commercial bank financing for investments and longer-term working capital of up to 3 years. (iii) Entrusted loan facility project exclusively for high priority projects for the local government. The FIL will be strategically combined with BDS, a subcomponent of output 5.	Domestic financing mobilized to support local SME and high priority projects for local governments.
Output 2 - Key infrastructure and SME facilitate non-coal industrial parks improved			
2.1	Infrastructure and business support facilities	HG 2.1. Construct three roads (total length about 6.25 km), SME service/training center and park management building (floor space 8000 m^2), and utilities (including about 6.25 km of water supply pipeline, drainage pipeline, sewer pipeline and heating pipeline) at the green food, green energy, high-tech industrial park. JX 2.1 Rebuild stage I ring road (3.0 km) and construct middle ring road (1.3 km) along with new water supply and sewage/heating pipes at the Hengshan District high-tech graphite based materials and E-mobility industrial park. QH 2.1 At the green food and pharmaceutical bio-fermentation industrial park infrastructure and business support facilities; construct two new roads and upgrade two existing roads (total length 2.1 km), construction of new water and drainage pipelines (39 km), one pumping station, heating,	Facilitate development of local SME and development of non-coal industrial sector. Improved energy and water supply and efficiency through provision of new utilities. Improved surface water quality through improved recycling of industrial wastewater and improvement of wastewater discharge standards.

[2] Sponge City is a concept in which greenways, parks, and wetlands maximize ecosystem services, including water resource management and stormwater retention.

No.	Component	Project Description	Primary Benefits
		lighting (820 lamps), electricity transmission (7 km), heating pipelines (2 km), boiler (75 tons) room and one exchange station. SY 2.1 At Middle and Small Enterprises (MSE) Business Park (22 ha) and China-Russia Business & Trading Park (194.15 ha), construct four roads totaling around 5.7 km. Also construct related utilities including water, sewer and drainage, heating and power pipelines under the road, and additional 4.4 km water supply pipelines, and 7 km sewer pipelines.	
2.2	infrastructure (WWTP) and business support facilities	HG 2.2 Construct a greenfield WWTP of 6,000 m^3 /day to treat the wastewater from graphite purification process from the green food, green energy, high-tech industrial park. After treatment, the wastewater will be reused by the industrial park through a newly constructed 11.5 km pipeline. JX 2.2 Construct new industrial WWTP (20,000 m^3/day) and related collection pipelines (2.0 km, DN400 mm - 600 mm).	
Output 3 - Remediation and environmental cleanup from mining impacts			
3.1	Remediation of open pit mine / waste-rock dump site rehabilitation	HG 3.1 Remediation of 23.6 ha of Lingbei open-cast coal mine through filling with waste rock interspersed with layers of clay. A new 3.85 km road with sidewalks on both sides will be built on the surface. A pedestrian way of 2.58 km to be built and a total of 13.7 ha of green space to be landscaped. JX 3.1 Two-phase remediation of abandoned coal mine in Hengshan District. Phase I comprises geotechnical survey of 89.7 ha site; Phase II comprises site remediation, site grading of 20.5 ha, reforestation of 69.2 ha, construction of 2023 m drainage interceptor ditch, 1041 m drainage ditch, 287 m retaining wall, 571 m fence and related landscaping works. QH 3.1 Remediation of a waste rock dump-site (10.4 ha) and mining subsidence area (11.3 ha) in the Taoshan District. 187,313.5 m^3 of waste rock will be removed from the dump site and used as fill in the subsidence area. Reforestation of both sites will be conducted after remediation. SY 3.1 A former mining site at Lingdong District of 24.7 ha will be rehabilitated through removal of waste rock, regrading with fill, reforestation and construction of drainage system. 6.10 ha of existing forestry land linked with the site will be improved with additional tree planting. Work includes 20.7 m^3 of waste rock removal, 19.2 m^3 of fill, reforestation and drainage ditch.	Improved air quality through reduced dust emissions and reduction in potential underground fires. Surface and groundwater protected from potential heavy metal pollution/acidification from mine leachate. Improved aesthetic and ecological value of post-industrial urban areas Potential for socio-economic development of degraded urban areas.
Output 4 – Integrated urban infrastructure and services in the project cities improved			
4.1	Integrated river rehabilitation and clean-up from mining and ecosystem based adaptation	HG 4.1 Dredging, channel widening and bank protection works to increase flood protection standard of three rivers (total 16.61 km) to 1-50 year flood and one creek (3.3 km) to 1-20 year flood. Green belt up to 30 m wide on one or both sides of the rivers to be planted with native tree and shrub species. The total greening area is about 0.75 m^2 million. JX 4.1 Dredging, channel widening and bank protection works to increase flood protection standard of two rivers (total 9.65 km) to meet	Improved flood protection for key urban waterways in Hegang and Jixi. Improved water quality through removal of sediments and dumped solid waste Enhanced ecological and landscape value of rivers and lakes through eco-

No.	Component	Project Description	Primary Benefits
		relevant flood standards. Green belt up to 30 m wide on one or both sides of the rivers, and area around Hongqi Lake to be planted with native tree and shrub species.	engineering and restoration of riparian areas.
4.2	Utilities improvements and urban regeneration	HG 4.2 District heating system energy efficiency improvements in Hegang, upgrading of 6.6 km primary pipe network and 65.2 km secondary pipe network. JX 4.2 Urban regeneration of 5.02 ha in the Hengshan District, including construction of a library (gross floor area (GFA) 5000 m^2), stadium (GFA 5000 m^2), two public toilets (GFA 140 m^2 *2), and a remediation monitoring and training center (GFA 8000 m^2). The water supply system will be rehabilitated including upgraded water intake (84,000 m^3/day), upgraded WTP (50,000 m^3/day), new advanced treatment units (80,000 m^3/day) and sludge treatment facilities. Replacement of 16.8 km water supply pipelines to reduce leakage. 24.3 km of new sewage pipelines will be built to separate sewage and storm water. Construction of three sewer pumping stations and one drainage pumping station. Construction of 15.2 km drainage pipelines, drainage trench of 10.1 km, and four sedimentation tanks to collect and discharge storm water. QH 4.2 Upgrading of two WTP (100,000 m^3/day and 50,000 m^3/day), water intakes and development of Taoshan reservoir basin pollution comprehensive control masterplan to improve performance. Water supply and distribution system will be replaced and expanded, replacing 17.8 km old main pipelines and installing 73.2 km new main pipelines, and 15 booster pump stations. SY 4.2 Water supply: 28.8 km of water pipelines; three new pumping stations (15,000 m^3/day, 15,000 m^3/day and 3000 m^3/day); two clean water reservoirs (3000 m^3 and 4000 m^3), and other associated facilities including the drainage pipeline in the WTP, new laboratory, flow meters at key intersections and SCADA system. Drainage: 61.6 km pipelines in Jianshan District. Sewer network: 25.5 km sewer pipeline in Lingdong. District and 53 km sewer pipeline in Jianshan District.	Improved utilities and public facilities for residents of the four cities. Improved energy and water supply and efficiency through upgrading of old utilities.
4.3	Road rehabilitation, public and non-motorized transport improvements	HG 4.3 Construction of separated bus lanes along two North-South arterials of about 13 km in the city, and another 18 km for other roads. To improve service of public transport and non-motorized transit (NMT): • Infrastructure along 35.3 km roads, including roads resurfacing, over 50 pairs of bus bays, NMT and some intersections' channelization; • Intelligent transportation system (ITS) including Intelligent Signal Control System, Passenger Information System, surveillance system and related devices. • System and special vehicles/equipment for road maintenance will be purchased; 10.4 km drainage pipes will built along 30 roads.	Improved traffic conditions in the four cities. Promote use of sustainable transportation

No.	Component	Project Description	Primary Benefits
		JX 4.3 Jiaotong Street (409 m) to be rebuilt, and a road on riverbank will be built (1.51 km). Gongqu Flyover will be built (around 330 m). QH 4.3 Sustainable and clean fuel public transport improvements. Purchase 209 electric buses to replace the old diesel buses, build three parking lots with garages and charging stations, introduce smart bus transportation system and smart ticketing. SY 4.3 Improvements to two roads (South ring road of 3.75 km and Xinxing Avenue flyover with a total length of 1.47 km including a bridge of 0.576 km). Construction of Yunfeng Tunnel: left sub-tunnel of 940 m long, right sub-tunnel of 920 m long.	
Output 5 – Inclusive capacity in business development services and integrated project planning and management developed.			
5.1	Project management support	Capacity development programs, study tours, policy dialogue, and stakeholder consultation on: (i) project planning and management, procurement, financial management, site supervision; (ii) BDS capacity development and support to SMEs, (iii) labor force assessment and planning, education and training; (iv) smart city cluster cooperation; (v) mining remediation management and environment cleanup; (vi) flood risk management, sponge city planning, urban climate resilience, and ecological river management; (vii) water, wastewater and drainage management system design, construction, management, operation, and service and tariff reform; and (viii) sustainable urban transport, road and traffic safety, and public transport management.	Enhance capacity of stakeholders for business development, education and training, smart city planning and environmental management.

D. Project Environmental Benefits

7. The project will directly benefit 2.73 million residents in the four cities. Specific environmental benefits will include:

(i) **Improved domestic utilities.** The project will connect 73,600 people to municipal water supply systems, and overall will improve water supply to 75,000 people. 52,900 people will benefit from improved wastewater treatment, and improved heating services will be provided for 50,000 people.

(ii) **Enhanced industrial wastewater management.** The provision of two new WWTPs will treat 20,000 m^3/day and 6,000 m^3/day industrial wastewater. This comprises 100% of the wastewater from two industrial parks (in Hegang and Jixi), with wastewater from the Hegang industrial park being reused within the park.

(iii) **Improved flood control.** The project will improve flood standards of rivers and creeks in Hegang and Jixi from as low as 1–10 year return period to 1–20 year, 1–30 year and 1–50 year return periods. These initiatives will reduce flood damage to properties, crops and livestock, help prevent losses/injury to 79,600 people already living within 2 km of the rivers, and accommodate potential future developments included in the masterplans of the cities.

(iv) **Land remediation.** A total of 90.5 ha of abandoned mines and quarries will be

remediated by the project, directly benefiting 123,600 people who are living within 2 km of the remediation areas through reduced pollution, improved safety and enhanced access to public open space.

(v) **Surface water quality improvement.** Improved domestic and industrial wastewater management, separation of waste water and drainage infrastructure, dredging of rivers and channels, and mine remediation will contribute to improved surface water quality in the four cities and surrounding areas. In particular, operation of the Jiguan WWTP will reduce COD, BOD_5, SS, TP, TN and ammonia by 3240 t/a, 2248 t/a, 266.4t/a, 54 t/a, and 396 t/a respectively. Operation of the Luobei WWTP will reduce COD, SS, Cl^-, dissolved solids and salts by 197.1 t/a, 843.15 t/a, 1708.2 t/a, 4182.9 t/a and 2515.35 t/a respectively.

(vi) **Ecological enhancement.** River and creek enhancement works will improve the ecological and landscape functioning of a total of 29.56 km river channels in Hegang and Jixi. Together with surface water quality improvements, the overall functioning of aquatic ecosystems will benefit. Rehabilitation of 90.5 ha of land damaged by mining activities will increase the area of urban forests and green open space, resulting in multiple ecosystem services benefits.

(vii) **Energy efficiency.** The project will improve energy efficiency through installing/retrofitting 85.25 km heating pipelines, and replacing 209 diesel buses for public transportation with electric buses.

(viii) **Improved road and sustainable traffic services.** 1.16 million people will benefit from improved transportation.

E. Baseline Environment

8. Areas within and adjacent to physical works proposed under the project are largely urban, industrial or abandoned-industrial areas that have been substantially modified by past human activities. No protected areas or rare, protected or threatened species (i.e., species occurring on the International Union for Conservation of Nature (IUCN) red-list, or PRC's national or provincial wildlife protection list) or habitats (i.e., 'critical habitats' as defined in the SPS, 2009), are known from the project component sites. The nearest site of conservation significance is the Qixing Lazi Siberian Tiger Nature Reserve, which lies some 12.5 km southwest of the closest works component at Shuangyashan, and would not be affected by the project.

9. Ambient air quality monitoring dya show compliance with PRC's Class 2 air quality standard and World Bank Group environmental health and safety interim target standard in all tested locations. Some project components in urban areas (i.e., road rehabilitation works) were affected by traffic noise, and the existing noise environment did not meet relevant standards. All rivers in Hegang and Jixi selected for rehabilitation under the project had very poor water quality, in most cases not meeting Category 5 standards due to high ammonia, chemical oxygen demand (COD) and biological oxygen demand (BOD_5). These rivers have been polluted by untreated domestic and industrial wastewater from urban areas. Baseline soil and groundwater quality data was available for the Lingbei mine in Hegang. Soils at the mine were found to have elevated cadmium (Cd) levels. Heavy metals (including Cd) are common contaminants in open cast mine pits. No contamination of groundwater in areas adjacent to the mine was recorded during baseline monitoring. Although, this proposed project activities will improve environmental status and not add any pollutions. Groundwater quality data in Luobei WWTP (HG 2.2) and Jiguan WWTP (Jixi 2.2) showed exceedance of PRC Category III of Goundwater Quality Standard for manganese, iron and nitrogen due to high background concentrations in areas rich in graphite resources.

F. Potential Environmental Impacts and Mitigation Measures

10. **Environmental sceening and avoided impacts at design stage.** Screening of environmental impacts resulting from the project has allowed several environmental impacts to be avoided. These include: (i) avoided air and noise impacts associated with long-distance

transportation of fill for quarry rehabilitation in Shuangyashan. This works component was removed from the project; (ii) the design of river rehabilitation works to incorporate ecological engineering approaches rather than standard gabion or concrete channel bank linings; (iii) The Gonggu flyover (JX 4.3) crosses the Huangni River, and was designed to require no piers in the riverbed; and (iv) design of the Yunfeng tunnel was considered to reduce overall length of tunneling works.

11. **Construction phase.** Key potential construction phase impacts will include: (i) air quality impacts from powered mechanical equipment (PME) used on various components and fugitive dust from earthworks; (ii) noise impacts from PME, transportation of fill materials for land remediation works, and also blasting required for construction of the Yunfeng road tunnel; (iii) water quality impacts resulting from river dredging and embankment works, as well as potential impacts to surface and ground water from land remediated under output 3.1 from leachate containing high levels of suspended sediment and potentially other contaminants. The majority of impacts can be controlled with good site practice and standard mitigation measures. Noise impacts from blasting works, although short in duration, will cause unavoidable impacts. Clear communication channels with local residents and businesses will be established to minimize inconvenience. Potential impacts to surface and ground water from land remediated under output 3.1 would be mitigated through the use of liners to contain leachate. Comprehensive leachate and groundwater monitoring programmes would be established to ensure the effectiveness of control measures.

12. **Operation phase.** Operational phase impacts would be largely beneficial. In particular, there will be substantial improvements in water quality, air quality, landscape and ecological value at the various land remediation sites included under output 3. Water and habitat quality in rehabilitated rivers and lakes will also be enhanced through the revegetation programme, ecological embankment construction, removal of polluted sediments and improved wastewater management. Potential negative noise impacts are expected from increased traffic on widened existing and newly constructed roads under output 4.3. However, these impacts can be controlled within relevant standards through implementation of common mitigation measures including imposition of speed limits along certain stretches of road, use of low-noise road surfaces, and providing double-glazing for properties close to the road alignments. Potential impacts to surface and ground water from land remediated under output 3.1 would be mitigated through the use of liners to contain leachate. Comprehensive leachate and groundwater monitoring programmes would be established to ensure the effectiveness of control measures.

13. **Induced and Cumulative impacts.** The potential concern that the project may induce uncontrolled industrial development within the industrial parks will be addressed through the conduct of planning EIA for the industrial parks. In two of the project cities (Jixi and Qitaihe), enhanced water treatment and supply systems included in the project have the potential to adversely impact regional water resources. A water balance analysis for both cities has been conducted (including components to be constructed under this project) and presented in the FSR. From this assessment, it appears that sufficient water will be available to meet demand in both cities.

G. Public Consultation and Grievance Redress Mechanism

14. Two rounds of information dissemination and two rounds of public consultation were conducted for the project. Various government agencies and local resident groups were consulted. No major concerns were raised about the environmental aspects of the project. The domestic EIA institutes presented the planned mitigation measures to be adopted. All government agencies present expressed their support for the project and readiness to coordinate with the PMO. Other participants expressed support and there was no opposition.

15. A grievance redress mechanism (GRM) has been developed to address environmental, health, safety, and social concerns associated with the project.

H. Climate Change

16. Observed results suggest that temperatures have increased in Heilongjiang over the last 50 years, and temperatures are projected to increase in the future, with these changes combined with an increase in the frequency and intensity of extreme weather events. A climate risk vulnerability assessment (CRVA) was conducted for the project based on observed and projected climate change assuming a project design life of 30-40 years. Many of the project components and outputs will have significant positive effects and contributions to the climate change resilience of the project area. Key adaptation measures in the project design include design of drainage with additional capacity to manage increased rainfall and severe rainfall events, design of water and wastewater infrastructure (including materials) to accommodate potential increases in demand due to higher temperatures, and various measures to increase energy efficiency and reduce water demand.

I. Environmental Management Plan

17. An environmental management plan (EMP) was developed that brings together all the mitigation measures for identified impacts as well as pre-construction requirements, and construction and operational management prescriptions. The EMP also includes the GRM and an environmental monitoring program, to monitor and report on the environmental performance of construction and operations. The EMP also includes institutional responsibilities, training needs, reporting schedules, implementation costs, and future public consultation.

J. Risks and Assurances

18. The main project risks include the low institutional capacity and/or failure of the PMO, PIUs and O&M units to implement the EMP during construction and operational stage. The following assurances would be implemented to support effective implementation of the project EMP: (i) full-time environment officers will be appointed by the project management and implementation offices; (ii) a loan implementation environmental consultant will be recruited to support local agencies; (iii) pre-construction readiness procedures and defined roles and responsibilities of all relevant agencies have been included in the EMP; and (iv) staff will receive training in EMP implementation. Project-specific environmental assurances have been agreed and are included in the project agreement between the HPG and ADB.

K. Conclusion

19. It is concluded that full and effective implementation of the project EMP, together with the training and project assurances, will minimize the environmental risks of the project and achieve compliance with the policies and regulatory standards applied in this EIA.

II. INTRODUCTION

1. The four cities covered by this project, Hegang, Jixi, Qitaihe, and Shuangyashan, are located in the eastern part of Heilongjiang province, covering the most northeast part of the PRC (**Figure II-1**). The four cities cover a total area of 66,155 km^2, accounting for 14.6% of the total area of the province.

Figure II-1. Four project city locations (Hegang, Jixi, Qitaihe and Shuangyashan) in Heilongjiang Province

2. The East Heilongjiang sub-region and the four cities have been an important coal base and electricity production hub delivering a cumulative total of more than 3.2 billion tons of coal to the PRC economy. However, Heilongjiang and the project cities face serious economic decline and population loss due to severe price cuts of coal and reduced revenue from coal mining dependent industries due to changes in the PRC's energy and climate policies. Urban poverty has become serious as a consequence of declining wages combined with poor and unsanitary living conditions due to lack of proper urban infrastructure and services.

3. The four cities are now entering a phase of major economic restructuring in response to the decline of coal mining and related heavy industries, as reflected in the recently approved

Thirteenth Five-year Plans of Heilongjiang and the four cities, as well as urban and economic development masterplans of the four cities.

4. The ADB has approved a Project Concept Paper and a PPTA on the loan to the PRC for the Heilongjiang Green Urban and Economic Revitalization Project (the Project) to revitalize the economy of the East Heilongjiang sub-region with non-coal industries in the four cities; improve smart city cluster cooperation in East Heilongjiang (to integrate multiple Information and Communication Technology (ICT) solutions to manage the four cities' assets); and improve living environment, safety, and public health in the four cities. A PPTA was needed to ensure that the design and preparation of the proposed works by the relevant Government Departments meet the loan processing requirements of the ADB, and that they are suitable for ADB lending support.

5. This EIA forms part of the PPTA, and is based on: (i) information in the FSR prepared by North China Municipal Design Institute and Northeast Municipal Design Institute of China and 31 domestic environmental impact assessments (DEIAs) prepared by Heilongjiang Agricultural Development Survey and Design Institute; Heilongjiang Xingye Environmental Protection Company; Heilongjiang Heida Environmental Protection Technology Company, Hebei Qizheng Environmental Science and Technology Company, Zhongye Energy Conservation and Environmental Protection Company, and Heilongjiang Yipu Environmental Protection Technology Company; (ii) site visits conducted between August 2016 and April 2017 by the PPTA consultant team. PPTA fieldwork included inspection of most proposed sites for major construction, river embankment and dredging, sections of proposed alignments and easements, and the WWTP; and (iii) other sector studies by the PPTA team, including, water resources, social assessment, and climate change. The data presented in tables and figures in this EIA are from the FSR and DEIAs unless stated otherwise. The EMP (Attachment 2) is based on the findings and recommendations of the EIA and domestic studies, and will be the key guiding document for environmental-related issues in the construction and operation phases of the project.

III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Provincial Policy Framework

6. The HPG's overall development strategy is documented in the Thirteenth Five-year Plans of Heilongjiang Province and the Transformation Development Planning of Coal Cities in Heilongjiang Province (2014–2020). These plans aim to develop diversified non-coal alternative industries; strengthen advantageous processing industries such as graphite and green food; promote the transformation and upgrading of steel, mining machinery, medicine, and wood processing industries; and expand the scale of modern services including tourism, commerce and trade. The FYP also seeks to accelerate the development of high-end graphite and molybdenum industries and their supply chains, develop new graphite material industrial clusters in Jixi and Hegang, and molybdenum industrial clusters in Daxinganling and Xiaoxinganling. It seeks to ensure the reconstruction of areas affected by coal mining subsidence, shanty towns, and isolated industrial and mining communities.

7. At the city level, each of the four cities has also outlined their economic plans by the Thirteenth Five-year Economic and Social Development Plan and their City Master Plans (2010–2020 or 2013–2030, varying by city).

- **Hegang –** The Thirteenth Five-year Plan of Hegang calls for the portion of value added index (VAI) in the coal sector to decline from 60% to 30% by 2020, with non-coal VAI rising from 40% to 70%. The city will focus on deep processing of coal resources as a basis for poverty alleviation and transformation, and green food processing as the key support for greater affluence. The city aims to develop the high-end graphite industry, setting up the Hegang Application and Development Centre for New Graphite Material, and laying a solid foundation for creating a Chinese Yuan (RMB) 100 billion-class graphite industry. Hegang also wishes to construct a frontier eco-tourism base and expedite the development of health services for the elderly.

- **Jixi –** Based upon the Thirteenth Five-year Plan Jixi wishes to build strong and competitive clusters around the four leading industries of coal, graphite, green food, and pharmaceuticals. It will also use the tourism and business service sectors to lead the overall development.

- **Qitaihe –** Qitaihe's goals include being a national demonstration base of mining cities, a national coal chemical industrial base, and a national demonstration city for information technology benefiting people. It also wants to be the provincial-level new materials and new energy industrial base, as well as a production base and a distribution center for furniture and home decoration materials. It also plans to be the commerce, trade, and logistics center of eastern Heilongjiang Province.

- **Shuangyashan –** Shuangyashan plans to reduce the share of coal in industrial VAI from 38.5% in 2016 to 35% by 2020, with non-coal VAI moving from 61.5% to 65%. It wishes to build a new industrial system around four key industries including the modern coal/electro-chemical/steel sectors, organic food, black soil/ecotourism, and foreign trade services.

8. The project will assist revitalizing economy of east Heilongjiang sub-region with non-coal industries in the four cities and will support the implementation of Thirteenth Five-year Ecological and environmental plan (EEP) (2016–2020) released in 5 December 2016 by the State Council in the four cities to:

- Accelerate improvement of urban sewage treatment systems and strengthen the construction of supporting sewage collection networks;
- Restore vegetation and the environment in waste rock dump areas;
- Promote green credit for the selected commercial banks in Heilongjiang Province through establishment of environment and social management systems (ESMS);
- Develop centralized wastewater treatment systems for industrial parks;
- Improve public transportation systems and promote usage of clean fuel buses.

B. Legal and Administrative Framework for Environmental Impact Assessment in the PRC

9. The DEIAs conducted for the project were prepared under the Environmental Impact Assessment Law of the PRC (2016) and the following laws and regulations (**Table II-1** and **Table II-2**). The suite of laws, regulations, guidelines and standards shown indicates the comprehensive coverage on PRC's environmental safeguard system, which covers air and water pollution prevention, noise control, solid waste management; as well as discharges from WWTP and the reuse of treated effluent and sludge for various purposes. References to specific laws and regulations and are made in subsequent sections of the EIA.

Table III-1: Applicable laws

Law	Effective Date
Environmental Protection Law	1 January 2015
Environmental Impact Assessment Law	1 September 2016
Water Law	1 October 2002
Law on Prevention and Control of Environmental Pollution by Solid Wastes	April 24 2015
Water Pollution Prevention and Control Law	Jun. 1, 2008
Law on Water and Soil Conservation	March 1 2011
Law on Energy Conservation	1 April, 2008
Law on the Protection of Cultural Relics	29 December, 2007
Law on Promotion of Clean Production	1 June, 2003
Law on Prevention and Control of Air Pollution	1 January 2016
Law on Prevention and Control of Pollution from Environmental Noise	1 March, 1997
Land Administration Law	1 January, 1999
Urban and Rural Planning Law	1 January 2008

Sources: Consolidated by PPTA Environmental Team, January 2017.

Table III-2: Applicable administrative regulations and rules

No.	Name of Regulations and Rules	Effective Date
National Level		
1.	Ordinance of Urban Drainage and Sewage Treatment	State Council Order No. 641, 2014
2.	Notice by the State Council on Issuing the Air Pollution Prevention and Control Plan	Doc. No. 37, 2013
3.	Notice on Issuing the Guidelines of Facilitating Joint Prevention and Joint Control of Air Pollution and Improving Regional Air Quality"	State Council General Office Doc. No. 33, 2010
4.	Ordnance of the People's Republic of China on Government Information Disclosure	State Council Order No. 492, 2008
5.	Decision by the State Council on Implementing the Concept of Scientific Development and Strengthening Environmental Protection	State Council Doc. No. 39, 2005
6.	Ordnance of Environmental Protection and Management of Construction Projects	State Council Order No. 253, 1998
7.	Catalogue of Environmental Impact Assessment Classification and Management of Construction Projects	MEP Order No. 33, 2015

No.	Name of Regulations and Rules	Effective Date
8.	Notice by the General Office of Ministry of Environmental Protection on Implementing the Air Pollution Prevention and Control Action Plan and Strictly Enforcing Environmental Impact Assessment Permit System	MEP Doc. No. 30, 2014
9.	Detailed Rules of Implementation of the Action Plan of Air Pollution Prevention and Control in Beijing, Tianjin and Hebei and the Surrounding Areas	MEP Doc. No. 104, 2013
10.	Notice on Issuing the Guidelines of Government Information Disclosure of Environmental Impact Assessment of Construction Projects	MEP-Office Doc. No. 103, 2013
11.	Catalogue for the Guidance of Industry Restructuring (amended in 2011)	NDRC Order No. 21, 2013
12.	Notice on Strengthening Risk Precaution and Strictly Managing Environmental Impact Assessment	MEP Doc. No. 98, 2012
13.	Notice on Further Strengthening Management of Environmental Impact Assessment and Preventing Environmental Risks	MEP Doc. No. 77, 2012
14.	Provisional Methods of Public Participation in Environmental Impact Assessment	MEP Doc. No. 28, 2006
15.	Provisional Methods of Management of Projects Financed by International Financial Institutions and Foreign Governments	NDRC Order No. 28, 2005
16.	Management Methods of Final Acceptance of Environmental Protection Aspects of Construction Projects	SEPA Order No. 13, 2002
Heilongjiang Provincial Level		
17.	Regulation on Environment Protection of Heilongjiang Province	April 1, 1995
18.	Regulation on Air Pollution Prevention and Control of Heilongjiang Province	May 1, 2017
19.	Regulation on Geological Environment Protection of Heilongjiang Province	October 1, 2009
20.	Water Function Zone of Heilongjiang Province	August 12, 2004
21.	Regulation on Industrial Pollution Prevention and Control of Heilongjiang Province	January 1, 1997

Sources: Consolidated by PPTA Environmental Team, January 2017.

10. Implementation of the environmental laws and regulations is supported by a series of associated management and technical specifications and standards, as described in **Table II-3**.

Table III-3: Applicable environmental impact assessment guidelines

No.	Name of Guideline	Year/Code
1.	Technical guidelines for environmental impact assessment of Construction Project-General Outline	HJ2.1-2016
2.	Technical guidelines for environmental impact assessment - Atmospheric environment	HJ2.2-2008
3.	Technical guidelines for environmental impact assessment - Surface water environment	HJ/T2.3-93
4.	Technical guidelines for environmental impact assessment-Groundwater	HJ610-2016
5.	Technical guidelines for noise impact assessment – Acoustic environment □	HJ2.4-2009
6.	Technical guidelines for environmental impact assessment- Ecological environment	HJ19-2011
7.	Technical Guidelines for Environmental Risk Assessment on Projects	HJ/T 169-2004
8.	Technical Specifications on Comprehensive Management of Water and Soil Conservation	T16453.1~6-96
9.	(Trial) Guidelines on Identification of Solid Wastes	SEPA Announcement No. 11, 2006

Sources: Consolidated by PPTA Environmental Team, January 2017.

11. 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 III-4: Applicable environmental standards

Name of Standards	Code
Ambient Air Quality Standard	GB3095-2012
Environmental Quality Standards for Noise	GB3096-2008
Environmental Quality Standard for Surface Water	GB3838-2002
Environmental Quality Standard for Groundwater	GB/T14848-93
Water Quality Standard for Sewage Discharged into Municipal Sewers	CJ343-2010
Emission Standard of Environment Noise for Boundary of Construction Site	GB 12523-2011
Domestic Drinking Water Quality Standard	GB 5749-2006
Standard for Pollution Control on Hazardous Waste Storage	GB 18597-2001
Integrated Wastewater Discharge Standard	GB 8978-2002

Sources: Consolidated by PPTA Environmental Team, January 2017.

C. International Agreements

12. The PRC is a signatory to several international agreements relating to environment protection. Those relevant to the project, along with the date of signing by the PRC, are listed in **Table II-5**. No specific separate approvals process would be required for the project under these international agreements.

Table III-5: Relevant international agreements with the PRC as a signatory

Name of Agreement	PRC Signing Date	Agreement Objective
Convention on Biological Diversity	December 29, 1993	To develop national strategies for the conservation and sustainable use of biological diversity. Project greening using native species is in line with this convention
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. The project CRVA is developed under this framework.
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. Project greening using native species is in line with this convention
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. Control of greenhouse gas emissions in project components is in line with this convention.
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.

D. Applicable PRC and ADB Safeguards Policies and Assessment Categories

13. **Domestic environmental requirements**. The PRC Guideline on EIA Classification for Construction Projects (Ministry of environmental protection (MEP) 2015) classifies EIAs for construction projects into three categories with different reporting requirements, based on "significance" of potential environmental impacts, based on the type and scale of project and the environmental sensitivity of the project site. An EIS is required for construction projects with potential significant environmental impacts. An EIT is required for construction projects with less significant environmental impacts. An environmental impact registration form (EIRF) is required for construction projects with few significant environmental impacts. For the

proposed project, the required domestic environmental documents consist of nine EISs and 22 EITs, their preparation institutes and approval authorities are shown in **Table II-6**.

Table III-6: Domestic environmental deliverables for the project

No.	Comp. No.	Description	Type of Deliverable	Prepared by	Approval Authority
Hegang					
1	HG2.1	Road with related pipes in industrial parks	Two EITs	HDEPC	HEPB
2	HG2.2	Luobei Industrial WWTP with pipes	EIS	HDEPC	HEPB
3	HG3.1	Waste rock dump site rehabilitation	EIS	HDEPC	HEPB
4	HG4.1	River rehabilitation	Four EITs	HDEPC	HEPB
5	HG4.2	Heat pipe network	EIT	HDEPC	HEPB
6	HG4.3	Transport improvement	EIT	HDEPC	HEPB
Jixi					
7	JX2.1	Roads and heat supply facilities in industrial park	EIS	HXEPC	JEPB
8	JX2.2	WWTP and wastewater collection pipes for Jiguan industrial park	EIS	YEEC	JEPB
9	JX3.1	Waste rock dump site remediation	EIT	HXEPC	JEPB
10	JX4.1	Lake and river rehabilitation	Two EITs	HXEPC	JEPB
11	JX4.2	Public buildings	EIT	HXEPC	JEPB
12	JX4.3	Roads and bypass bridge	EIS	HXEPC	JEPB
13	JX4.4	Utility pipeline for water supply, wastewater and storm water	Two EITs	HYPEPC	JEPB
14	JX4.5	No. 3 WTP upgrading and expanding	EIT	HYPEPC	JEPB
Qitaihe					
15	QH2.1	Infrastructures for the industrial park	EIS	HXEPC	QEPB
16	QH3.1	Remediation of waste rock dump site and mining subsidence area	EIT	HXEPC	QEPB
17	QH4.1	WTP upgrading and distribution pipes	EIT	HXEPC	QEPB
18	QH4.2	Bus parking lots	EIT	HXEPC	QEPB
Shuangyashan					
19	SY2.1	Roads in the industrial park	Two EITs	HADSDI	SEPB
20	SY3.1	Waste rock dumpsite rehabilitation	EIT	HADSDI	SEPB
21	SY4.1	Utility pipeline for water supply, wastewater and storm water	EIT	HADSDI	SEPB
22	SY4.2	South ring road and tunnel	Three EISs	HQZC	SEPB

Note: HEPB = Hegang Environmental Protection Bureau; HADSDI = Heilongjiang Agricultural Development Survey and Design Institute; HDEPC=Heilongjiang Heida Environmental Protection Company; HQZC=Hebei Qizheng Environmental Science and Technology Company; HXEPC = Heilongjiang Xingye Environmental Protection Company; JEBP = Jixi Environmental Protection Bureau; QEPB = Qitaihe Environmental Protection Bureau; SEPB = Shuangyashan Environmental Protection Bureau; ZYEEC=Zhongye Energy Conservation and Environmental Protection Company.

14. **ADB environmental safeguard requirements.** This project is classified as Category A for environment on the basis of ADB's Rapid Environmental Assessment (REA), requiring preparation of a comprehensive EIA report, including an EMP. This project EIA has been prepared under the provisions of the ADB's SPS based on information in the individual FSRs and DEIA documents for each component, as well as site visits and technical studies conducted by the PPTA environment team. In addition, the project also involves a FIL to support business development for SMEs. This component is classified as category FI that

required an environmental and social management system (ESMS).

E. Evaluation Standards

15. The environmental standards system that supports the implementation of 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. These are described in the following sections. The ADB SPS also 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 (EHS) Guidelines[3]. For this assessment, where EHS standards exist for parameters and are relevant, they have been used in parallel with PRC standards. Where PRC Standards are more stringent than EHS standards, or no relevant international standard is available, the PRC standard has been adopted for the assessment.

1. Evaluation against Ambient Standards

16. **Air quality**. The PRC ranks air quality into two classes according to its Ambient Air Quality Standard (GB 3095-2012), with Class I targets for nature reserves and scenic areas, and Class II for residential, commercial, educational, industrial and rural areas. The World health organization (WHO) has established air quality guideline (AQG) standards for various parameters for the protection of public health. Recognizing that progressive action is needed to achieve these standards, and the financial and technological limitations of some countries, cities or localities especially in developing countries, WHO have also established interim targets as intermediate milestones towards achieving the AQG. National and WBG EHS Standards are summarized in **Table II-7**.

Table III-7: Summary of PRC and WBG EHS ambient air quality standards

Air Quality Parameter	Averaging Period	PRC Class II (μg/m^3)	World Bank Group EHS[4] (μg/m^3)	
		GB 3095-2012	Interim Targets	AQG
SO_2	1-year	60	n/a	n/a
	24-hour	150	50-125	20
	1-hour	500	n/a	n/a
TSP	1-year	200	n/a	n/a
	24-hour	300	n/a	n/a
PM_{10}	1-year	100	30-70	20
	24-hour	150	75-150	50
$PM_{2.5}$	1-year	n/a	15-35	10
	24-hr	150	37.5-75	25
	1-hour	350	n/a	n/a
NO_2	1-year	40	n/a	40
	24-hour	80	n/a	n/a
	1-hour	200	n/a	200
CO	24-hour	4,000	n/a	n/a
	1-hour	10,000	n/a	n/a

Note: **n/a** = not available; **CO** = carbon monoxide; **NO_2** = nitrogen dioxide; **$PM_{2.5}$** = particulate matter with diameter ≤2.5 μm; **PM_{10}** = particulate matter with diameter ≤10 μm; **SO_2** = sulfur dioxide; **TSP** = total suspended particulate

17. **Noise.** According to the Technical Specifications to Determine the Suitable Areas for Environmental Noise of Urban Area (GB/T 15190-94), areas within 200 m on both sides of a

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

[4] World Bank Group 2007, ibid.

road or road junction should comply with the corresponding provisions in Environmental Quality Standard for Noise (GB 3096-2008). 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 have the most stringent day and night time noise standards. Category 1 is for predominately 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 areas adjacent to traffic noise sources such as major roads and highways, and is subdivided into 4a and 4b. 4a is applicable to major road and marine traffic noise, and 4b to rail noise. Standards for various functional area categories are compared with the WBG's EHS guidelines in **Table II-8**, 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 note that as well as impacts not exceeding the levels presented in **Table II-8**, they should also not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. There are no EHS guidelines equivalent to category 4 under the PRC Standards that define noise limits adjacent to trunk roads.

Table III-8: Environmental quality standards for noise (equivalent sound level L_{Aeq}: dB)

Noise Functional Area Category	Applicable Area	GB 3096-2008 Standards		WBG EHS[5] Standards	
		06:00-22:00	22:00-06:00	07:00-22:00	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	-	-
4b	Area within 35 m from both sides of railway	70	60	-	-

18. **Surface water quality**. For water quality assessment, the determining standard is PRC's Environmental Quality Standards for Surface Water (GB 3838-2002). It defines five water quality categories for different environmental functions. Category I is the most stringent, suitable for head waters and National Nature Reserves. Category II is suitable for drinking water sources in Class I protection areas, habitats for rare aquatic organisms, breeding grounds for fish and crustaceans, and feeding grounds for fish fries. Category III is suitable for drinking water sources in Class II protection areas, wintering grounds for fish and crustaceans, migration routes, water bodies for aquaculture and capture fishery, and swimming activities. 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. These standards are set out in **Table II-9**. 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. United Nations Environment Programme (UNEP) standards for some of the parameters are also listed in **Table II-9** for reference.

[5] World Bank Group 2007, lid.

Table III-9: Environmental quality standards for surface water

Parameter	GB 3838-2002					UNEP standard	
	Category					Category	
	I	II	III	IV	V	High Integrity (Category 1)	Extreme Impairment (Category 4)
pH	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9	6 ~ 9	6.5 ~ 9.0	<5
Dissolved oxygen (DO) [mg/L]	90% saturation or ⩾7.5	⩾6	⩾5	⩾3	⩾2	7.3-10.9	3 or >13.6
Permanganate index (I_{Mn}) [mg/L]	⩽2	⩽4	⩽6	⩽10	⩽15	-	-
Chemical oxygen demand (COD) [mg/L]	⩽15	⩽15	⩽20	⩽30	⩽40	-	-
5-day Biochemical oxygen demand (BOD_5) [mg/L]	⩽3	⩽3	⩽4	⩽6	⩽10	--	>10
Ammonia nitrogen (NH_3-N) [mg/L]	⩽0.15	⩽0.5	⩽1.0	⩽1.5	⩽2.0	0.015	0.1
Total phosphorus (as P) [mg/L]	⩽0.02	⩽0.1	⩽0.2	⩽0.3	⩽0.4	<0.02	>0.190
Lakes & reservoirs	⩽0.01	⩽0.025	⩽0.05	⩽0.1	⩽0.2	<0.01	>0.125
Total nitrogen (lakes, reservoirs, as N) [mg/L]	⩽0.2	⩽0.5	⩽1.0	⩽1.5	⩽2.0	<0.5	>2.5
Copper (Cu) [mg/L]	⩽0.01	⩽1.0	⩽1.0	⩽1.0	⩽1.0	0.001	0.0025
Zinc (Zn) [mg/L]	⩽0.05	⩽1.0	⩽1.0	⩽2.0	⩽2.0	0.008	0.05
Fluoride (as F^-) [mg/L]	⩽1.0	⩽1.0	⩽1.0	⩽1.5	⩽1.5	-	-
Selenium (Se) [mg/L]	⩽0.01	⩽0.01	⩽0.01	⩽0.02	⩽0.02	-	-
Arsenic (As) [mg/L]	⩽0.05	⩽0.05	⩽0.05	⩽0.1	⩽0.1	0.01	0.15
Mercury (Hg) [mg/L]	⩽0.0005	⩽ 0.0005	⩽ 0.0001	⩽0.001	⩽0.001	0.00005	0.001
Cadmium (Cd) [mg/L]	⩽0.001	⩽0.005	⩽0.005	⩽0.005	⩽0.01	0.00008	0.001
Chromium (Cr, hexavalent) [mg/L]	⩽0.01	⩽0.05	⩽0.05	⩽0.05	⩽0.1	0.001	0.04
Lead (Pb) [mg/L]	⩽0.01	⩽0.01	⩽0.05	⩽0.05	⩽0.1	0.002	0.005
Cyanide (CN) [mg/L]	⩽0.005	⩽0.05	⩽0.2	⩽0.2	⩽0.2	-	-
Volatile phenol [mg/L]	⩽0.002	⩽0.002	⩽0.005	⩽0.01	⩽0.1	-	-
Total petroleum hydrocarbon (TPH) [mg/L]	⩽0.05	⩽0.05	⩽0.05	⩽0.5	⩽1.0	-	-
Anionic surfactant [mg/L]	⩽0.2	⩽0.2	⩽0.2	⩽0.3	⩽0.3	-	-
Sulfide [mg/L]	⩽0.05	⩽0.1	⩽0.2	⩽0.5	⩽1.0	-	-
Fecal coliform bacteria [number/L]	⩽200	⩽2000	⩽10000	⩽ 20000	⩽ 40000	-	-

19. **Soil and river sediment quality**. Soil quality in the PRC is divided into three classes according to the Environmental Quality Standard for Soils (GB 15618-1995). Class 1 represents the best and Class 3 the worst. The PRC does not have quality standards for

sediments in waterways such as rivers, lakes, reservoirs and the sea. However, it is common practice to adopt the Control Standards for Pollutants in Sludge from Agricultural Use (GB 4284-84) to assess sediment quality. The rationale being that the physical nature of river sediment is similar to sludge. **Table II-10** presents both GB 15618-1995 (soil) and GB 4284-84 (sludge for agricultural use) standards. The WBG does not have EHS standards for soil and sediment quality.

Table III-10: Comparison of environmental quality standards for soil and control standards for pollutants in sludge for agricultural use

Parameter		Maximum Allowable Concentration (mg/kg dry weight)						
		GB 15618-1995 (Soil)					GB 4284-84 (Sludge for Agricultural Use)	
		Class 1	Class 2			Class 3		
	Soil pH	Back ground	<6.5	6.5~7.5	>7.5	>6.5	<6.5	⩾6.5
Cadmium (Cd)		0.20	0.30	0.30	0.60	1.0	5	20
Mercury (Hg)		0.15	0.30	0.50	1.0	1.5	5	15
Arsenic (As)	Paddy	15	30	25	20	30	75	75
	Dry land	15	40	30	25	40		
Copper (Cu)	Farm land	35	50	100	100	400	250	500
	Orchard	---	150	200	200	400		
Lead (Pb)		35	250	300	350	500	300	1000
Chromium (Cr)	Paddy	90	250	300	350	400	600	1000
	Dry land	90	150	200	250	300		
Zinc (Zn)		100	200	250	300	500	500	1000
Nickel (Ni)		40	40	50	60	200	100	200
Boron (B, soluble)		---	---	---	---	---	150	150
DDT		0.05	0.50			1.0	---	---
666 (Lindane)		0.05	0.50			1.0	---	---
Mineral oil		---	---	---	---	---	3000	3000
Benzo(a)pyrene		---	---	---	---	---	3	3

2. Emission Standards for Construction and Operation Activities

20. **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.

Table III-11: 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

21. **Air quality.** Fugitive emissions of particulate matter (such as dust from construction sites)

are 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 $\leqslant$1.0 mg/m^3 as the concentration limit at the boundary of construction sites, with no specification on the particle diameter. Odor from WWTP and sediment dredging 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) respectively.

22. **Noise.** Construction noise is 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-12**). The WBG's EHS standards require that noise impacts do not exceed the levels presented in **Table II-8**, or result in an increase in background levels of 3 dB at the nearest sensitive receptor.

Table III-12: 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

23. **Vibration.** Construction activities can cause vibration impacts, and should comply with the Standard for Urban Area Environmental Vibration (GB10070-88) (**Table II-13**).

Table III-13: 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

24. **Assessment areas and evaluation standards for the project**. The following PRC evaluation standards were adopted for this project in the domestic EISs and EITs for the various project components in accordance with the requirements set forth by each project city EPB (**Table II-14**). The assessment area is deemed to be representative of the project area of influence.

Table III-14: PRC evaluation standards adopted for this project

Type of Standard	Environmental Media	Applicable PRC Standard	Assessment Area
Environmental quality	Ambient air quality	Class II standards in *Ambient Air Quality Standard* (GB3095-2012)	Up to 200 m beyond the permanent and temporary project footprint
	Noise	*Environmental Quality Standard for Noise* (GB3096-2008)	Up to 200 m beyond the permanent and temporary project footprint or up to 200 m beyond the project road red line.
	Surface water quality	*Environmental Quality Standards for Surface Water* (GB3838-2002) Categories III and V standards	From 100 m upstream to 500 m downstream of the project sections for the following river rehabilitation components: • Daheli river; • Xiaoheli River • Shitou River, • Qianjin Creek; • Huangni River; and

Type of Standard	Environmental Media	Applicable PRC Standard	Assessment Area
			• Anle Creek. From 500 m upstream and 5000 m of Muling River at the outfall of Jiguan WWTP.
	Ecology	No applicable standard	Permanent and temporary project footprint and adjacent areas.
	Soil quality	*Environmental Quality Standard for Soils* (GB15618-1995) Class 2 standards	Permanent and temporary project footprint.
	River sediment quality	*Control Standards for Pollutants in Sludge from Agricultural Use* (GB4284-84) and *Environmental Quality Standard for Soils* (GB15618-1995) Class 3 standards.	Dredged sediment from the rivers
	Physical cultural resources	No applicable standard but controlled under PRC's *Cultural Relics Protection Law*	Permanent and temporary project footprint.
	Occupational health and safety	No applicable standard but controlled under PRC's *Labor Law*	Construction sites within the "footprint" of the permanent and temporary engineering land take areas and within the WWTPs/WTPs during operation.
	Community health and safety	No applicable standard	Up to 200 m beyond the permanent and temporary project footprint
Pollutant emission	Air pollutant	*Air Pollutant Integrated Emission Standard* (GB16297-1996), Class II and fugitive emission standards	Construction sites within the "footprint" of the permanent and temporary engineering land take areas. Up to 200 m from the boundaries of the WWTPs/WTPs;
	Noise	*Emission Standard of Environmental Noise for Boundary of Construction Site* (GB12523-2011)	Construction sites within the permanent and temporary.
		Industrial Enterprises Noise at Boundary (GB13248-2008) for noise functional area category 2.	At boundaries of the WWTPs/WTPs
	Wastewater	*Integrated Wastewater Discharge Standard* (GB8978-1996), Class I standard (for discharging into Category III water bodies)	Construction sites within the permanent and temporary.
		Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002), Class 1(A) standard	Treated effluent from Luobei WWTP and Jiguan WWTP

Source: EISs & EITs

F. Assessment Period

25. The assessment period covers both the construction and operational stages of the project components. Construction is assumed to take place over a six-year period for all the components combined (**Attachment 1**). The assessment period road operation covers the design horizon of the proposed roads, which is 15 years from road commissioning. For other components, the operational stage assessment period covers the first year of operation.

IV. DESCRIPTION OF THE PROJECT

A. Project Rationale

26. The four cities in the People's Republic of China, are bordering the Russian Federation to the east and to the north. The four cities have been an important coal mining base and electricity production hub delivering a cumulative total of more than 3.2 billion metric tons of standard coal equivalent to the country's economy.6 The local economies were until recently relying on coal mining and related industry with more than 60% of annual gross domestic product. They have been strongly affected by significant coal price reduction since 2013 and a planned economic transformation shifting away from heavy coal use towards an ecological civilization.7 Urban poverty, increasing underemployment, declining wages, and population loss have since become serious challenges for the four cities.

27. The population of the four cities was 5.2 million in 2015 and 66% of the population was urban, higher than Heilongjiang (49%) and the PRC as a whole (56%). Between 2010 and 2015, a total of 255,000 people out-migrated resulting in a population decline by 4.7%. The four cities are aging with a substantially lower percentage of young people (0 to 34 years old) and a much higher percentage of persons over 60 years of age compared to the national average. About 18% of the labor-aged people are unemployed or working at casual jobs, and average wages by State owned enterprises (SOEs) and private company workers are lower than in other cities in Heilongjiang Province. More than 10% of urban residents in the project area are poor. In 2014, per capita gross domestic product in Heilongjiang was 16% below the national average and the project cities' economies were below the provincial average with 14.1% of provincial population and only 9.5% of its gross domestic product. In 2015, trade in three of the project cities trade collapsed, declining 40% for Jixi and Shuangyashan, and 89% for Qitaihe. In education and training, the project cities are lagging others in Heilongjiang, especially in tertiary education and in areas relevant for non-coal diversified jobs qualification. Around 10% to 20% of the young people from the project cities who go elsewhere for tertiary education return, and a large portion of those who attend tertiary institutions in the project cities leave after graduation. Senior experienced people must often be attracted into the area with very high salaries or benefits.

28. The four cities' fundamental reliance on coal mining and related industries makes their economies vulnerable to coal price fluctuations and changing global and domestic energy, and climate change policies and caused the economic downturn. In addition, much of the value from their coal resource was harnessed outside i.e. by companies registered elsewhere and by coal-consuming regions. Therefore, only limited amounts of resource wealth are available in the project cities as a basis for investments in economic revitalization. A key challenge to private sector and entrepreneurship culture development is also the long tradition of large state-owned enterprises dominating the project cities' economies. The lack of effective enabling policies and programs for SME development; and lack of access to longer term working capital or cash-flow based SME financing, combined with a lack of needed capacity to develop and expand businesses, technical skills, strategic workforce development, lack of access to advanced industry practices, and product research and development mechanisms and investments makes diversification into new industries challenging.

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6 Heilongjiang Statistical Yearbook 2015, Harbin. 2016.

7 Government of the PRC, State Council. 2015. *National Economy and Social Development Thirteenth Five-Year Plan, 2016–2020*. Beijing.

29. The project cities suffer from environmental loss and degradation: pollution of soil, water, and air caused by more than 60 years of coal mining. The project cities' population is exposed to risks to safety, health, and environment from mining impacts, including (i) geohazard risks of subsidence from below-grade mining; (ii) waste rock dumpsites that burn uncontrolled and wash out heavy metals into soil, ground, and surface water; (iii) air-polluting dust particles, and (iv) rivers and lakes pollution and sedimentation from mining and coal-related industries, and also from untreated domestic wastewater, and agricultural use of chemical fertilizers and pesticides.

30. The project cities lack urban livability and adequate urban infrastructure and services. This is partly due to a backlog in infrastructure investments since the large state-owned enterprises were no longer responsible to provide infrastructure and services to their workers, families, and communities in the 1990s. Water supply and wastewater management systems lack capacity and cannot meet required quality standards, especially in Jixi and Qitaihe, and Qitaihe has a high nonrevenue water ratio. In all project cities, the water supply, sewer, and drainage pipe networks do not reach many of the existing urban areas and do not meet the code-required separation of sanitary sewers and drainage pipes. District heating inefficiencies are serious due to aging pipes especially in Hegang. Some key missing links in the roadway network lead to detours and traffic jams especially in Shuangyashan. All project cities lack adequate road maintenance and have inadequate public transport, bus lanes, bus stops, narrow or unpaved sidewalks, and bicycle lanes, and urgently need road rehabilitation. Some rivers especially in Hegang and Jixi overflow and cause floods during heavy storms and snow melt in the spring, and river courses are narrow, scattered with solid waste, and water is polluted from untreated discharge of domestic and industrial wastewater.

31. **Problem Tree Analysis.** A Problem Tree analysis was conducted for the project to identify key issues and appropriate outputs (Figure IV-1). The analysis lists the symptoms of coal-mining based economy, loss of jobs and population, lack of infrastructure planning and investment, and pollution from years of coal mining and heavy industry production causing unsafe and degraded environments in the four cities. Each box indicates a specific cause of the problem which contributes to decline of local economies, poor living conditions and lack of basic infrastructure and services which hinder sustainable development in the project sites. Climate change would likely aggravate the situation of some of the issues, e.g. water supply and flooding.

32. The problems must be addressed systematically through provision of appropriate infrastructure and services to help non-coal mine industrial transformation; remediation and cleaning up of the adverse impacts from over 60 years' coal mining activities in the project cities; and provision of integrated urban facilities and services to improve the living conditions of the project cities. The physical improvements must be coupled with comprehensive capacity building and improved planning and management systems, including non-coal industry development planning and smart city cluster cooperation; prioritization of investment program, mining remediation management and environment cleanup; labour force assessment and planning; as well as alternative finance and project delivery, such as public-private partnerships.

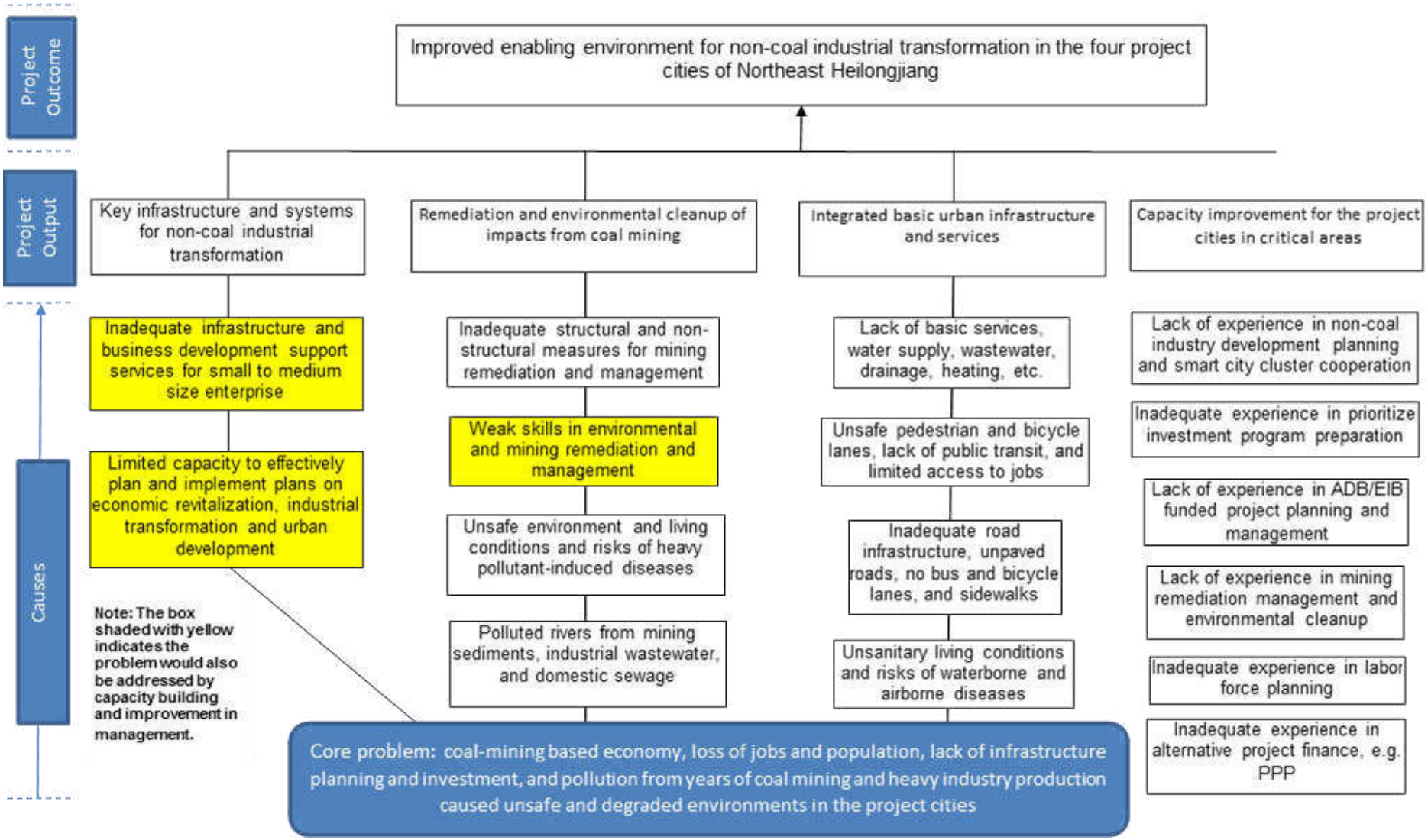


Figure IV-1: Problem Tree Analysis

33. **Value added by Asian Development Bank assistance.** ADB value added includes (i) mobilizing additional funding from ADB's ordinary capital resources ($60 million) and additional concessional financing from the European Investment Bank (€200 million) to address effectively the development constraints of the project cities; (ii) identifying the urgent need for economic and social and environmental sustainability to broaden the economic base to non-coal related industries and the need to build and strengthen private sector development through the preparation of an economic diagnostics study; (iii) preparing a non-coal economic diversification roadmap guiding economic development and diversification for the project cities; (iv) organizing an international conference and workshop on non-coal diversification with more than 150 participants discussing and learning lessons from international cases of economic transformation similar to what is needed in East Heilongjiang, and applying key findings from the conference in further project design including a strategic combination of SME financing and SME capacity development, technical training to deliver needed skills for newly developing industries, financing of key infrastructure in non-coal industrial parks, and improving livability of cities as prerequisite to attract and retain companies and qualified workers; (v) adding SME financing platform (SMEFP) and integration with business development services providing tailored capacity development to reduce barriers to private sector SME development and non-coal diversification and supporting inclusive business development; (vi) establishing strategic financing partnerships with local guarantee companies and banks to leverage additional commercial direct value added co-financing; (vii) establishing an environment and social management system (ESMS) and enhancing the capacity of domestic banks in such a management systems to ensure safeguard compliance; (viii) identification of mining remediation as key environmental and public health challenge, and presenting opportunities for remediation through international expertise, developing pilot demonstration projects included in the project; (ix) integrating urban infrastructure and enhancing efficiency and co-benefits across sectors; (x) applying sponge city principles and ecologically sound river rehabilitation in the flood risk management components; (xi) following a climate change risk and vulnerability assessment (CRVA) components were subjected to climate-proofing applying structural and non-structural adaptation measures; and (xii) city cluster cooperation and smart city applications.

34. **Strategic fit.** Through its strategic and holistic approach, the proposed project will support the (i) Thirteenth Five-Year plans, 2016-2020 of the PRC, Heilongjiang Province, and the project cities to revitalize and achieve industrial transformation, and deepening access to finance emerging industries and SMEs,[8] (ii) Heilongjiang Provincial Government (HPG) Master Plan for Economic Development (2014–2020) and Transformation Development Planning of Coal Cities in Heilongjiang Province (2014–2020) by strengthening the non-coal pillar industries identified, (iii) PRC's National New-Type Urbanization Plan (2014–2020), and (iv) urban development master plans of the project cities. The proposed project has been advanced from standby to firm for 2017 in ADB's country operations business plan (2017–2019) for the PRC. The project is aligned with relevant ADB policies including (i) the Midterm Review of Strategy 2020, supporting private sector and financial sector development objectives and increase partnership-based co-financing and operations;[9] (ii) ADB's country partnership strategy, 2016–2020, supporting socially inclusive, environmentally sustainable, and economically competitive urban development;[10] and (iii) urban, green cities, water operational plans, sustainable transport initiative, and environment directions.[11]

[8] Several Opinions of the Central Committee of the Communist Party of China (CPC) and the State Council on the Overall Revitalization of the Old Industrial Bases in the Northeast and Other Parts of China (2016), the National Old Industrial Base Adjustment and Renovation Plan (2013–2022), the Sustainable Development Plan for Resource-based Cities in China (2013–2020), and the Guiding Opinions of the Four Ministerial Departments on Advancing the Development of Private Economy in the Northeast Region of China (2016).

[9] ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008–2020*. Manila; ADB. 2013. *Midterm Review of Strategy 2020: Meeting the Challenges of a Transforming Asia and Pacific*.

[10] ADB. 2016. *Transforming Partnership: People's Republic of China and Asian Development Bank, 2016–2020.* Manila.

[11] Manila; ADB. 2013. *Urban Operational Plan, 2012–2020.* Manila; ADB. 2011. *Water Operational Plan, 2011–2020.* Manila;ADB. 2013. *Environment Operational Directions, 2013–2020.* Manila*;* ADB. 2010. *Sustainable Transport Initiative Operational Plan.* Manila. ADB 2016. S. Sandhu, R. Naik Singru et. al. *GrEEEn Solutions for Livable Cities*. Manila: Asian Development Bank. http://www.adb.org/publications/greeen-solutions-livable-cities

35. **Impact and Outcome.** The project is aligned with the following impacts: (i) revitalized economy of East Heilongjiang sub-region with non-coal industries in the cities of Hegang, Jixi, Qitaihe, and Shuangyashan; and (ii) living environment, safety and public health in cities of Hegang, Jixi, Qitaihe, and Shuangyashan improved. The project will have the following outcome: enabling environment for non-coal economic diversification and urban livability in project cities improved.[12]

36. Responding to the urgent need of comprehensive sustainable and integrated urban and economic development, the project will improve the environment for private sector development enabling and catalyzing a diverse non-coal economic future for the project cities. The project will support key public investments and strategically promote priority non-coal industries that facilitate private sector growth delivering new, inclusive, and more gender balanced employment to the project cities, as identified in the economic diversification roadmap, building on and expanding existing industries, such as agricultural value chain and green food processing, machine building, high-tech graphite materials and products, building regional and product clusters around the pillar industries, expansion of processing of resources imported from the nearby Russian Federation, diversification through import substitution, support sector-independent development, promote cooperation and competition, provide market information and facilitate supply-chain integration. It will improve access to finance and capacity of SMEs, improve key infrastructure, facilities and support for non-coal SMEs. It will improve public safety, and human and environmental health through remediation of impacts from coal mining, and clean-up of degraded and polluted environments. It will improve urban livability and image change from coal-cities and modern attractive cities as a prerequisite to attract and retain residents, workers and companies, through improvements in urban infrastructure and public services, including water supply, wastewater management, drainage, flooding, river pollution, and urban public transport and roads in a connected, holistic manner. It will contribute to more sustainable and inclusive urban and economic development in the project cities and to more cooperation and coordination among the cities in the East Heilongjiang sub-region i.e. in tourism promotion, logistics and trade, supply chain integration, and SME support though smart city applications. The strengthened project cities will bring jobs, goods, assets, and public and private services to the cities and is expected to stop and reverse a trend of out-migration of younger qualified workforce and attract new companies and people in non-coal industries.

B. Project Benefits

37. The project will directly benefit 2.73 million residents in the four cities, through (i) enhanced access and quality of municipal services including water supply, wastewater management, district heating, and roads and public transport; (ii) improved living and recreational environment of people through mining remediation and environmental cleanup; (iii) improved living, working and training environments in the industrial parks; and (iv) enhanced traffic and safety conditions of the roads as well as public transportation services; (v) enhanced residence awareness of environmental protection, roads safety, and flood risk management through public education program; (vi) improved access to urban markets and employment opportunities, including jobs created by the project; (vii) improved access and BDS capacity building for SMEs through financial intermediary loans. The project will indirectly contribute to (i) increasing real estate value and recreational opportunities for the project areas, and (ii) generation of economic and employment opportunities through facilitation of non-coal industrial transformation as well as SMEs and by upstream and

[12] The design and monitoring framework is in Appendix 1.

downstream integration of value chains of the enterprises in the industrial parks. Specific project benefits will include:

(i) **Improved domestic utilities.** The project will connect 73,600 people to municipal water supply systems, and overall will improve water supply to 775,000 people. 52,900 people will benefit from improved wastewater treatment, and improved heating services will be provided for 50,000 people.
(ii) **Enhanced industrial wastewater management.** The provision of two new WWTPs will treat 20,000 m^3/day and 6,000 m^3/day industrial wastewater. This comprises 100% of the wastewater from two industrial parks (in Hegang and Jixi), with wastewater from the Hegang industrial park being reused within the park.
(iii) **Improved flood control.** The project will improve flood standards of rivers and creeks in Hegang and Jixi from as low as 1-10 year return period to 1-20 year, 1-30 year and 1-50 year return periods. These initiatives will reduce flood damage to properties, crops and livestock, help prevent losses/injury to 79,600 people already living within 2 km of the rivers, and accommodate potential future developments included in the masterplans of the cities.
(iv) **Land remediation.** A total of 90.5 ha of abandoned mines and quarries will be remediated by the project, directly benefiting 123,600 people who are living within 2 km of the remediation areas through reduced pollution, improved safety and enhanced access to public open space.
(v) **Surface water quality improvement.** Improved domestic and industrial wastewater management, separation of waste water and drainage infrastructure, dredging of rivers and channels, and mine remediation will contribute to improved surface water quality in the four cities and surrounding areas. In particular, operation of the Jiguan WWTP will reduce COD, BOD_5, SS, TP, TN and ammonia by 3240 t/a, 2248 t/a, 266.4t/a, 54 t/a, and 396 t/a respectively. Operation of the Luobei WWTP will reduce COD, SS, Cl^-, dissolved solids and salts by 197.1 t/a, 843.15 t/a, 1708.2 t/a, 4182.9 t/a and 2515.35 t/a respectively.
(vi) **Ecological enhancement.** River and creek enhancement works will improve the ecological and landscape functioning of a total of 29.56 km river channels in Hegang and Jixi. Together with surface water quality improvements, the overall functioning of aquatic ecosystems will benefit. Rehabilitation of 90.5 ha of land damaged by mining activities will increase the area of urban forests and green open space, resulting in multiple ecosystem services benefits.
(vii) **Energy efficiency.** The project will improve energy efficiency through installing/retrofitting 85.25 km heating pipelines, and replacing 209 diesel buses for public transportation with electric buses.
(viii) **Improved road and sustainable traffic services.** 1.16 million people will benefit from improved transportation.

C. Project Outputs

38. The project will continue ADB's long-term partnership with HPG and take a strategic, holistic, and long-term approach to further develop and implement the Transformation Development Plan of Coal Cities in Heilongjiang (2014-2020), establishing a non-coal economic base, i.e., green food, pharmaceutical, renewable energy, and high-tech industries. The project will also contribute to the Songhua River Basin Water Pollution Control and Management Project by river rehabilitation and wastewater treatment along tributaries to the Songhua River.

39. The indicative project impacts are a revitalized economy of the East Heilongjiang sub-region with non-coal industries in the four cities; improved East Heilongjiang smart city cluster cooperation; and improved living environment, safety, and public health in the four cities. The

indicative project outcome is improved enabling environment for non-coal economic and industrial transformation.

40. Under the framework of integrated city cluster planning and development, the project comprises five outputs: (i) Output 1 – Sustainable SME investment and access to finance in project cities improved; (ii) Output 2 – Key infrastructure and SME facilities in non-coal industrial parks in the project cities constructed; (iii) Output 3 – Remediation and environmental cleanup of impacts from coal mining in the project cities improved; (iii) Output 4 – Integrated urban infrastructure and services in the project cities improved; and (iv) Output 5 – Inclusive capacity in business development services and integrated project planning and management developed.

41. Output 1 will involve establishment of a SMEFP using FIL modality to mobilize domestic financing. The FIL will offer three types of financial products: (i) co-financing of SME investments with the cities taking the subordinated debt position, (ii) a first loss cash collateral facility to mobilize commercial guarantees and facilitate access to commercial financing for investments and longer-term working capital of up to 3 years for SMEs, and (iii) entrusted loan facility project exclusively for high priority projects for the local government. The FIL will be strategically combined with BDS, a subcomponent of output 5.As specified in the ABD SPS (2009), an ESMS has been developed for the project FIL, and has been produced as a separate document to this EIA. No further assessment of Output 1 is therefore included in this document.

42. The components for outputs 2-5 are arranged by city and summarized in **Table IV-1** below.

Table IV-1: Summary of project outputs 2-5 and components arranged by city

No.	Component	Description
Hegang City		
HG2 - Key infrastructure and SME facilitate non-coal industrial parks		
HG 2.1	Green food, green energy and high-tech industrial park - infrastructure and business support facilities	Construct three roads (total length about 6.25 km), SME service/training center and park management building (floor space 8000 m^2), and utilities (including about 6.25 km of water supply pipeline, drainage pipeline, sewer pipeline and heating pipeline)
HG 2.2	Luobei County high-tech graphite based materials and E-mobility industrial park – infrastructure (WWTP) and business support facilities	A greenfield WWTP of 6,000 m^3 /day to treat the wastewater from graphite purification process. After treatment, the wastewater will be reused by the Industrial Park through a newly constructed 11.5 km pipeline.
HG3 - Remediation and environmental cleanup from mining impacts		
HG 3.1	Remediation of open pit mine / waste-rock dump site rehabilitation	Remediation of 23.6 ha of Lingbei open-cast coal mine through filling with waste rock interspersed with layers of clay and graded. A new 3.85 km road with sidewalks on both sides will be built on the surface. A pedestrian way of 2.58 km to be built and a total of 13.7 ha of green space to be landscaped.
HG4 – Integrated urban infrastructure and services		

No.	Component	Description
HG 4.1	Integrated river rehabilitation and clean-up from mining and ecosystems based adaptation (Shitou River, Qianjin Creek, Heli River, Xiaoheli River)	Dredging, channel widening and bank protection works to increase flood protection standard of the three rivers (total 16.61km) to 1-50 year flood and the creek (3.3 km) to 1-20 year flood. Green belt up to 30 m wide on one or both sides of the rivers, to be planted with native tree and shrub species. The total greening area is about 0.75 m^2 million.
HG 4.2	District heating system energy efficiency improvements	Upgrading of 6.6 km primary pipe network and 65.2 km secondary pipe network.
HG 4.3	Road rehabilitation, public and non-motorized transport improvements	Construction of separated bus lanes along two North-South arterials of about 13 km in the city, and another 18 km for other roads. To improve service of public transport and NMT, two aspects are included: • Infrastructure along 35.3 km roads, including road resurfacing, over 50 pairs of bus bays, NMT and some intersections' channelization; • ITS part including Intelligent Signal Control System, Passengers Information System, Surveillance system and related front devices. • System and special vehicles/ equipment for road maintenance will be purchased; 10.4 km drain pipes will be also built along 30 roads.
Jixi City		
JX2 - Key infrastructure and SME facilities in non-coal industrial parks		
JX 2.1	Hengshan District high-tech graphite based materials and E-mobility industrial park - infrastructure and Business Support Facilities	The Stage I Ring Road (3.0 km) will be rebuilt along with a new road-Middle Ring Road (1.3 km). Water supply and heating pipelines will be included in the road construction.
JX 2.2	Jixi City wastewater treatment and discharge infrastructure in the industrial park of Jiguan District	Construction of new WWTP (20,000 m^3/day) and related collection pipelines (2.0 km, DN400 mm - 600 mm).
JX3 - Remediation and environmental cleanup of impacts from coal mining		
JX 3.1	Hengshan District waste rock dump-site remediation / safe closure and management of former mines	Work includes 2 phases: Phase I comprises geotechnical survey of 89.7 ha site; Phase II comprises site remediation, site grading of 20.5 ha, reforestation of 69.2 ha, construction of 2023 m drainage interceptor ditch, 1041 m drainage ditch, 287 m retaining wall, 571 m fence and related landscaping works.
JX4 – Integrated urban infrastructure and services		
JX 4.1	Hengshan District integrated lake and rivers rehabilitation and ecosystems based adaptation (Hongqi Lake, Anle Gou Creek and Huangni Rivers)	Dredging, channel widening and bank protection works to increase flood protection standard of the two rivers (total 9.65 km) relevant flood standards. Green belt up to 30 m wide on one or both sides of the rivers, and area around Hongqi Lake to be planted with native tree and shrub species.
JX 4.2	Utilities improvements and urban regeneration	Urban regeneration of 5.02 ha in Hengshan district, including construction of a library (GFA 5000 m^2), stadium (GFA 5000 m^2), two public toilets (GFA 140 m^2 *2), and a monitoring and training center (GFA 8000 m^2). The water supply system will be rehabilitated including upgraded water intake (84,000 m^3/day), upgraded WTP (50,000 m^3/day), new advanced treatment units

No.	Component	Description
		(80,000 m^3/day), and sludge treatment facility. Replacement of 16.8 km water supply pipelines to reduce leakage. 24.3 km of new sewage pipelines will be built to separate sewage and storm water. Construction of three sewer pumping stations and one drainage pumping station. Construction of 15.2 km drainage pipelines, drainage trench of 10.1 km, and four sedimentation tanks to collect and discharge storm water.
JX 4.3	Hengshan District, Jiaotong Street, Riverbank Road and bypass bridge	Jiaotong Street (409 m) to be rebuilt, and a road on riverbank will be built (1.51 km). Gongqu Flyover will be built (around 330 m).
Qitaihe City		
QH2 - Key infrastructure and SME facilities in non-coal industrial parks		
QH 2.1	Green food and pharmaceutical bio-fermentation industrial park infrastructure and business support facilities	Construction of two roads and upgrade two existing roads (total length 2.1 km) related with the 2 km^2 industrial park. Construction of other infrastructure including water and drainage pipelines (39 km), one pumping station, heating, lighting (820 lamps), electricity transmission (7 km), heating pipelines (2 km), boiler (75 tons) room and one exchange station.
QH3 - Remediation and environmental cleanup of impacts from coal mining		
QH 3.1	Mining remediation and environmental rehabilitation	Remediation of a waste rock dump-site (10.4 ha) and mining subsidence area (11.3 ha). 187,313.5 m^3 of waste rock will be removed used to partially or totally fill the subsidence area. Reforestation of both sites will be conducted after remediation.
QH4 – Integrated urban infrastructure and services		
QH 4.2	Water treatment plant upgrading and water supply distribution system replacement and expansion	Two WTP will be updated, Shingle WTP with design capacity of 100,000 m^3/d and Water & Sewerage Company's WTP with design capacity of 50,000 m^3/d. Currently, Taoshan reservoir in Qitaihe City is the water resource for the two plants. ADB's loan will help to develop a river basin pollution comprehensive control master plan. Water supply and distribution system will be replaced and expanded in this component, including replacing 17.8 km old main pipes and installing 73.2 km new main pipes, and 15 nos. booster pump stations will also be built. The project will also pilot test an NRW control program in two pilot communities in the city under Output 5. The experienced gained in the pilot tests will then be used in full scale (approximately 100 communities for an investment of 10 million USD) NRW control activities supported by this project.
QH 4.3	Sustainable and clean fuel public transport improvements	Purchase 209 electric buses to replace the old diesel buses, build three parking lots with garages and e-charging stations, introduce smart bus transportation system and smart ticketing.
Shuangyashan		
SY2 - Key infrastructure and SME facilities in non-coal industrial parks		

No.	Component	Description
SY 2.1	Industrial parks-infrastructure and business support facilities	Development of MSE Business Park (22 ha) and China-Russia Business & Trading Park (194.15 ha), including roads totaling around 5.7 km. Construct related utilities including water, sewer and stormwater drainage, heating and power pipelines under the roads, and additional 4.4 km water supply pipelines, and 7 km sewer pipelines.
SY3 - Remediation and environmental cleanup of impacts from coal mining		
SY 3.1	Waste rock dump-site remediation/ safe closure and management of former mines	A former mining site at Lingdong District of 24.7 ha will be rehabilitated through removal of waste rock, regrading with fill, reforestation and construction of stormwater drainage system. 6.10 ha of forestry land related with the site will be improved through additional tree planting. Work includes 20.7 m^3 of waste rock removal, 19.2 m^3 of fill, reforestation and drainage ditch.
SY4 – Integrated urban infrastructure and services		
SY 4.2	Urban regeneration and urban infrastructure (water supply, wastewater collection and stormwater drainage)	Water supply: 28.8 km of water pipelines; three new pumping stations (15,000 m^3/day, 15,000 m^3/day and 3000 m^3/day); two clean water reservoir (3000 m^3 and 4000 m^3), and other related facilities include the drainage pipeline in the WTP, new laboratory, flow meters at key intersections and SCADA system. Drainage: 61.6 km stormwater pipelines in Jianshan District. Sewer network: 25.5 km sewer pipeline in Lingdong. District and 53 km sewer pipeline in Jianshan District.
SY 4.3	South ring road and tunnel	Improvements to two roads (South ring road of 3.75 km and Xinxing Avenue flyover: a total length of 1,47 km including a bridge of 0.576 km). Construction of Yunfeng Tunnel: left sub-tunnel of 940 m long, right sub-tunnel of 920 m long.

43. Under Output 5, project implementation consultants will support project management, monitoring, and evaluation. They will carry out capacity development programs, study tours, policy dialogue, and stakeholder consultation on (i) project planning and management, procurement, financial management, site supervision; (ii) BDS capacity development to SMEs, and support to local SME bureaus institutionalizing sustainable BDS mechanisms, and non-coal diversification planning and implementation; (iii) labor force assessment and planning, and technical vocational education and training; (iv) smart city cluster cooperation; (v) mining remediation management and environment cleanup; (vi) flood risk management, sponge city planning, urban climate resilience, and ecological river management; (vii) water, wastewater, and drainage management system design, construction, management, operation, and service and tariff reform; and (viii) sustainable urban transport, road and traffic safety, and public transport management.
44. .

45. The project implementation consulting services to be financed by the loan include six packages: (i) CS1: Consulting Services for Project Management and Implementation Support and Capacity Development and Training (international firm); (ii) CS2: Business Development Services Capacity Development to SMEs Consulting Services; (iii) CS3: external social and resettlement monitoring services (national institute), excluding field environment monitoring sampling and laboratory test to be fully domestically funded; (iv) CS4: External environment monitoring services (national institute); (ii) Package bundle CS5: project implementation startup support (individual national consultants) (v) CS6: Consulting services for NRW reduction piloting in Qitaihe (national institute). More details are provided in **Table IV-2**.

Table IV-2: Summary of consulting services under output 5.

No.	Package Name	Details
CS1	Consulting Services for Project Management and Implementation Support and Capacity Development and Training	An international firm with international and national experts. Selected by for PMOs with supports from the HDRC through ADB's QCBS (90:10) selection method. Expected duration: 5 years. Financed by the loan.
CS2	Business Development Services Capacity Development to SMEs Consulting Services	Selected by the HPG on behalf of the IAs through ADB's QCBS (90:10) selection method. Expected duration: 1 year. Financed by the loan.
CS3	External resettlement and social monitoring services	A national firm with national experts. Selected by for PMOs with supports from the HDRC through ADB's QCBS (80:20) selection method Expected duration: Intermittent input from the project start to 2 years after the completion of resettlement. Financed by the loan
CS4	External environment monitoring services	A national firm with national experts. Selected by for PMOs with supports from the HDRC through ADB's QCBS (80:20) selection method Expected duration: Intermittent input from the project start to 2 years after project completion
CS5	Project implementation start-up support consulting services	Contract bundle with Individual consultants: a project management specialist, a resettlement specialist, and a financial management specialist Expected duration: 10 months Selected by PMOs with support from the HDRC through ADB's ICS selection method. Financed by the loan
CS6	Consulting services for non-revenue water (NRW) reduction piloting in Qitaihe	A national firm with national experts. Selected by the QPMO through ADB's CQS selection method. Expected duration: 1 year. Financed by the loan.

ADB = Asian Development Bank, CQS = consultant qualification selection, implementing agencies = IAs, ICB = international competitive bidding, ICS = individual consultant selection, NCB = national competitive bidding, PIU = project implementation units, HPG = Heilongjiang provincial government, PMO = project management office, QCBS = quality- and cost-based selection.
Source: Asian Development Bank.

46. Domestically funded consulting services are to be recruited by the PMOs. The Heilongjiang development and reform commission (HDRC) in coordination with the PMOs will recruit a tendering agency to provide tendering support, including preparation of bidding documents, invitation for bids and bid evaluation reports. They will also engage domestic design institutes to carry out preliminary and detailed designs. Construction supervision engineers will be recruited for overseeing and inspecting the construction sites to ensure compliance with national regulations, safety standards, and the ADB requirements. Different engineering consultants will be recruited for design of different subcomponents in river rehabilitation, road construction, water and wastewater, mine remediation, ITS support, etc.

47. The following sections describe the engineering components of the project (Outputs 2-4) in more detail in each of the four cities.

D. Hegang

48. The engineering components in Hegang are presented in the **Figure IV-2**, and described in the following sections.

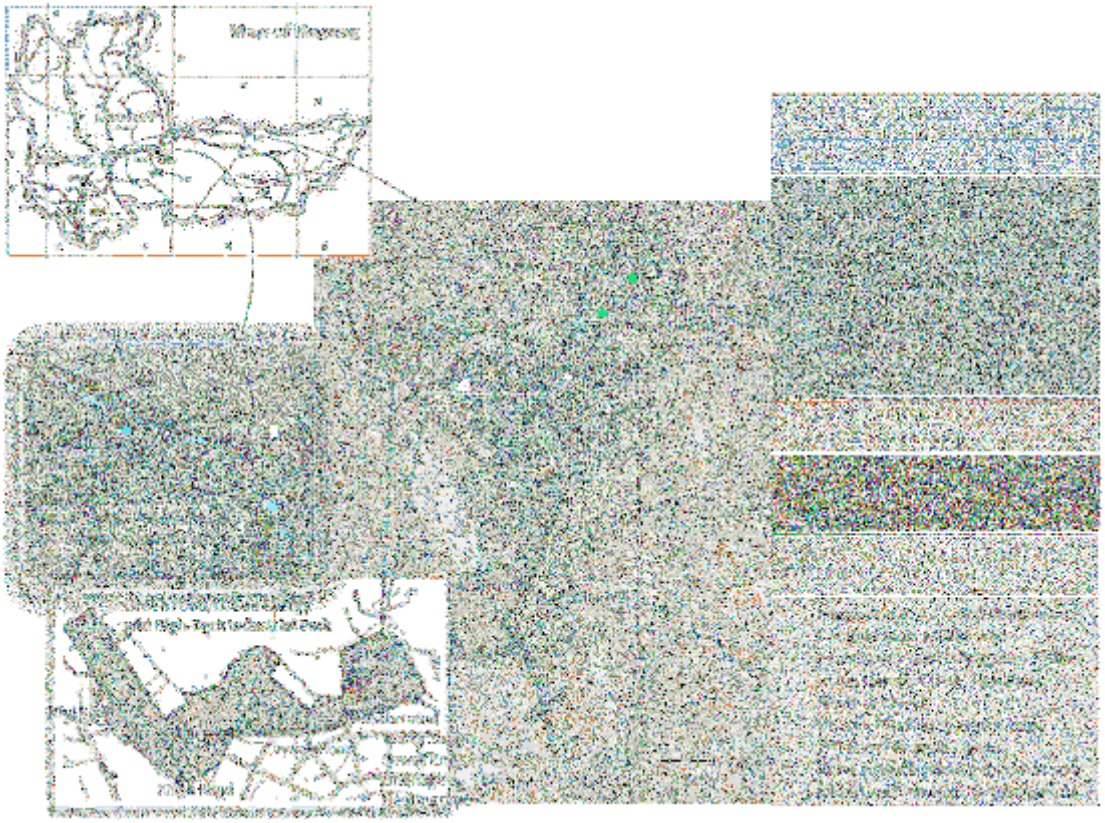


Figure IV-2: Layout of Hegang engineering components

1. HG 2.1 Green Food, Green Energy and High-Tech Industrial Park Infrastructure and Business Support Facilities

a. Road and Related Utilities

49. The Hegang Economic Development Zone is a provincial level development zone established in 2008, with an area of 35.05 km^2. The zone comprises four sub-zones: a coal chemical industry park, a graphite fine processing industrial park, a green food industrial park and a high-tech industrial park. The high tech industrial park aims to promote strategic emerging industries, providing a research and development center and incubator. The high-tech industrial park has developed a rice utilization research center and introduced biological protein and pharmaceuticals companies. The green food industrial park has 30 enterprises, and has developed a rice processing chain and soybean production chain. However, there are some issues with the planning and construction of the development zone. It is located on the outskirts of the city, with the main road connections being Heyi Road (S303) and Caifu Road as shown in **Figure IV-3**. The current intersection of the two roads is at a sharp angle, endangering drivers and other road users. Furthermore, internal roads of the development zone are sub-standard, having poor quality concrete surface and a narrow width of around 5 m which cannot meet the current traffic demand. The poor conditions and problems of the existing roads and facilities have hindered development, and also caused inconvenience to residents in the area.

Figure IV-3: Current road access to Hegang economic development zone (HG)

50. To rectify the situation, the project will improve the Heyi Road/Caifu Road junction, and upgrade three roads within the development zone with a total length of 6.25 km, a total car way area of 108,300 m^2, and a total NMT area of 42,100 m^2. The Xiyi Road and Xisan Road are located in the high-tech industry park, while the Lvyuan Road is located in the green food industry park, as shown in **Figures IV-4** and **IV-5**.

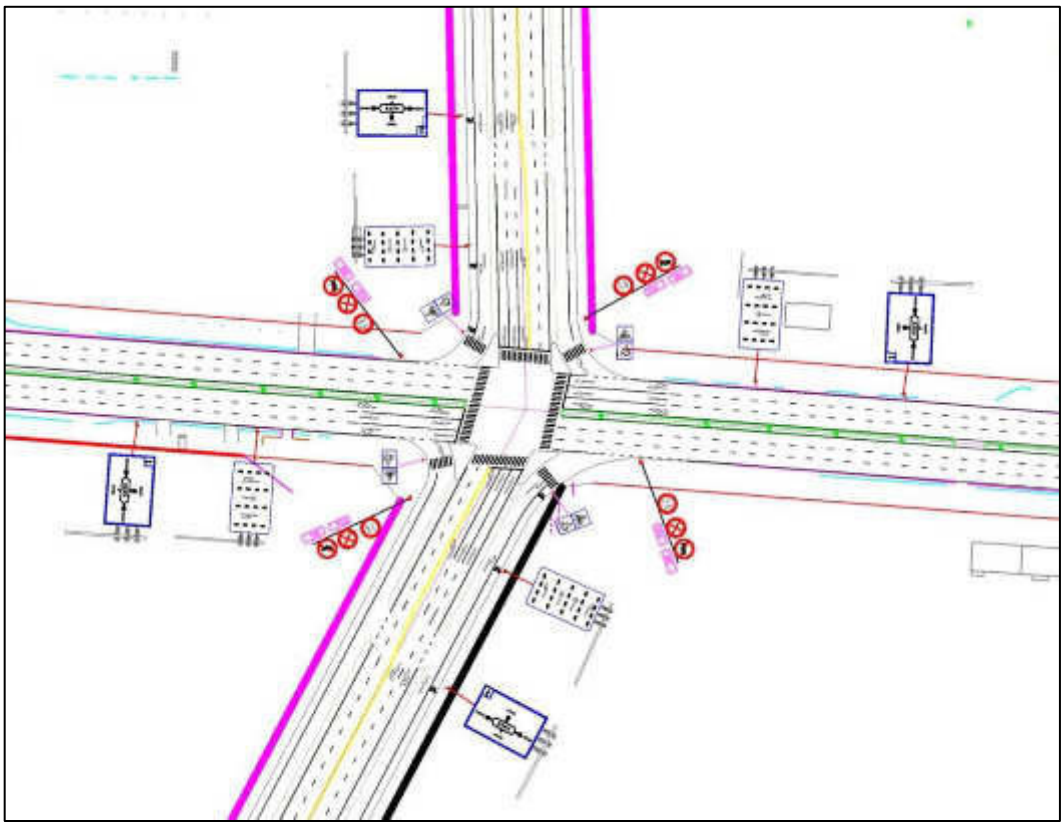


Figure IV-4: Proposed design of Xiyi road/Heyi road intersection (HG)

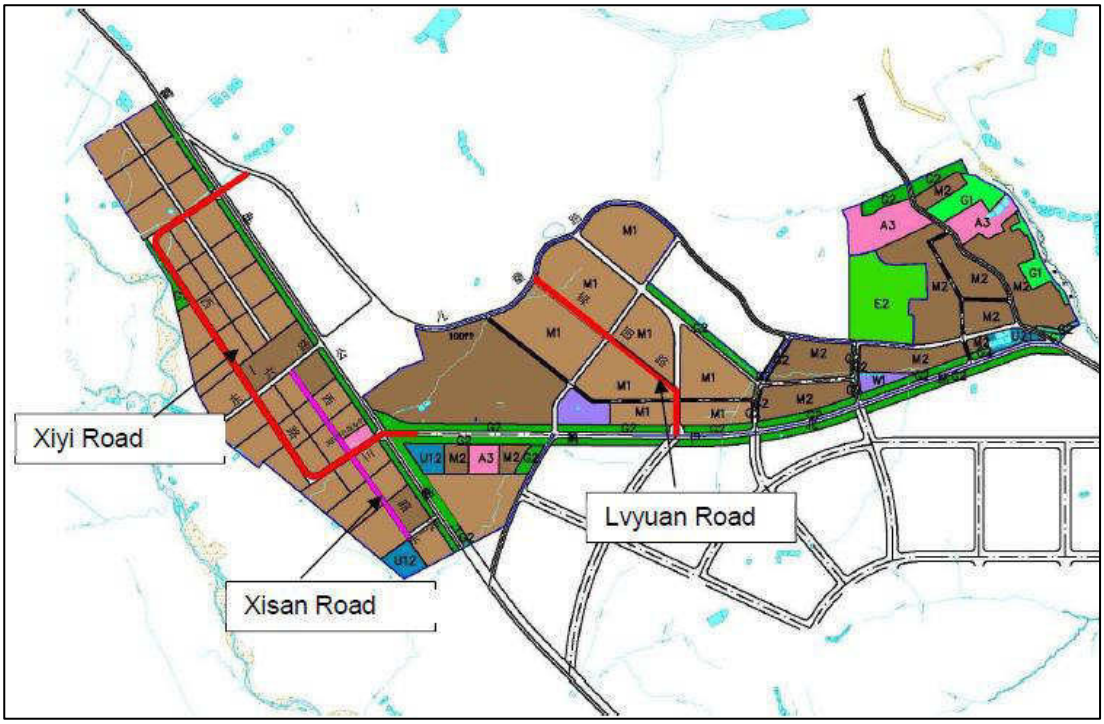
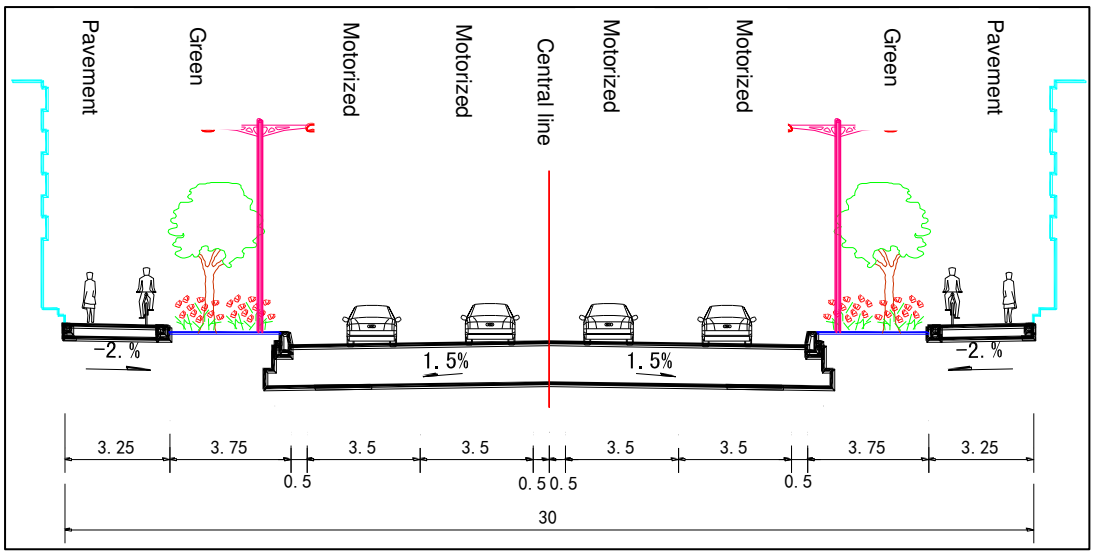


Figure IV-5: Layout of proposed road improvements (highlighted in red) for Hegang economic development zone (HG)

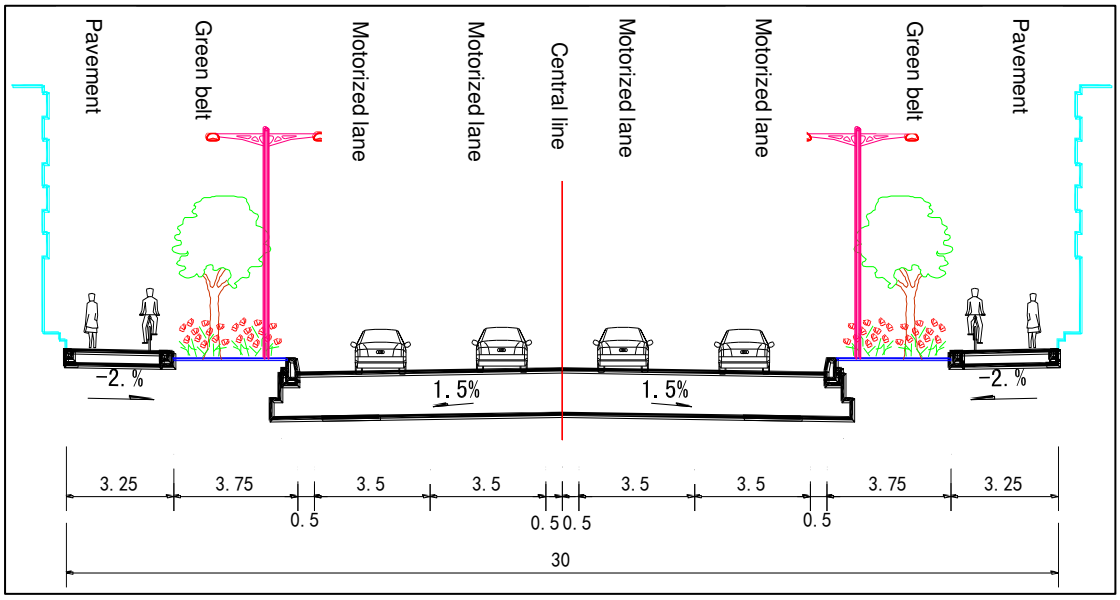
51. Xiyi Road and Lvyuan Road are designed as arterial roads, and Xisan Road as a secondary road. All the three roads will have a width of 30 m, and design criteria as shown in **Table IV-3**. The planned cross section of each road is illustrated in **Figure IV-6**.

Table IV-3: Key design standards for proposed roads in Hegang Industrial Park (HG)

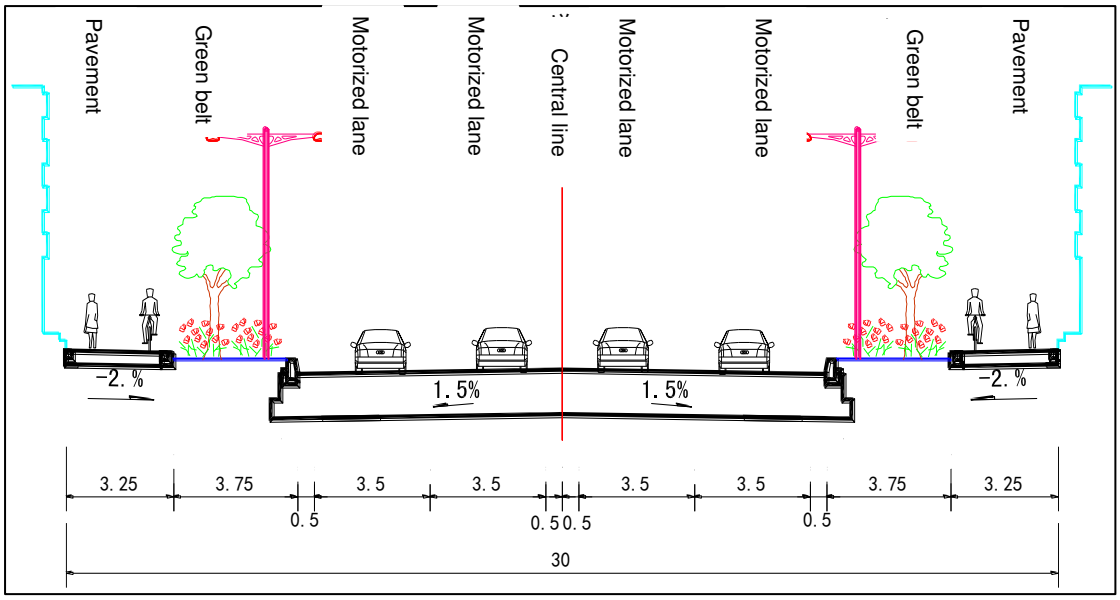
Item	Standard
Design Speed (Km/h)	60 (Arterial road)/ 50 (Secondary road)
Design Life (Y)	15
Design Axle Load	BZZ-100
Minimum Road Gradient (%)	0.3
Maximum Longitudinal Gradient (%)	4.5
Surface material	Asphalt Concrete



Xiyi Road



Lvyuan Road



Xishan Road

Figure IV-6: Cross-sections of proposed roads for Hegang Industrial Park (HG)

52. Municipal water supply, sewage, drainage and heating pipelines will be laid along the roads. Landscape design along the roads will integrate local natural and cultural features, as well as signage, streetlights etc. The total area of greening along the roads is 46,875 m^2.

b. Service Center

53. In addition to the roads, an 8000 m^2 service center will be constructed between the green food industrial park and high-tech industrial park to provide information services, training, exhibition facilities, and a business incubator.

2. HG 2.2 Luobei County High-tech Graphite Based Materials and E-Mobility Industrial Park – Infrastructure (WWTP)

54. The Luobei Yunshan Graphite Industrial Park is located in 32 km west of Luobei county downtown, with a total planned area of 476.16 ha (**Figure IV-7**). The park was founded in 2003, and now includes 17 graphite related enterprises. It has a total graphite production capacity of 3 million tons per year, and a fine graphite production capacity of over 300,000 tons per year, making it the largest producer of fine graphite in the PRC. Currently, industrial wastewater discharged from the factories is stored in a large temporary sedimentation basin, before being reused for coal washing. The size of the pond mean that there has been no previous requirement to remove and dispose of accumulated sediments. As the industrial park is being expanded, additional wastewater treatment facilities are proposed to increase the volume and quality of treated wastewater for additional reuse options.

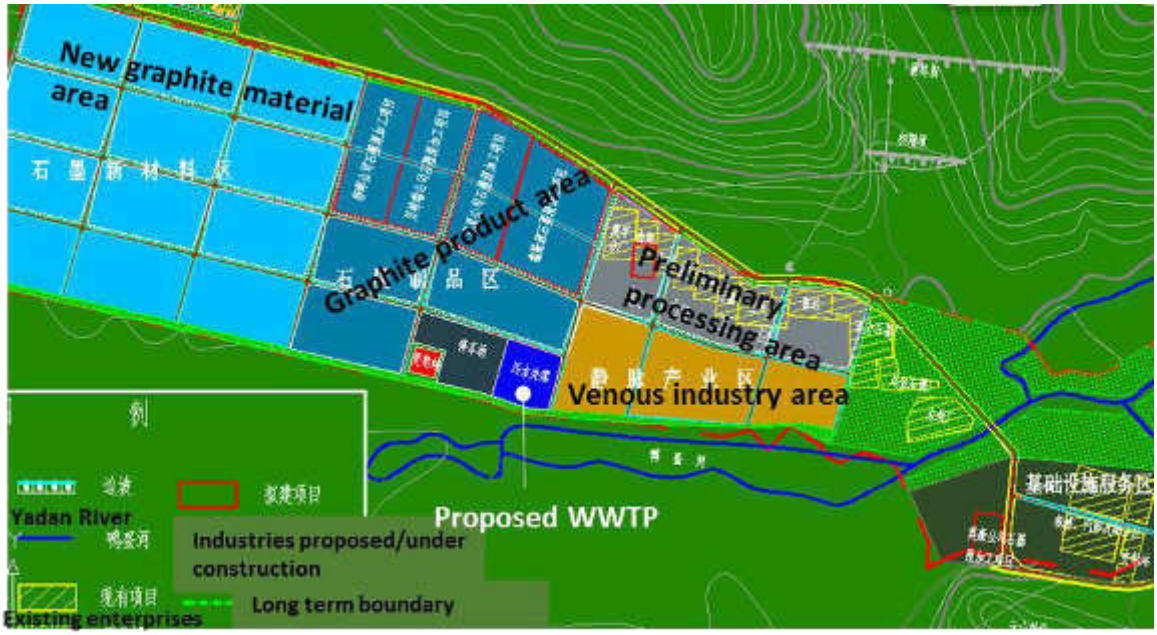


Figure IV-7: Layout of the Luobei Graphite Industrial Park (HG)

55. The production capacity of the park for graphite fining is 33,000t/a. During production processes, industrial wastewater generated from graphite fining production line will be 5,940 m^3/d (**Table IV-4**). Therefore a 6,000 m^3/d WWTP is proposed under this project.

Table IV-4: Wastewater Flow Prediction in the Hegang Industrial Park (HG)

Graphite Company	**Production Capacity t/a**	**Wastewater Flow Prediction m^3/d**
Aoxing New Materials Ltd. Co.	10,000	1,800
Luobei Fuda Graphite Ltd. Co.	1000	180
Baoquanlingnongkenyixiang New Energy Company	2,000	360
Xinshun High Carbon Graphite Materials Company	5,000	900
Baoquanilnnongkendiyuan Mining Ltd. Co.	5,000	900
Yunshan Carbon Production Ltd Co.	10,000	1,800
Total	**33,000**	**5,940**

56. The graphite fining process adopted in the park uses the sodium hydroxide method, which results in wastewater containing various types of salts. The proposed design process to treat this wastewater has been developed to address this, and is summarized in **Figure IV-8.** Treatment will include: equalization tank and lift pump, coagulation tank, sand filter, membrane filtration (comprised of ultrafiltration, softening system, RO membrane filtration, high-efficiency RO membrane filtration, STRO system, evaporation system), sludge dewatering room, clean water tank, and effluent pump station.

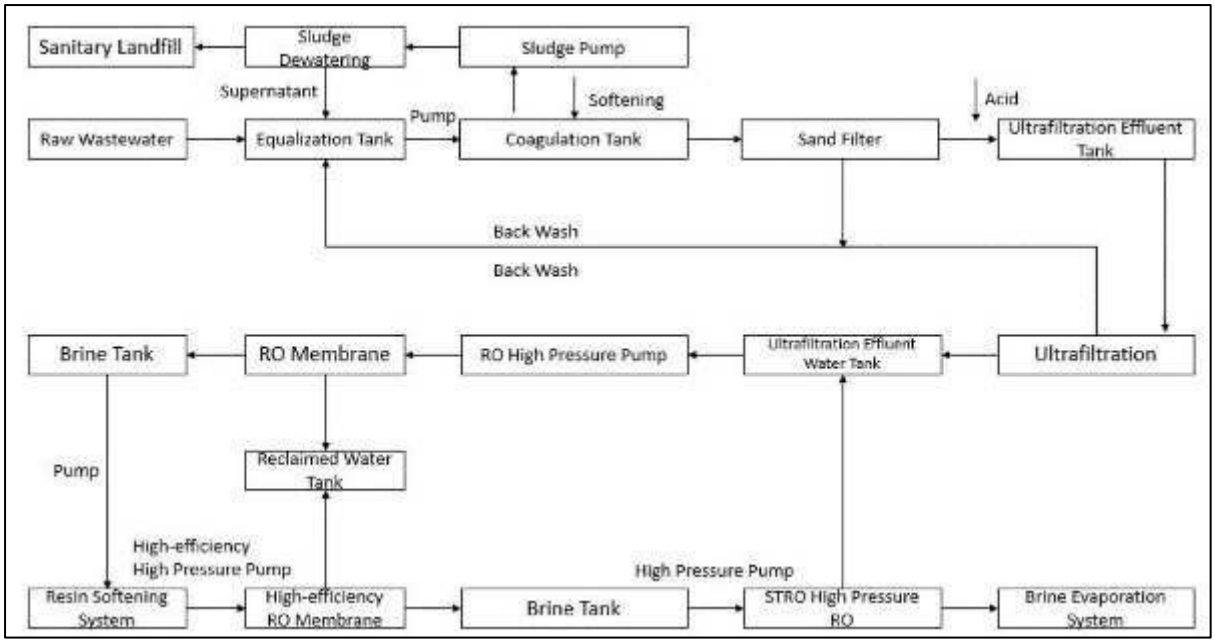


Figure IV-8: Process diagram for Luobei WWTP (HG)

57. To support reuse of treated wastewater, 11.5 km of pipelines will be constructed linking industrial facilities in the park with the WWTP.

3. HG 3.1 Remediation of Open Pit Mine/Waste Rock Dump-site Rehabilitation

58. Lingbei Mine is an open pit coal mine located in the Dongshan district between Hegang old city center and a new residential resettlement area (Yanhe community). The total area of the pit comprises approximately 110 ha, extending about 1.5 km in north-south direction and 0.8 km in an east-west direction. Commercial production at the mine started in 1966 and was expanded in 1974.

59. The south eastern part of the mine contains approximately 100,000 t of coal that will be mined before expected closure in late 2017. The western part of the mine has already been filled by using waste rock and construction waste, and other parts of the mine are currently being backfilled. Environmental issues that need to be addressed during remediation of the mine include:

- **Geological hazards.** Current backfilling methods are sub-standard, as fill material is not compacted, leading to potential settlement issues in the future. Furthermore, the eastern slope of the mine is steep and unstable, posing a risk to the Yanhe community adjacent to the mine.
- **Water quality.** The waste rock, construction waste and domestic waste in the mine can potentially contaminate surface run-off and leachate after rainfall events. Heavy metal contamination and leachate acidification are particular concerns for abandoned coal mines.
- **Air quality.** The large quantity of waste rock at the site can generate significant amounts of dust, and currently there are no dust-suppression measures in place at the mine. Furthermore, waste rock with a sulfur content $\geqslant$3% is liable to combust when exposed certain atmospheric conditions (with sufficient moisture and oxygen). Such combustion can generate toxic sulfur-containing gases that will pollute the atmosphere around the mine.

60. The remediation project will take advantage of the central location of Lingbei Mine to

benefit local residents. In the short term, the site will be used for public green open space. In the long-term, the site offers potential for mixed-use urban development. To facilitate both these uses, a road connection from north to south linking Dongxing Road and Nanyi Road will provide a bypass and access to the area as well as potential road and pathway connections east-west linking the future green space and development with the old downtown and the eastern residential community. A municipal solid waste transfer station will also be constructed at the mine to manage illegal solid waste dumping. However these works are to be conducted by local government, and do not form part of the ADB project.

61. The plan for remediation, reclamation and reuse of the former pit mine will be divided into three phases, with Phase 1 being financed by the ADB loan:

(i) Phase 1 (**Figure IV-9**) will cover approximately 48.2 ha of the northern sector of the mine, including construction of a public park. An existing green vegetated area in the south of the pit will be made safe and accessible to the public through slope improvement works, and further enhanced through landscaping works. Phase 1 will also include construction of the north-south road and public green corridor linking Dongxing Road with Nanyi Road. Remediation and land formation to be undertaken in Phase 1 will comprise the following works:

- **Geological surveys.** Site investigations will be undertaken to facilitate detailed design of subsequent geotechnical and construction works.
- **Site formation works** Areas to the west and north of the mine (totaling 23.6 ha) will be levelled, compacted and sealed with a 30 cm thick layer of clay. Topsoil will be laid over the clay for future landscaping. The clay and any additional waste-rock fill required will be sourced from the original Meilinmuye Company. Top-soil will be taken from the Dongshan Industrial Park, which is currently under construction about 2km from the mine.
- **Slope improvement works.** Existing slopes in the mine will be stabilized (the nature of required geotechnical works will be established during detailed design phase), sealed with clay and covered with top soil.
- **Road construction.** A 3.85 km north-south road and public green corridor will be constructed to the east of the mine.
- **Revegetation.** A total area of 13.7 ha of newly formed areas to the north and west of the mine, stabilized slopes and the north-south road will be revegetated with grass and *Pinus sylvestris*.

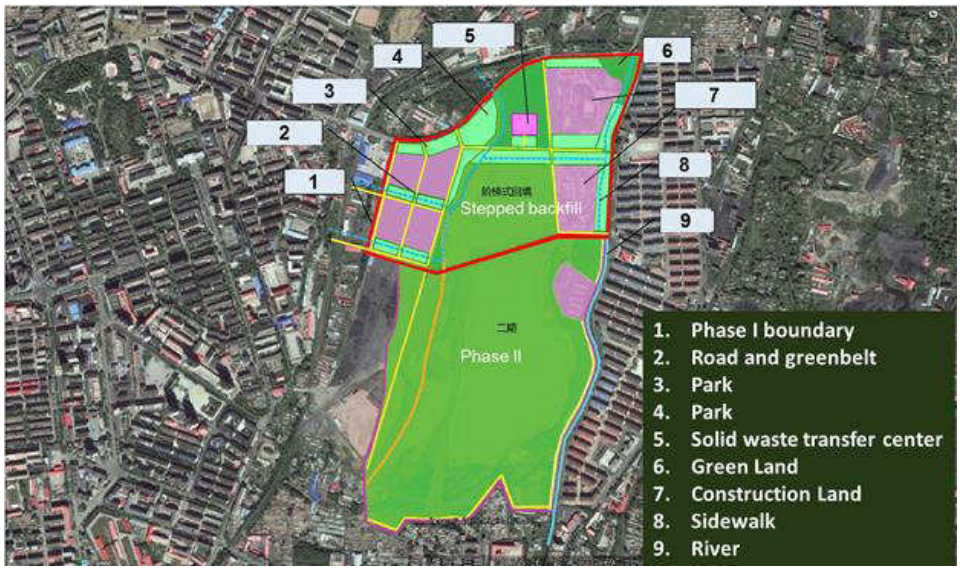


Figure IV-9: Remediation of Lingbei Mine Phase 1 (HG)

(ii) Phase 2 (**Figure IV-10**) will include an expansion of green parkland in the north, and in the south, consolidation and preparation of land for filling on the east and north slopes of the mine along with the planning and construction of east-west roads from downtown to the site, providing access to the expanded parkland. This parkland will be established after further filling, compaction and cover with topsoil of the re-graded areas. Subsequent investigations of soil quality and suitability of future land uses will be conducted. Further green parks along the east-west axis are planned to provide open space for urban residents and future land uses in the Phase 3 development. Phase 2 will also include a phasing out of some of temporary uses in anticipation of more permanent land use to be established in Phase 3.

Figure IV-10: Remediation Lingbei Mine phase 2 (HG)

(iii) Phase 3 (**Figure IV-11**) is planned to include a second north-south road (west of the mine and east of the planned road from Phase 1). The newly formed blocks between the streets

are ready for urban development. The remaining works to be undertaken in Phase 3 include further filling with waste rock, coal sludge/construction waste stabilization, land profiling, capping and landscaping to create a permanent large urban park with ecological, recreational, educational, and cultural features.

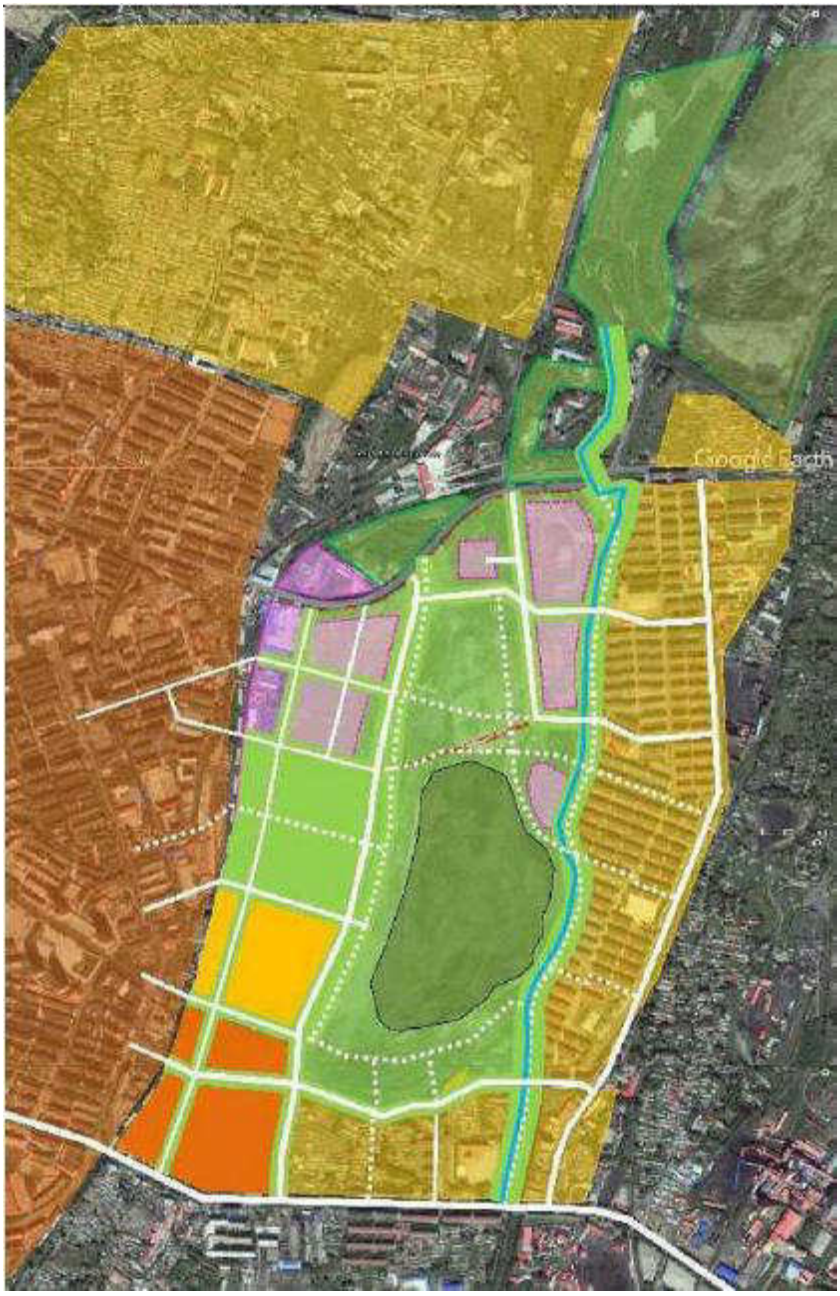


Figure IV-11: Remediation Lingbei Mine phase 3 (HG)

4. HG 4.1 Integrated River Rehabilitation and Cleanup from Mining and Ecosystem Based Adaption (Shitou River, Qianjin Creek, Heli River, Xiaoheli River)

62. Existing rivers and drainage channels in Hegang offer low levels of flood protection: in some cases the design standard can only accommodate 1-10 year flood event. This situation is a result of narrow river channels, low embankments on the sides of the channels and sediment deposition as a result of industrial pollution. Due to the urgent need for flood protection, the government will start construction in 2018 of gabion banks to provide 1-20 year flood protection along 1.94 km of Xiaoheli River and 4.82 km of Heilhe River. The ADB loan

will finance subsequent improvement works (including sections of the rivers already provided with gabion banks by the earlier government project) to address these issues in the longer term by improving drainage performance of three river channels to 1-50 year design standard and one creek to 1-30 year design standard. The works will comprise widening and dredging river channels and some minor retraining required at bottle-necks where sharp changes in river course leading to localized flooding. The location of these channels is shown in **Figure IV-12**, and the proposed works summarized in **Table IV-5**.

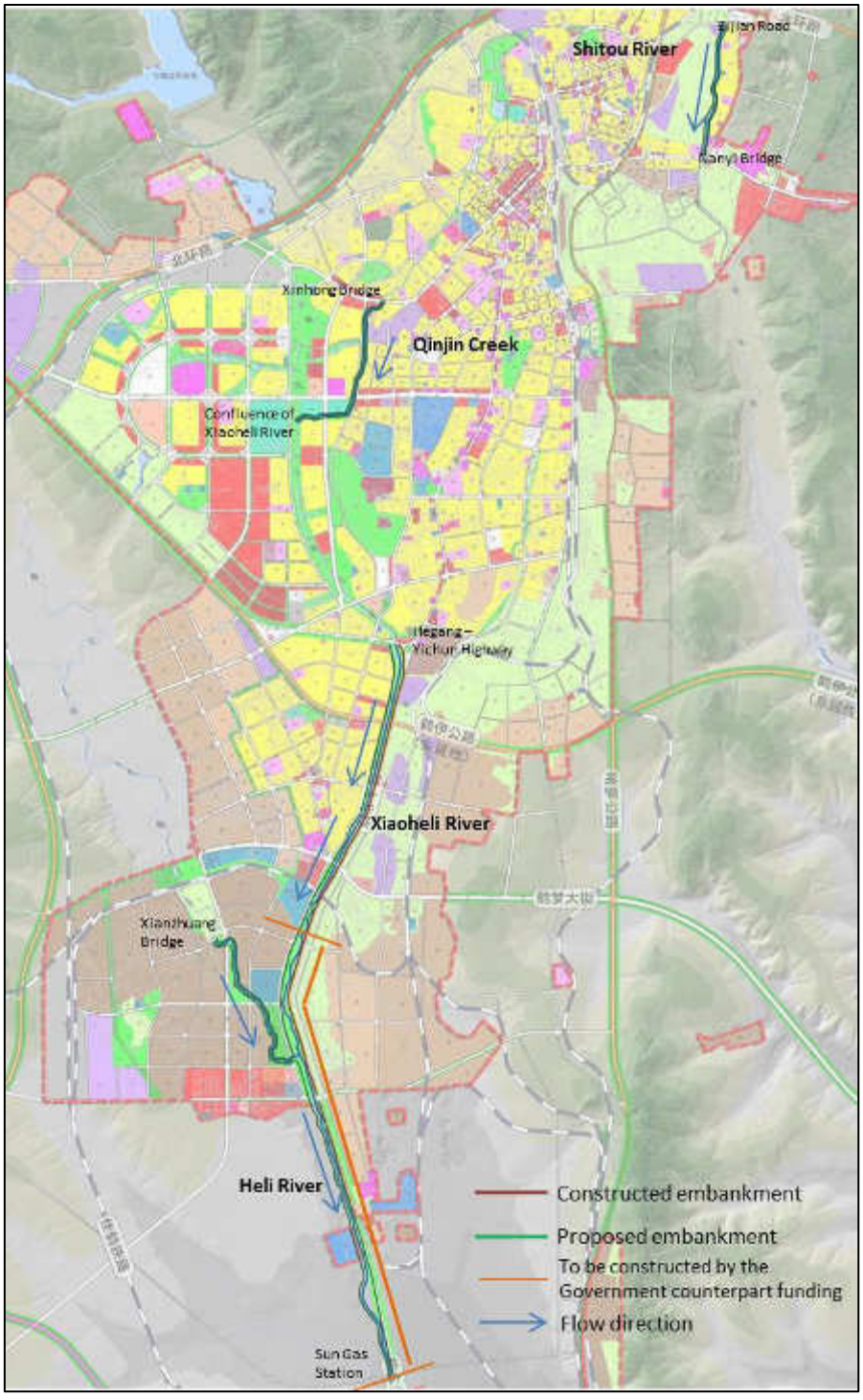


Figure IV-12: Location of proposed river rehabilitation works (HG)

Table IV-5: River rehabilitation components (HG)

River name	Length (km)	Start Point	End Point	Remark
Heli River	7.90	Tongyuan Road	Sun Gas Station	4.82 km of Heilhe River will be constructed by Government in 2018 to achieve 1 in 20 year flood protection. The whole section of 7.9 km will be further improved under this project to 1 in 50 year flood protection.
Xiaoheli River	6.60	Hegang – Yichun Highway	Confluence of Heli River	1.94km Xiaoheilhe River will be constructed by Government in 2018 to achieve 1 in 20 year flood protection. The whole section of 6.60 km will be further improved under this project to 1 in 50 year flood protection.
Qianjin Creek	3.3	Xinhong Bridge	Xiaoheli River	1 in 20 year flood protection
Shitou River	2.11	Dongxing Road Bridge	Nanyi Bridge	1 in 50 year flood protection

63. In addition to flood control, river rehabilitation works will incorporate ecological and landscape enhancement measures. Channel banks will incorporate ecologically friendly materials to allow the establishment of riparian, emergent and aquatic vegetation, and green belts up to 30 m wide will be provided on one or both sides of the river channel and planted with native tree species. The total greening area across the five restored channels will be about 0.75 million m^2. Typical sections of restored river sections with enhancement features and green belt are shown in **Figure IV-13** to **IV-16**.

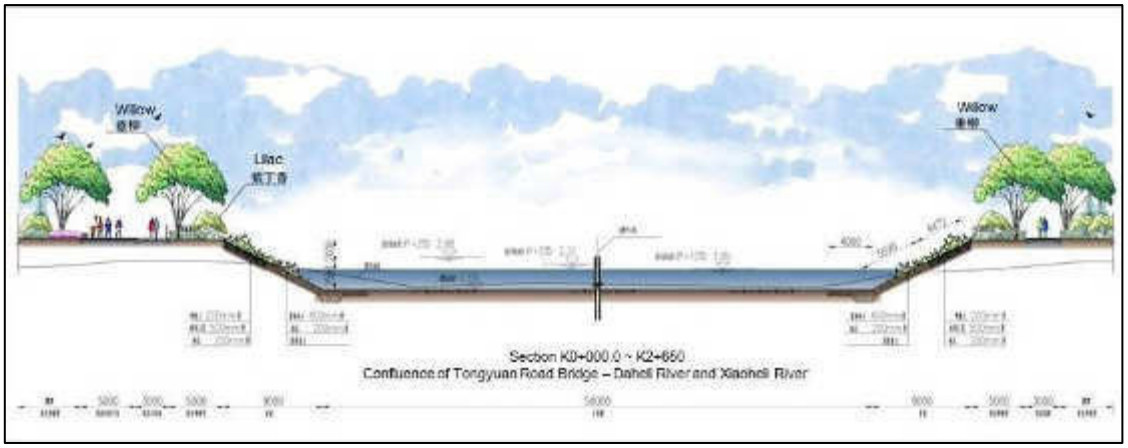


Figure IV-23: Typical rehabilitated section of Heli River (HG)

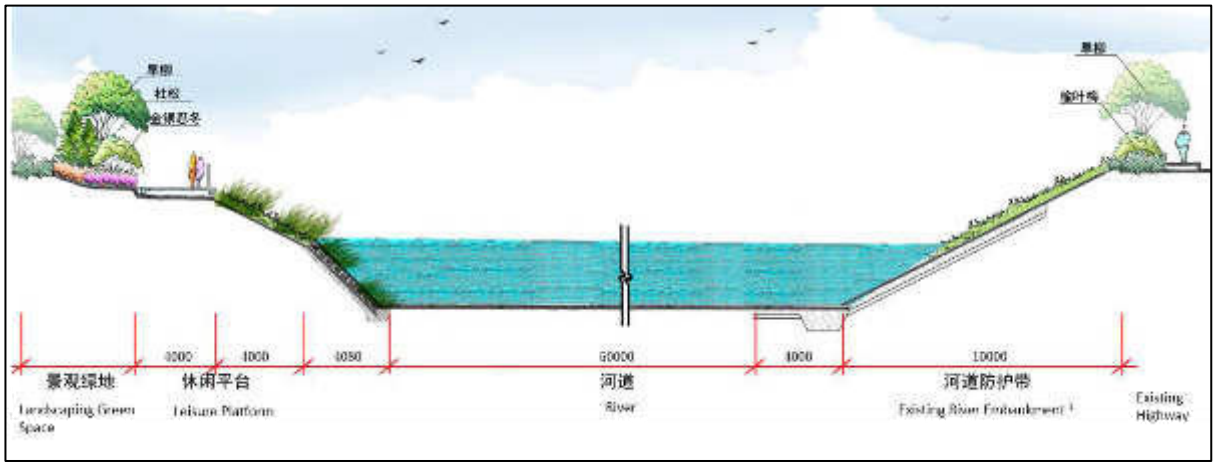


Figure IV-34: Typical rehabilitated section of Xiaoheli River (HG)

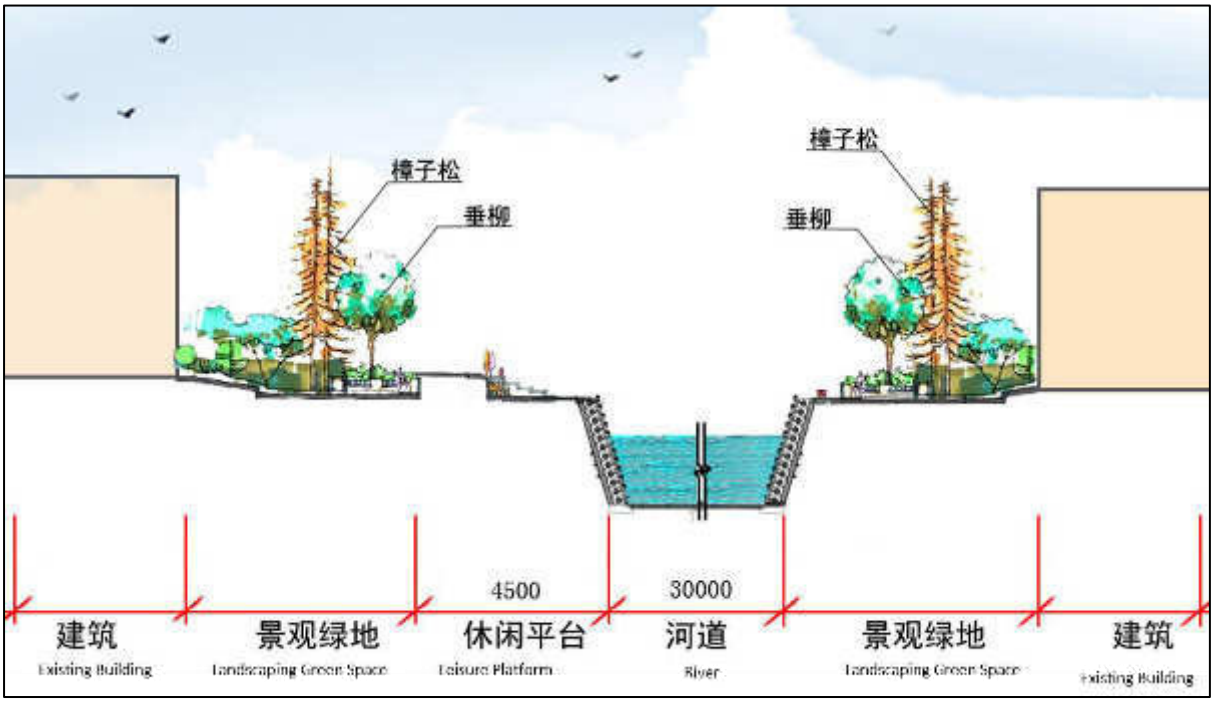


Figure IV-45: Typical rehabilitated section of Qianjin Creek (HG)

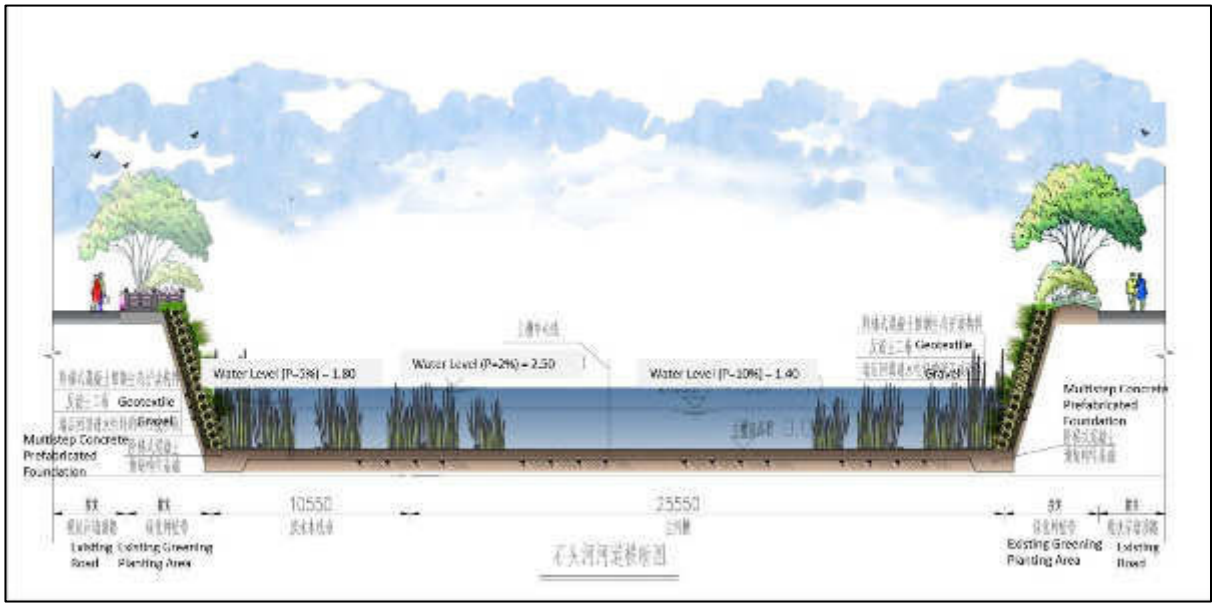


Figure IV-56: Typical rehabilitated section of Shitou River (HG)

64. Dredged sediments will be dewatered (to less than 60% water content) on-site. The dredged sediment will be mixed with lime to accelerate the dewatering process. Dewatered sediments will be transported to the sanitary landfill site of Hegang for final disposal.

5. HG 4.2 District Heating System Energy Efficiency Improvements

65. The existing heating networks in Hegang have been in service for decades. Some parts are in poor condition with leakages causing significant heat and water loss, low energy efficiency, and increasing the risk of accidents. The network is in urgent need of retrofitting and expansion. Pipelines with significant leakage or longer than 15 years of service have been selected for priority replacement.

66. Currently the Chengji Water, Power and Heating Company is in charge of the heating networks. The northern part of the network with a service area of 5.4 million m^2 takes heat from the coal-fired Longmei Hegang Cogeneration plant. The southern part network with service area 5.0 million m^2 takes heat from the Longmei Lida Waste Rock Cogeneration Plant.

67. The project will retrofit heating networks by replacing 6.6 km primary network (by pipe trench) and 65.2 km secondary network (26.2 km by direct bury and 39 km by pipe trench) with four exchange stations, and polyurethane will be used for insulation. To further improve energy efficiency, the project will also conduct pilot testing for building level heat exchange stations. Stations will be provided for eight selected buildings which were originally serviced by the Xiangyang Heat Exchange Station. The layout of the proposed facilities is illustrated in the **Figure IV-17**.

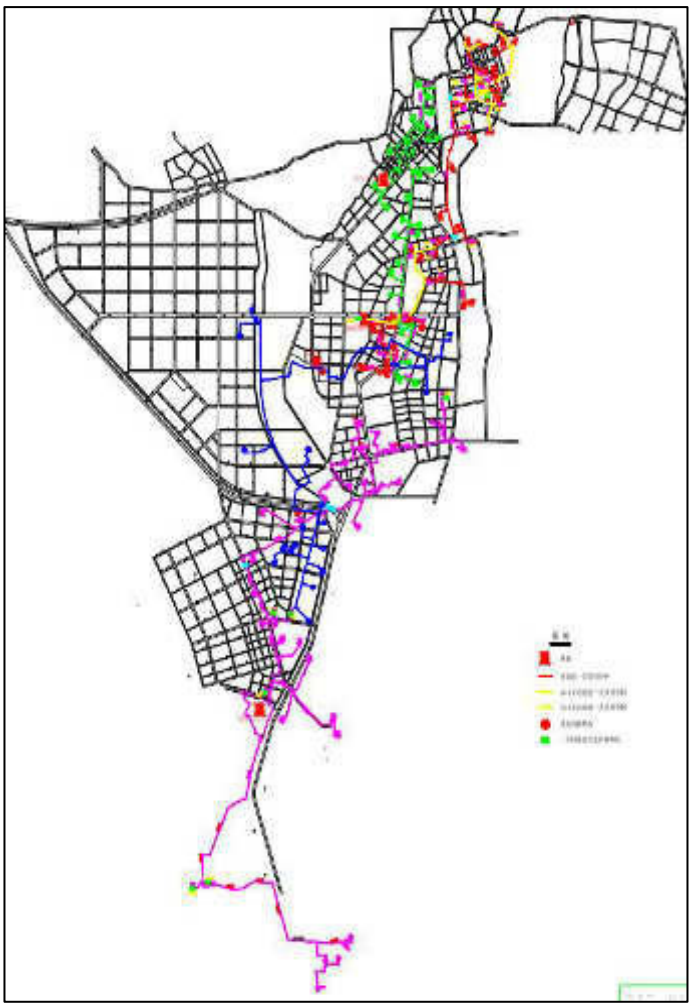


Figure IV-67: Layout of proposed facilities for heat network (HG)
(Yellow represents Primary network under this project. Green represents Secondary Network under this project. Red represents existing primary network)

6. HG 4.3 Road Rehabilitation, Public and Non-Motorized Transport Improvements

68. This component includes bus priority lanes covering most of the main roads in the downtown area, as well as widening and repaving walkways, reducing bus stop congestion, and upgrading the passenger information system at bus stops. It is also proposed to improve street landscaping, construct 10.4 km of drain pipelines, and improve 50 bus stops associated with the bus lanes. An Intelligent Transport System (ITS) including smart bus stops, smart traffic signal systems, passenger information system, traffic surveillance system and related devices will also be provided. The proposed works include four items:

a. Public transit networks

(i) Network construction

- Improve infrastructure along 35.3 km of roads including some road resurfacing.
- Construct separate bus lanes on selected roads to give priority to bus operation;
- Improve the design of bus stops including locations and length to reduce the boarding time of buses and provide passengers with more services;
- Redesign intersections including passenger islands to raise the efficiency and safety of passing flow (both vehicles and passengers);
- Design for NMT system and improve the green spaces on roads;
- Provide 10.4 km new drainage pipes during resurfacing work of the roads.

(ii) Intelligent construction for public transit

- Establish an ITS including passenger information system (web site for travel and smart LED boards on stations);
- Establish a surveillance system for operation of roads and bus stations, including cars entering bus lanes, passengers volume on stations, boarding buses and other abnormal cases identification and alarm;
- Implement signal control for bus priority at intersections, including traffic lights system, sensors on approach lanes.

b. Infrastructure construction for public transit

(i) Design new bus stations that are functional in extremely cold weather, including platform awnings, structures, communication and electricity facilities.

c. Traffic management and safety

(i) Signal control system

- Establish a traffic control system for intersections/sections of roads/areas of traffic control to reduce waiting times for queuing cars

(ii) Road safety surveillance and enforcement system

- Establish HD Video Surveillance at main gateways out of the city.

(iii) Road safety command system

- Establish a command system for collecting data for all vehicles under supervision and operation.

d. Road maintenance and emergency response

(i) GIS

- Establish an infrastructure database including all roads, bridges and pipes. Sensors will collect various data including construction date, details of accidents/damage etc. Maintenance planning can be arranged according to those data.

(ii) Road maintenance equipment

- Purchase various equipment/vehicles for road maintenance

(iii) Special vehicles for traffic safety

- Purchase engineering vehicles for communication, traffic facilities installation/maintenance, and equipment for emergency use

69. The main engineered item under these works will be the construction of separated bus lanes (3.5 m in width) along two North-South arterials of about 13 km in the city, and another 18 km for 14 roads. Typical sections for roads of different widths including new bus lanes are provided in **Figures IV-18** to **IV-20**. Other infrastructure and smart facilities included under this component will be constructed 34 roads throughout the city. The overall layout of works under this component is provided in **Figure IV-21**.

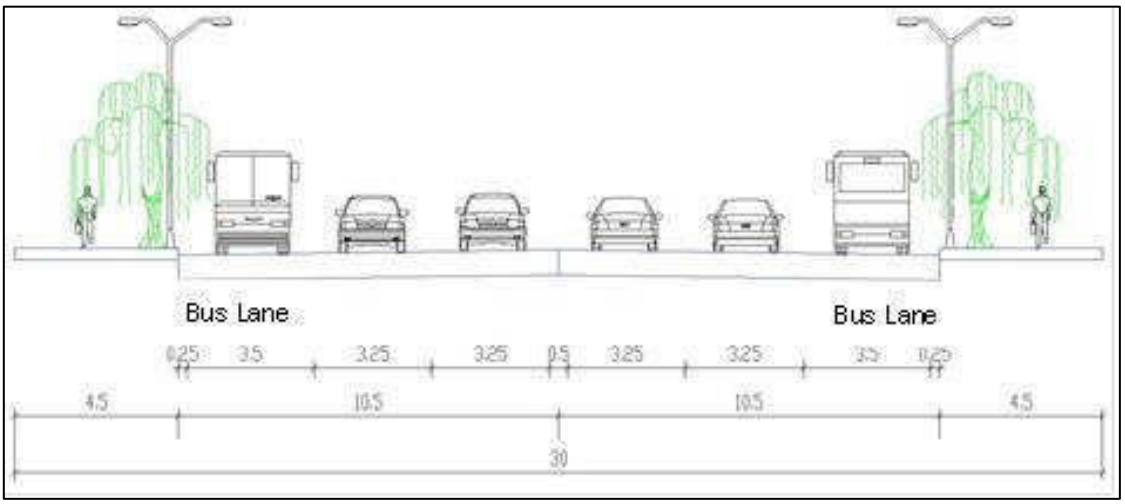


Figure IV-18: Cross-section of proposed 30 m wide road (HG)

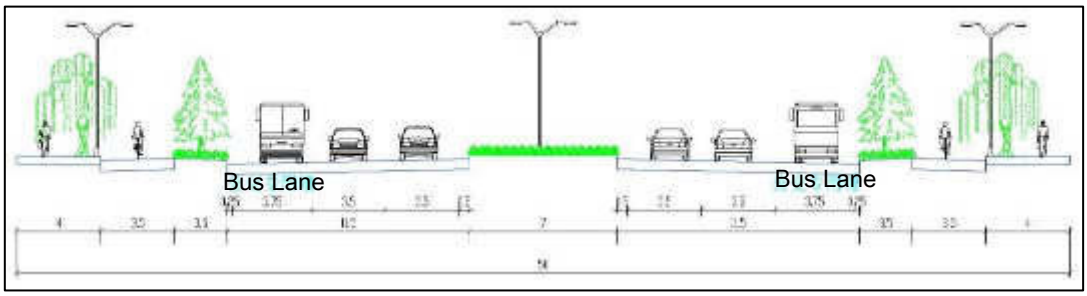


Figure IV-79: Cross-section of proposed 40 m wide road (HG)

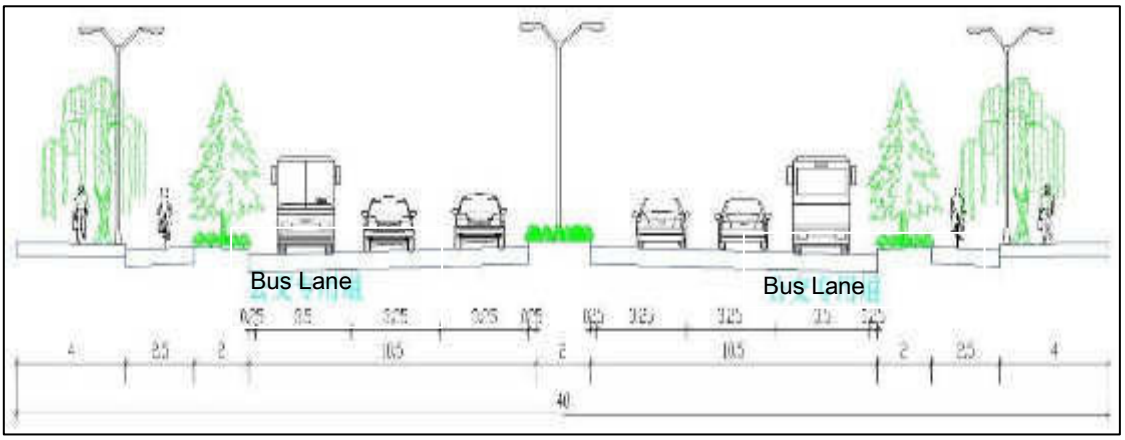


Figure IV-20: Cross-section of proposed 50 m wide road (HG)

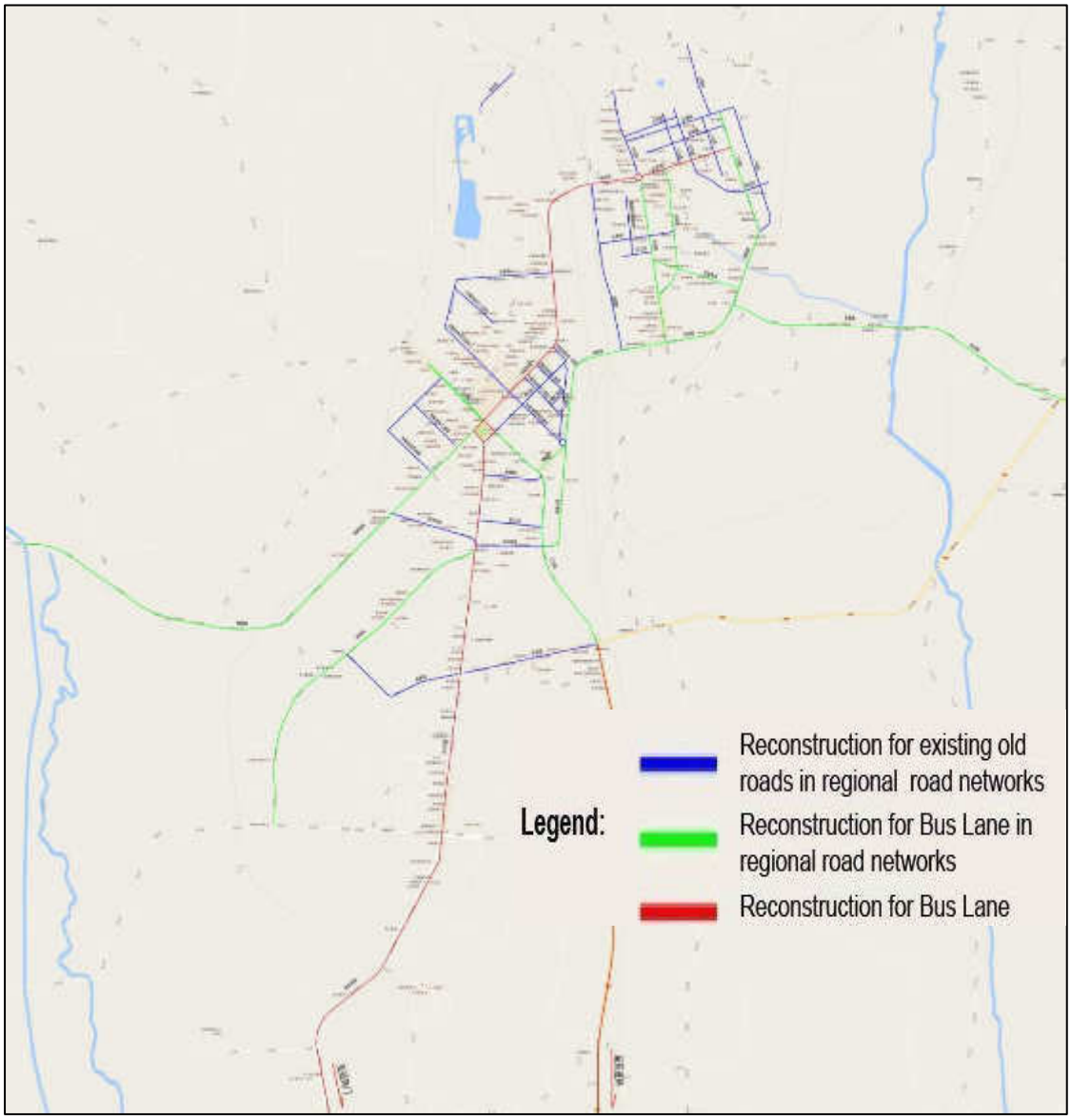


Figure IV-21: Plan of the road reconstruction, public and non-motorized transport improvements (HG)

E. Jixi

70. The engineering components in Jixi are presented in the **Figure IV-22**, and described in the following sections.

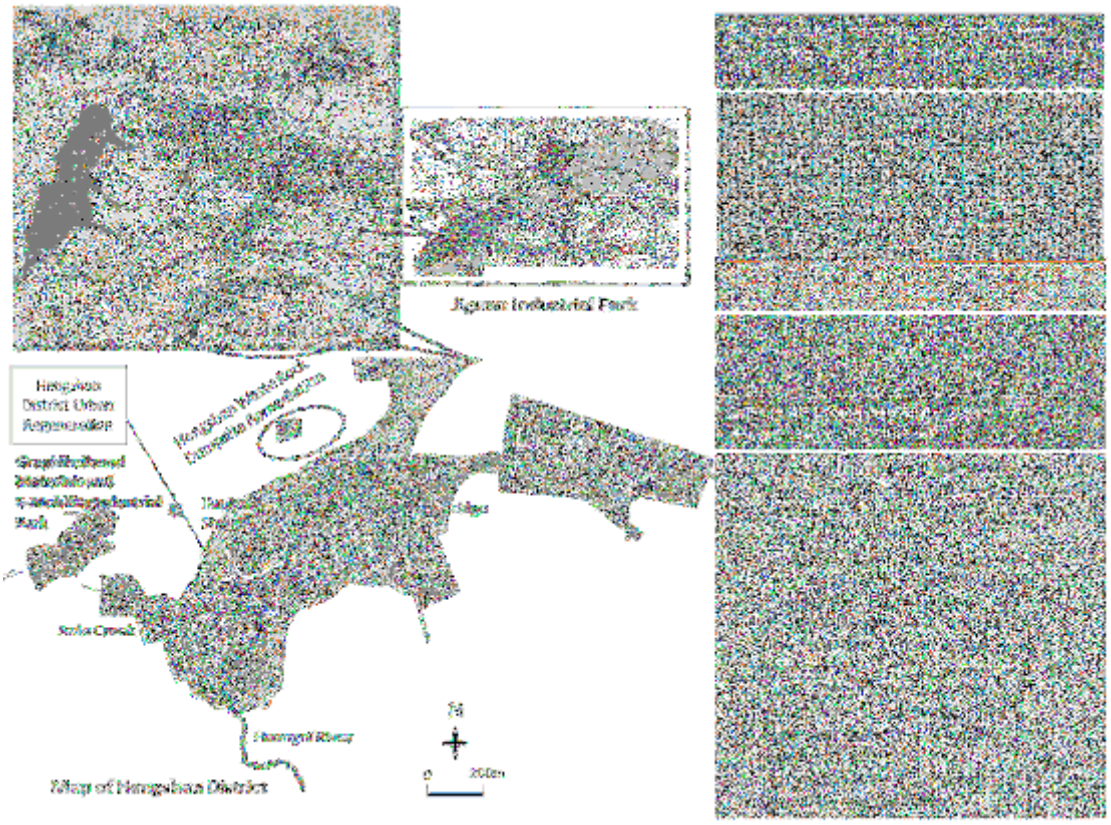


Figure IV-22: Location of engineering components of Jixi

1. JX 2.1 Hengshan District High-Tech Graphite Based Materials and E-Mobility Industrial Park – Infrastructure and Business Support Facilities

71. The Hengshan Graphite Industrial Park is located in the west of Hengshan District with a total planned area of 5.08 km^2, composed of three functional zones (**Figure IV-23**). Zone A, with an area of 0.82 km^2, is designed to produce high-purity graphite, spherical graphite, diamond powder, graphite paper, graphite seals, and lithium battery anode material. Zone B, with an area of 1.22 km^2, is targeting deep graphite processing products. Zone C, with an area of 2.81 km^2, aims to develop graphite sheet and other new graphite products. In addition, 0.23 km^2 of office and residential development is planned. Currently, Zone A as phase one is under construction. Eight enterprises have been introduced in Zone A so far.

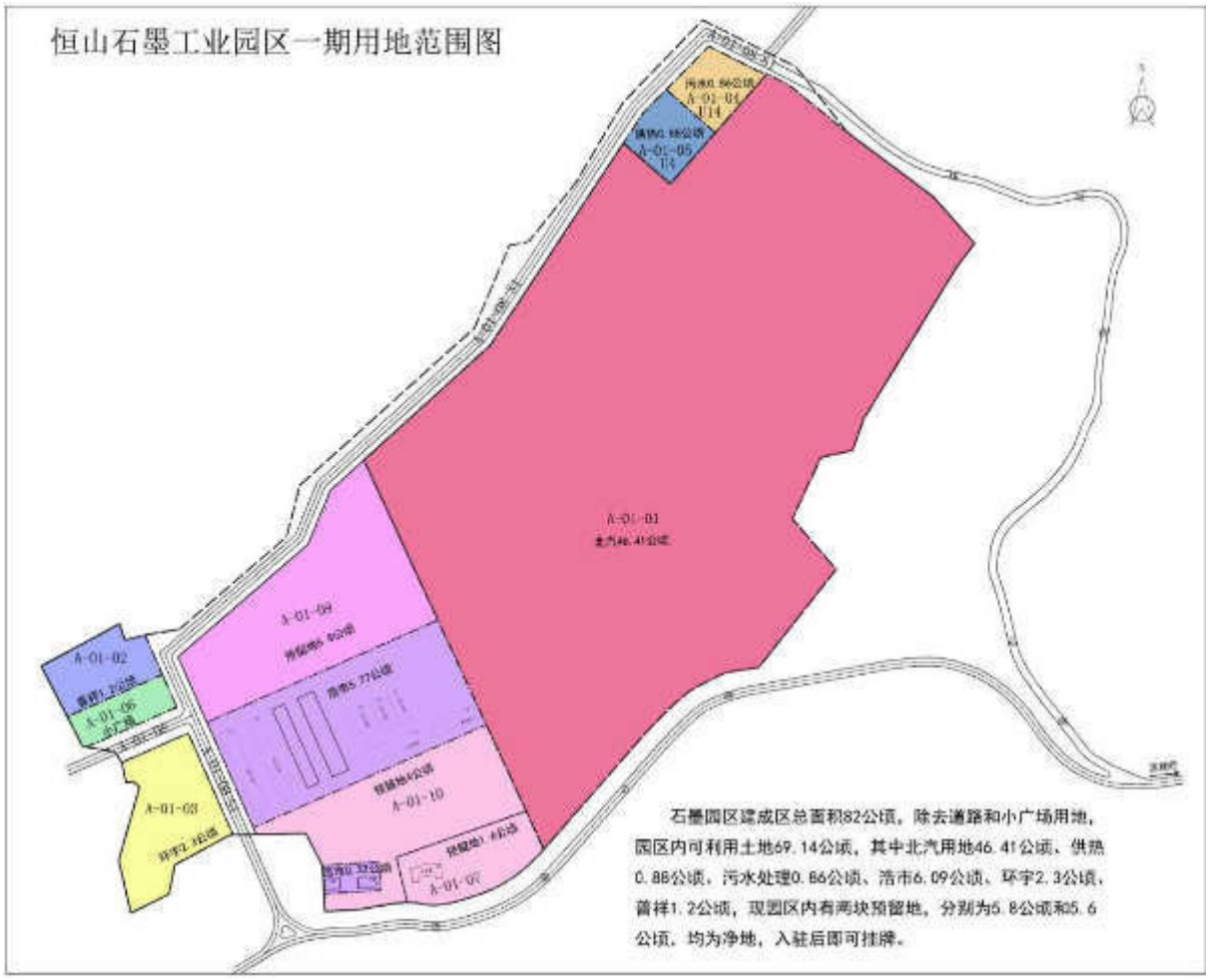


Figure IV-23: Layout of Hengshan Graphite Industrial Park (Phase one)

a. Roads and Utilities

72. The current Jixi Ring Road is an arterial road servicing the Hengshan District High-Tech Graphite Based Materials and E-Mobility Industrial Park. The road surface is concrete, and it has open drains along both margins. Due to the damage to the road surface from traffic and a lack of maintenance, the road condition is poor. To enhance development of the park, the project will enable rebuilding of the current ring road, and construct one new road (Central Road) in the park, together with the supporting utilities. The location of these works is shown in **Figure IV-24**, and further details of the works are provided below:

(i) **Roads.** The current section of the ring road adjacent to the park is 3.0 km long and has a width of 7 m. The design will coordinate with current conditions and improve from the aspects of surface quality, traffic safety as well as landscape. The new Central Road serves as an arterial road of city with a length of 1.3 km and a width of 3 m.
(ii) **Utilities.** Water supply, sewage, heating pipes and lighting facilities will be provided along 1.3 km of the newly built Central Road.

Figure IV-24: Location of Hengshan District High-Tech Graphite Based Materials and E-Mobility Industrial Park (JX)

73. The ring road will be rebuilt to meet current road alignment and related codes including road design, intersection and traffic safety facilities, as described in **Tables IV-6 and IV-7**.

Table IV-6: Main design standards for Ring Road and Central Road (JX)

Item	Standard
Road Level	Arterial Road of City
Design Axle Load	BZZ-100
Design Speed (Km/h)	50
Surface material	Asphalt Concrete
Design Life (Y)	15
Cross Slope (%)	1.5

Table IV-7: Widths for approach and exit at intersection (JX)

	Approach (m)		Exit (m)	
	For new building intersection	For rebuilding intersection	For new building intersection	For rebuilding intersection
Regular width for one lane	3.25	3.25	3.5	3.25
Minimum width for one lane	3.0	3.0	3.25	3.25

2. JX 2.2 Jixi City Wastewater Treatment and Discharge Infrastructure in the Industry Park of Jiguan District

74. Jiguan Industrial Park has a total planning area of 303 ha, and currently supports 26 enterprises, including pharmaceuticals, food processing, construction material production and logistics. The largest enterprises in the industrial park include: Heilongjiang Zhenbao Medicine Ltd. Co., Jixi Xingxing Mechanics Production Ltd. Co., and U.S.A. New Jixi Miercan Food Processing Ltd. Co. Currently, wastewater generated by the park is discharged to an existing domestic WWTP to the north. However, this facility does not have suitable treatment processes to deal with industrial wastewater. Furthermore, the predicted total wastewater flow from the industrial park (**Table IV-8**) is larger than the capacity of this WWTP. Therefore, a separate WWTP (20,000 m3/day) for the Jiguan Industrial Park will be constructed, with treated wastewater to be discharged to the nearby Muling River.

Table IV-8: Jiguan Industrial Park wastewater generation prediction (JX)

Item	Volume (m^3/day)
Comprehensive domestic water usage	2,100
Industrial water usage	18,082

Item	Volume (m^3/day)
Unforeseen water usage	2,018
Total water demand	22,200
Wastewater flow prediction (counted as 85%)	18,870

75. The WWTP is designed to meet Class 1A discharge standards. Influent (comprising wastewater from each enterprise) will be pretreated to meet Water Quality Standard for Wastewater Discharge into Municipal Sewer (CJ343-2010). The wastewater characteristics for wastewater inflow is predicted as SS=400mg/L, COD=500mg/L, BOD5=300mg/L, NH3-N=38mg/L, TN=40mg/L and TP=2mg/L. A flow chart of proposed treatment processes is shown in **Figure IV-25**.

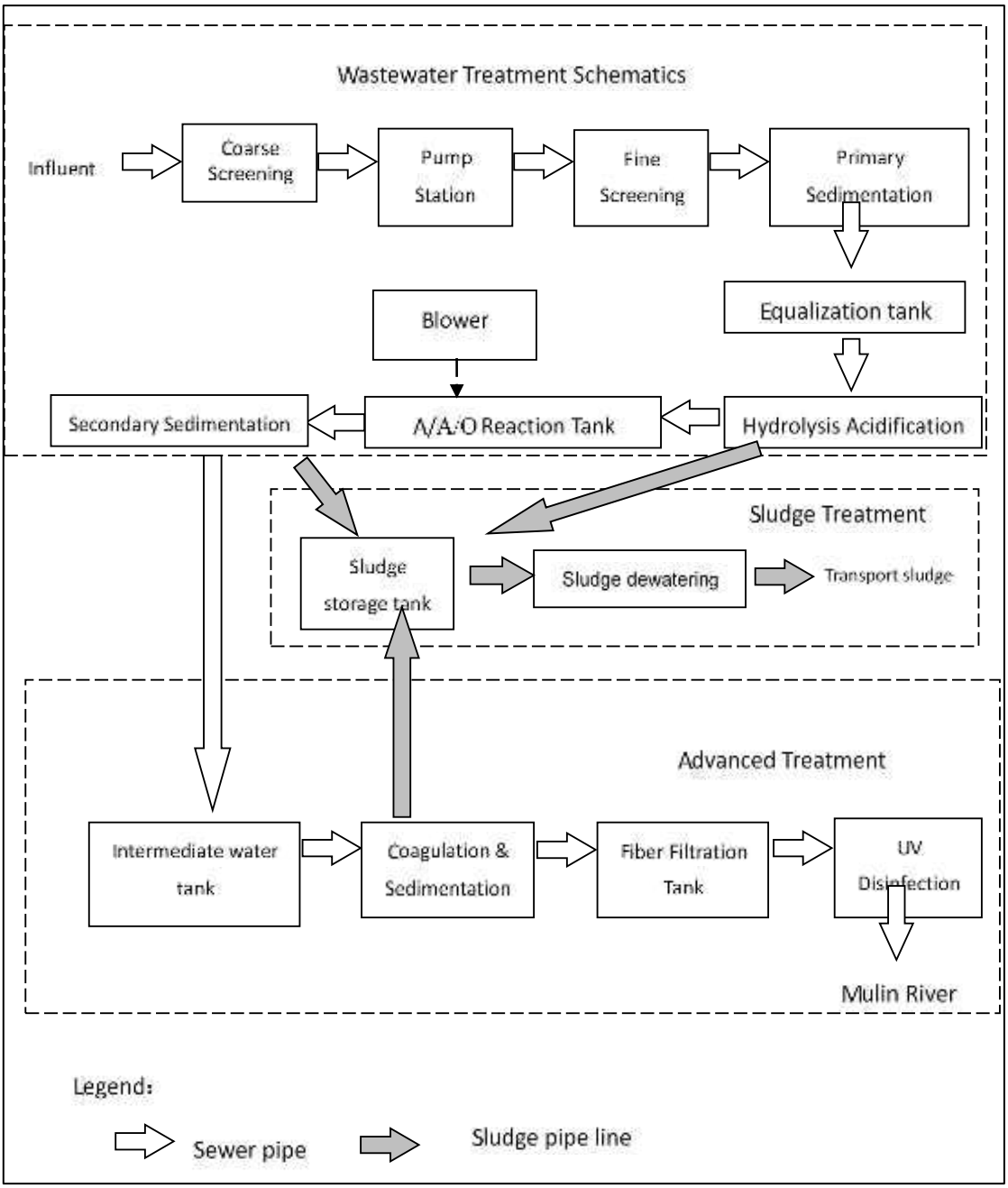


Figure IV-25: Jiguan Industrial Park WWTP treatment process schematic diagram (JX)

3. JX 3.1 Hengshan District Waste Rock Dumpsite Remediation / Safe Closure and Management of Former Mines

76. The project will address on-going environmental and safety concerns at a former mining area in Hengshan District, located north of and adjacent to an existing public open space (**Figure IV-26**). The mine was first established in 1911, and was finally closed on 1998 as the seam became uneconomical. There are various issues affecting the area, including:

- **Geological hazards.** The area has been affected by subsidence due to previous mining activities. An additional problem is historic and current underground fires, which affect ground stability of the areas above. Furthermore, the high temperatures generated by the fire burn off organic content in the soils above, leaving the area devoid of vegetation and prone to erosion.
- **Water Resources.** Mining operations and subsidence have affected the groundwater table in the area, risking heavy metal contamination and acidification of groundwater.
- **Air quality.** Underground fires generate toxic sulfur-containing gases that will pollute the atmosphere around the mine as it escapes from fissures in the rocks.

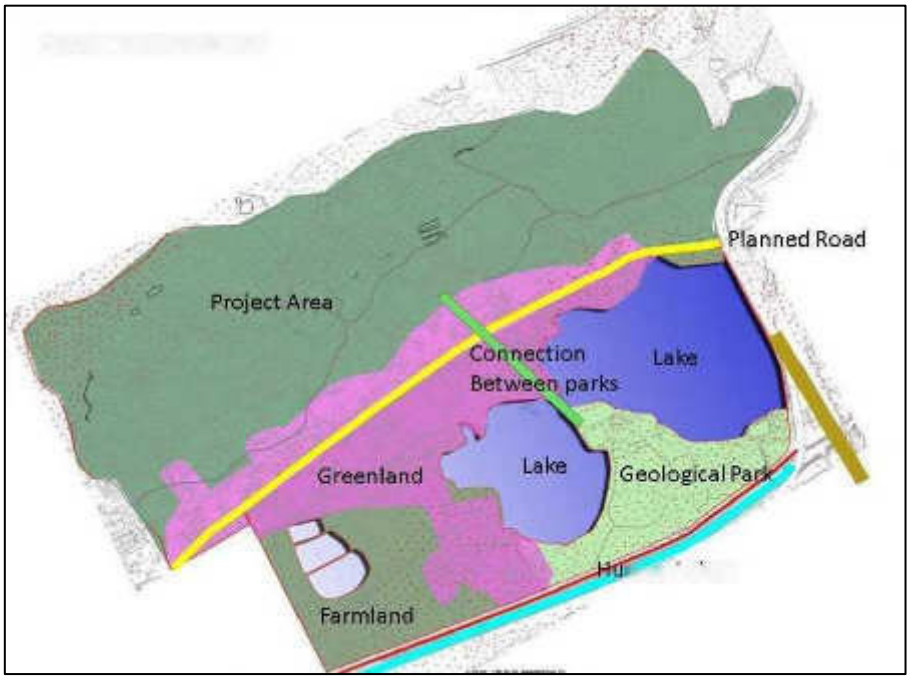


Figure IV-86: Location of abandoned mine site selected for remediation, Hengshan District (JX)

77. Remediation work at this site financed by the ADB loan will cover approximately 80 ha, and will include a plan and actions to manage: i) investigation surveys needed to provide adequate data of subsurface situation and ii) address subsidence issues and underground fires through back-filling of affected areas, and iii) work on environmental rehabilitation by improving existing forested areas, securing old shafts, detecting unstable areas that should be cordoned off to prevent accidents and reforesting of wastelands by suitable trees (scientific preparation for choosing trees including the soil investigations to be undertaken during design stage) to mitigate erosion on the currently sparsely vegetated area and input of high sediment rates into the amenity lake to the south.

78. In the long-term, this area will be turned into an ecological park and connected to the existing lake and park by improved landscaping. This improves the local recreation of the Hengshan District who is deeply impacted by industrial and mining activities.

79. Remediation works under the current project will include:

- Desktop data collection - Collection of local geological, hydro-geological and geological data within the project area.
- Ground survey - Inventory of ground fissures, ground collapses, abandoned shafts, waste-rock dump sites and original soil distribution.
- Geotechnical Surveying - Geophysical investigation, drilling and trenching with a combination of methods to identify the geo-environment.
- Mining environmental restoration project - Remediation of the project site, including site grading of 20.5 ha, reforestation of 69.2 ha, construction of 2023 m drainage interceptor ditch, 1041 m drainage ditch, 287 m retaining wall, 571 m fence and related landscaping works (including measures to avoid damaging ground water and soils).

4. JX 4.1 Hengshan District Integrated Lake and Rivers Rehabilitation and Ecosystem based Adaptation

80. The project will provide integrated rehabilitation of Huangni River, Anle Creek and Hongqi Lake through various measures including: construction of new embankments, channel widening, river bank stabilization, dredging, removal of in-stream blockages, landscaping and greening along river corridors, rehabilitation of ecological function along river and banks, repair and construction of necessary auxiliary engineering facilities. The proposed river components are shown in **Figure IV-27**, and are described in more detail in the following sections.

Figure IV-97: Proposed river rehabilitation components (JX)

a. Huangni River

81. The Huangni River flows through urban districts, rural villages and agricultural land. Its current flood design standard is less than 1-10 year, due to narrow width and illegal structures in the river course. Furthermore, existing bank conditions are poor with broken concrete lining, which has low ecological and landscape value.

82. The proposed rehabilitation works would cover a length of 7.9 km. 4.8 km of this (from Gaihe Bridge to the railway bridge) would include widening and dredging to increase flood design standard to 1-20 year, as well as landscaping, lighting and revetment works. The bank condition of the remaining 3.1 km has already been improved through previous works, so the ADB loan would only fund landscaping, lighting and dredging of this stretch. Landscaping works would adopt ecological design principles including use of native riparian, emergent and aquatic vegetation. Dredged material is expected to be fully re-used on-site for embankment construction as possible after proper test. A typical section of the proposed improvement works is shown in **Figure IV-28**.

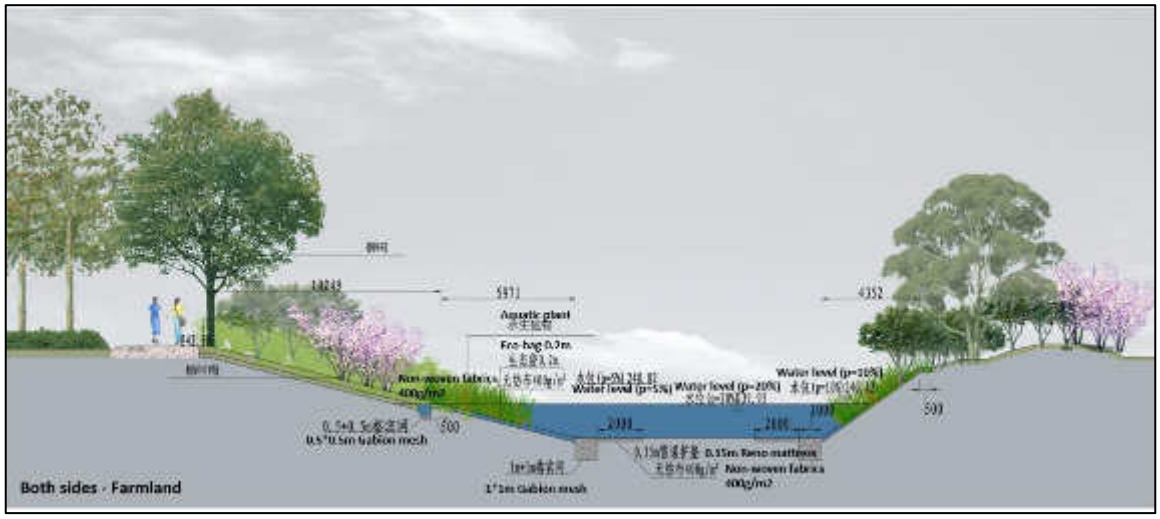


Figure IV-28: Typical rehabilitated section of Huangni River (JX)

b. Anle Creek

83. Anle Creek flows through the urban Hengshan District, and the local drainage network in this area is subject to wastewater discharge. The Creek is prone to flooding in the wet season after heavy rain. In addition, coal mining subsidence has caused disturbance the riverbed, resulting in agricultural land on both sides of the creek being frequently inundated during the wet season.

84. The total length of Anle Creek to be rehabilitated is 1.75 km, in which 0.79 km will be widened and dredged to meet 1-30 year design standard. Additional bank reconstruction, landscaping works and lighting will be provided (**Figure IV-29** refers). Dredged material is expected to be fully re-used on-site for embankment construction as possible after proper test. The remaining 0.96 km has already undergone previous rehabilitation works, and therefore the ADB loan will only finance landscaping and street lighting facilities. Landscape enhancement design has been considered to be pedestrian friendly and for consistency with the surrounding urban context.

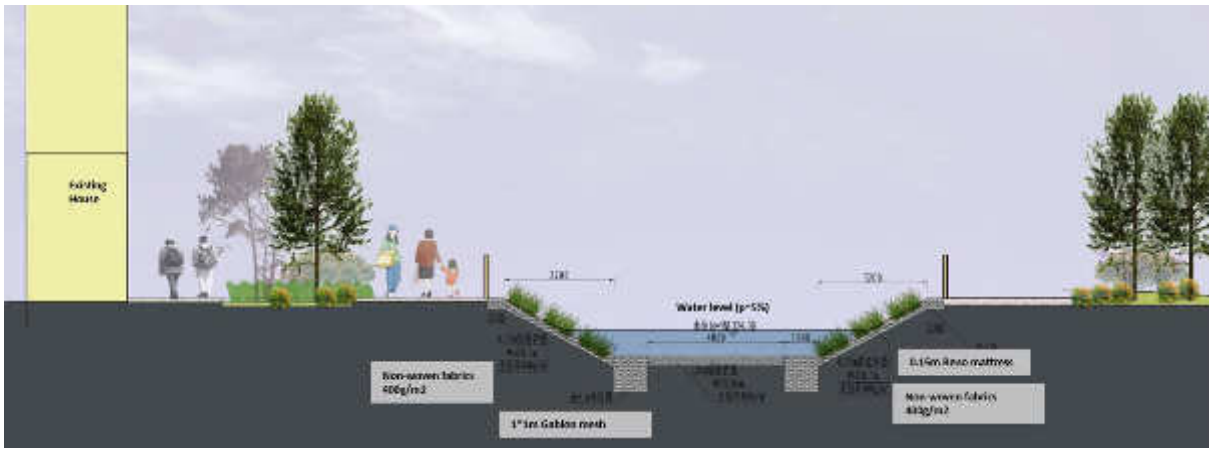


Figure IV-29: Typical rehabilitated section of Anle Creek (JX)

c. Hongqi Lake

85. Hongqi Lake lies at the foot of Beishan Mountain and forms an important local green open space for local residents together with the surrounding hills and agricultural land. Landscape improvement works have already been implemented around the south and east of the lake, including a national mineral park highlighting the geological features of the coal city (**Figure IV-30**). The proposed works under this project involve improvement of 23.51ha of the edge condition of the waterbodies in Hongqi Lake Park to facilitate public access and enhance landscape condition and ecological functioning through the planting of native wetland and terrestrial vegetation.

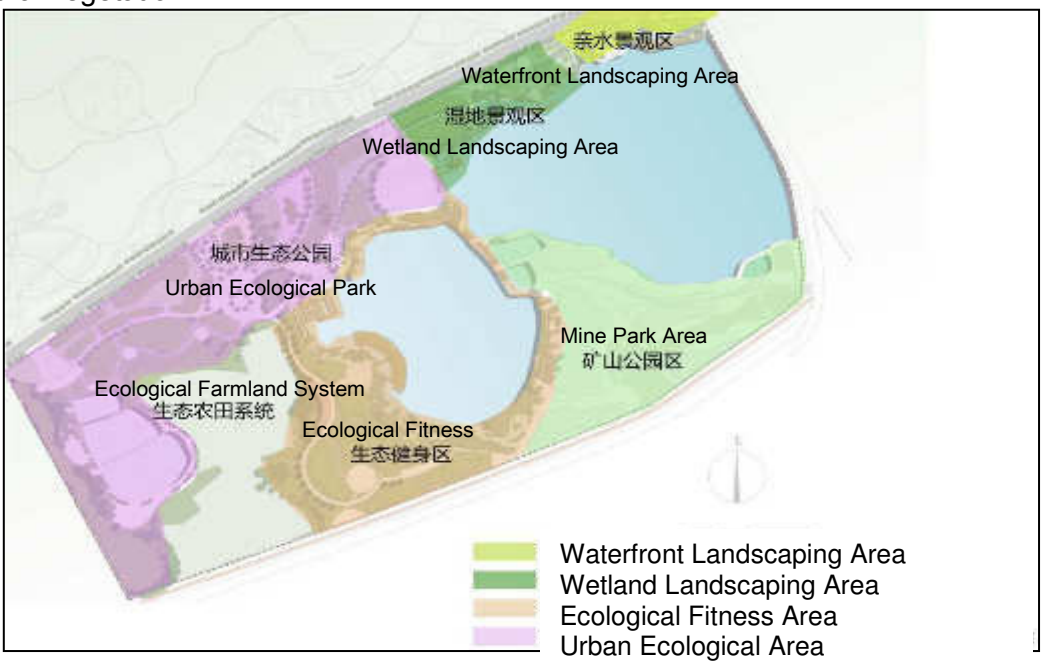


Figure IV-30: Layout design of Hongqi Lake (JX)

5. JX 4.2 Hengshan District Utilities Improvements and Urban Regeneration

a. Urban Regeneration

86. The component is located at the southern side of Jitu Road in Hengshan District. Improvements will cover an area of 3.18 ha (which will already be serviced by local utilities), with the total built area of 18160 m^2. The works will comprise:

- A stadium: one floor (GFA 5000 m^2)
- A library: four floors, (GFA 5000 m^2)
- A remediation monitoring and training center, four floors, (GFA 8000 m^2)
- Two public toilets, one floor, (GFA 160 m^2)

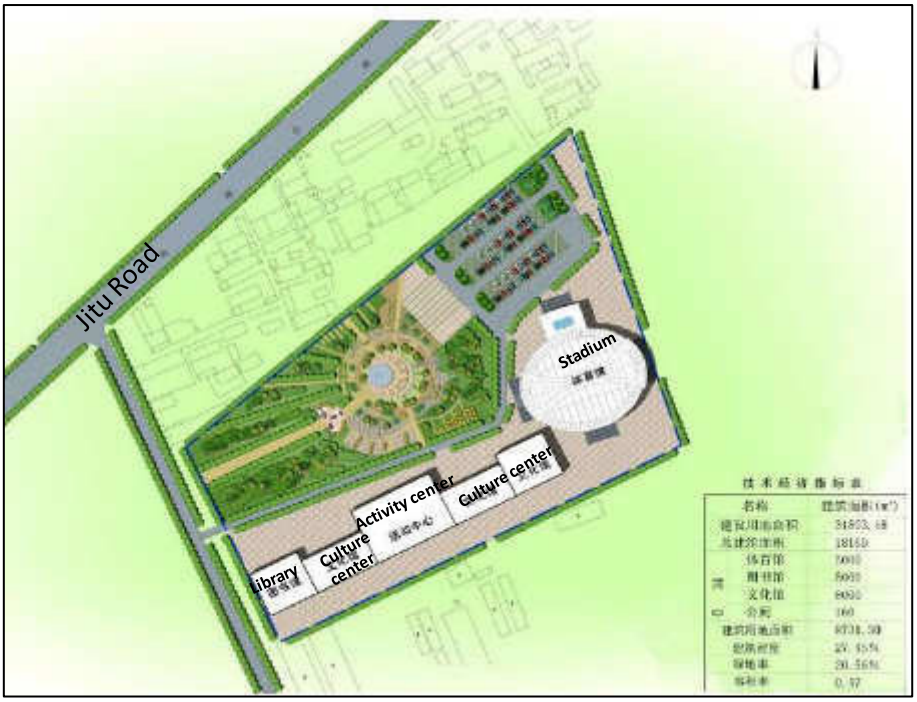


Figure IV-31: Layout design of Hengshan District Public Buildings (JX)

b. Water Distribution System

87. The water distribution system in Jixi is significantly aged and in poor condition, and has various issues including:

- Currently the coverage rate for water supply is only 78% in the urban area, with many residents still reliant on private wells.
- The total length of the distribution network is 704 km, among which 165 km has been in operation longer than the designed service life. The NRW ratio (based on interviews with operators), is higher than 50% in many sections, and as high as 65% in some areas. Leakages not only cause loss of treated water, but also can lead to pollution and water safety risks.
- There are 65 pumping stations in the network, among which 20 are in poor condition and are in need of retrofitting.
- In some areas, water supply is limited, with insufficient amount and head as the pipe size is too small. An upgrade or retrofit of the distribution system will reduce the water loss from leakage and address issues with reliability.

88. The proposed water distribution pipelines under this component includes replacement of 16.8 km priority water supply pipelines in poor repair, as shown in **Figure IV-32**.

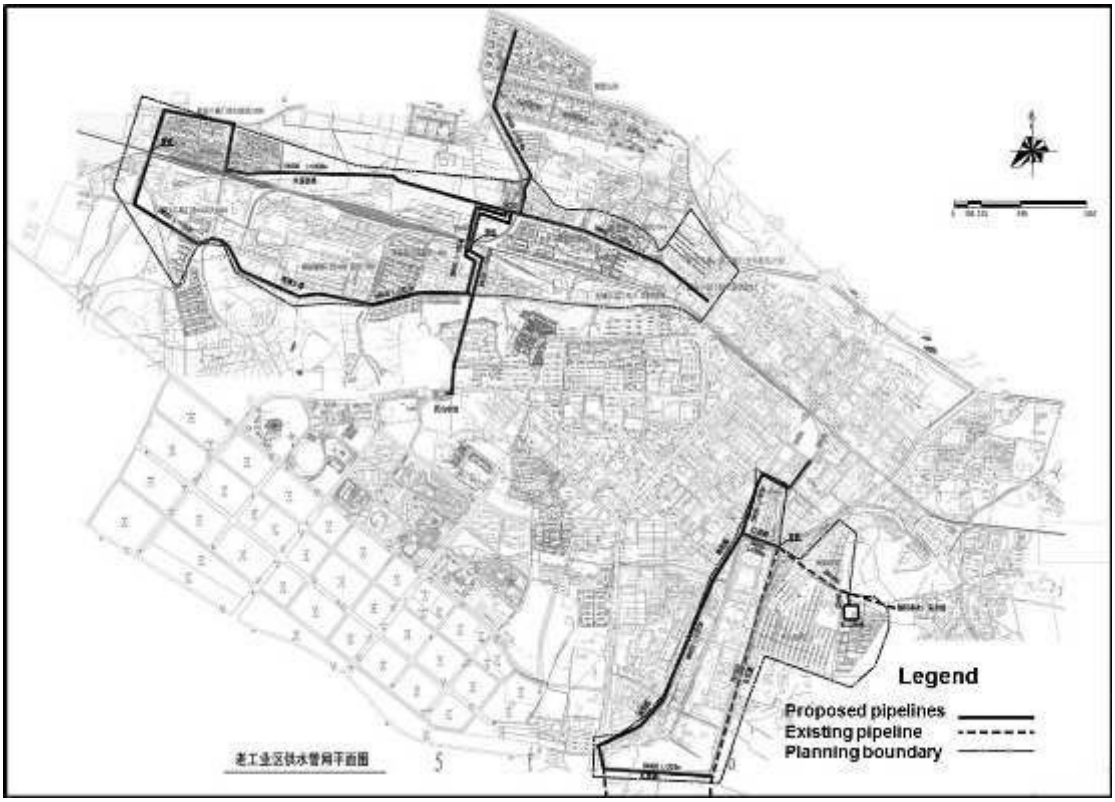


Figure IV-32: Proposed layout of water distribution system pipelines (JX)

c. Sewerage and Drainage Network

89. In Jixi city, a combined sewer overflow (CSO) system still accounts for a large portion of the city sewers, with many of these pipelines discharging directly to the Muling River. In addition, some newly developed areas have no sewer or drainage service at all. In the wet season, flooding occurs frequently in these areas, not only causing inconvenience, but also posing an environmental pollution and public health risk.

90. The project will include construction of 24.3 km sewer pipelines (DN600-DN1500), and three sewage pumping stations at Xinfa (1.48 m^3/s), Shuian (3.16 m^3/s) and Zhongxing (3.14 m^3/s). New drainage infrastructure will comprise 15.2 km of drainage pipelines (DN600-DN1500), 10.1 km of surface drainage channels (1.5m*1m), and four sedimentation tanks. The layout of the proposed sewer and drainage infrastructure is shown in **Figure IV-33**.

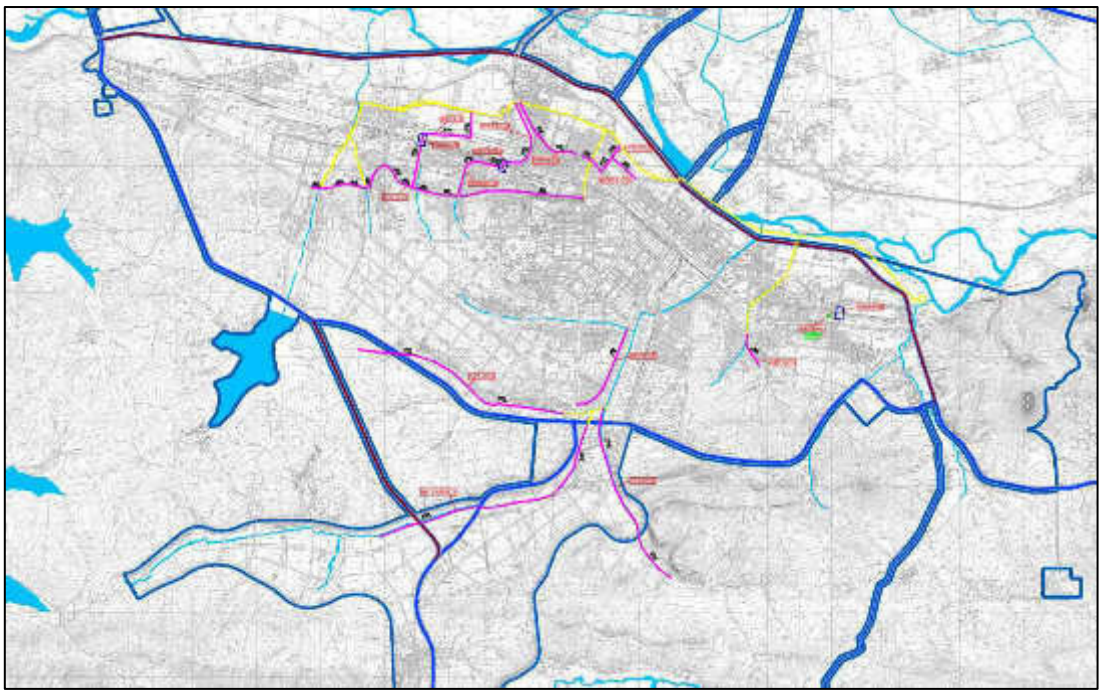


Figure IV-33: Proposed layout plan of sewer and drainage pipelines (JX)
(Blue: existing sewer; Purple: proposed sewer; Blue Square: proposed culverts; Green square: proposed pumping station)

d. JX 4.5 Jixi City No.3 WTP Upgrading and Expansion

91. The Jixi No.3 WTP (**Figure IV-34**) has a design capacity of 80,000 m^3/day, comprising two water trains with capacity of 50,000 m^3/day (built in 1993) and 30,000 m^3/day (built in 2010). However due to design faults/aging of the equipment, the older facility can only operate at 40% of its design capacity (20,000 m^3/day). Furthermore, the original design of the WTP has poor treatment capability as it did not consider organics/nutrient removal or sludge handling.

92. An upgrade is planned that will bring the capacity back to 80,000 m^3/day to meet increasing water demand (as outlined in the Jixi City Master Plan, 2010-2020) and water quality standards. A summary of the upgrading works included in the project is provided in **Table IV-9**. As part of this upgrade, the ADB project will finance (i) expanded capacity of the intake pump station from 50,000 m^3/day to 84,000 m^3/day through replace three out of four pumps in the existing pumping house; and ii) upgrading the water treatment facility with new advanced treatment units and sludge treatment facilities.

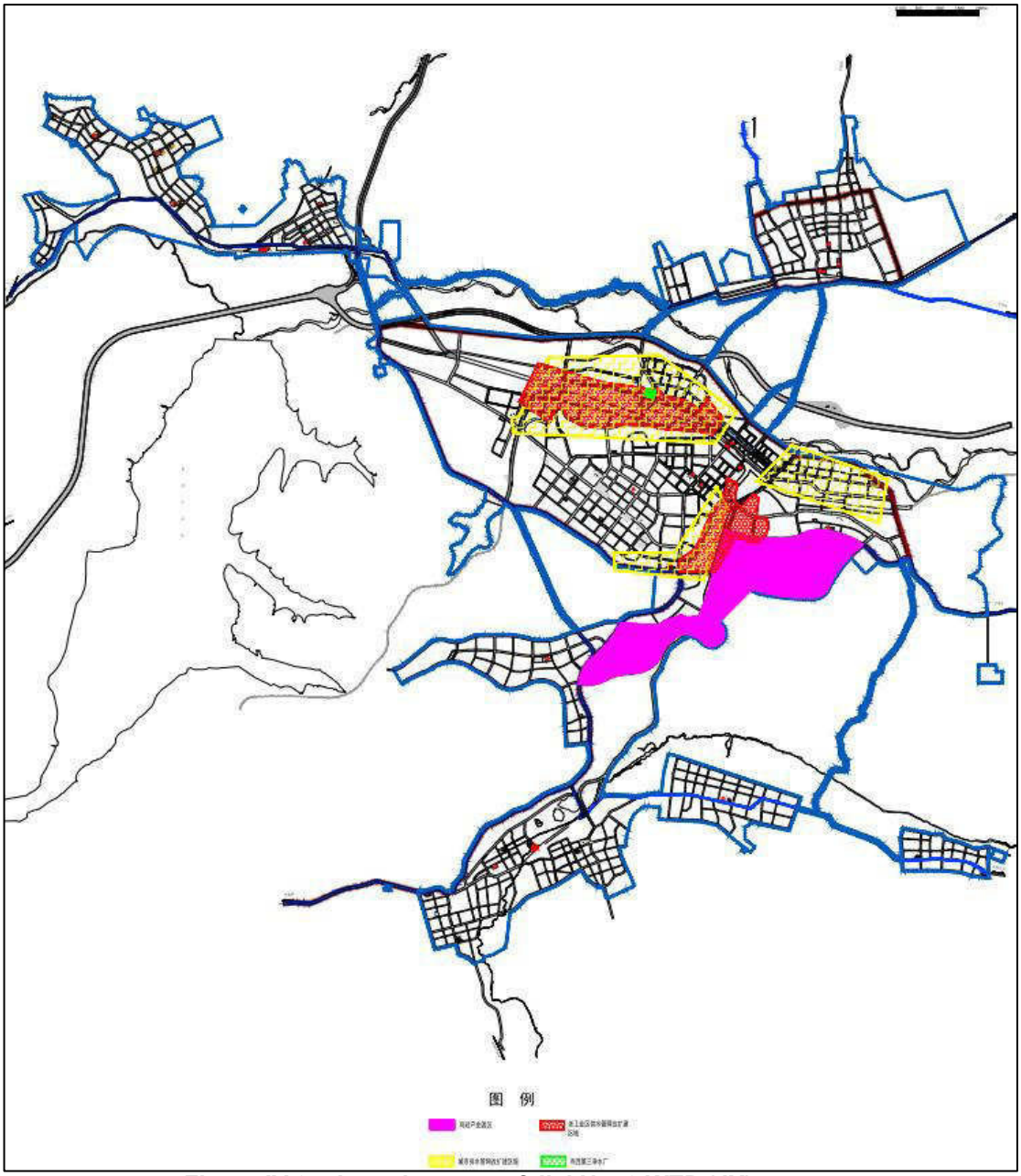


Figure IV-34: Location map of Jixi No. 3 WTP (JX)
(Green: No.3 WTP; Yellow: Sewer and Drainage; Red: Distribution system, Magenta: Jiguan Industrial Park)

Table IV-9: Proposed upgrading works for Jixi City Water No. 3 (JX)

Item	Nature	Proposed activity
Intake pumping house	Existing	Equipment
Water distribution room	Existing	Equipment
Sedimentation room	Existing + retrofit	Works + Equipment
Filter room	Existing + retrofit	Works + Equipment
Purification room	Existing	Equipment
Clean water reservoir	Existing	Equipment
Clean water reservoir	Existing	Equipment
Distribution PS	Existing	
Collection sump	Existing	
Dosing room	Existing + retrofit	Equipment + works
Warehouse 1	Existing + retrofit	
Warehouse 2	Existing + retrofit	

Item	Nature	Proposed activity
Chlorination room	Existing	
Chlorine warehouse	Existing	
Back wash reservoir	To be demolished	Demolishing
Drainage pumping station	To be demolished	Demolishing
Boiler	Existing	
Office building	Existing	
Advanced treatment unit	New	Works + Equipment
Flocculation room	New	Works + Equipment
Sludge handling room	New	Works + Equipment

6. JX 4.3 Hengshan District: Road Improvements

93. Hengshan District has a grid road network, with main roads in North-South direction including Jiaotong Street, Xiangyang Road, Anquan Street, Zhongxin Street, and Shichang Street; and in the East-West direction including Beier Road and Jitu Road. Common issues with the design of all these roads are a narrow width and lack of green space/landscaped areas. Furthermore, because of heavy loading due to heavy good vehicles (HGV) transporting coal and a lack of maintenance, the road foundations and surfaces have been seriously damaged in some areas. Roads conditions are particularly bad in the central urban district, especially for pedestrians during the wet season. Because of the lack of road lighting, the situation is even worse at night.

94. An additional problem with the road system relates to connectivity in the east of the district, where several railway lines are in operation. Only one poorly maintained two-lane road crosses these railways at grade, meaning connectivity between the urban centre of Jixi and Hengshan District is very poor.

95. The project would address the issues above through funding of the following works.

(i) **Roads**. The project would involve reconstruction of Jiaotong Street and construction of a new Riverbank Road. The location of these roads is shown in **Figure IV-35**, and the main design criteria for Jiaotong Street described in **Table IV-10**.

Figure IV-35: Location of Road Improvement Works in Hengshan District (JX)
(Red line shows the alignment of Jiaotong Street, the yellow line shows the river bank road)

Table IV-10: Main design standards for Jiaotong Street (JX)

Standard	Jiaotong Street
Road Level	Branch Road of City
Design Axle Load	BZZ-100
Design Speed (km/h)	30
Surface material	Asphalt Concrete
Design Life (Y)	15
Cross Slope (%)	1.5

Jiaotong Street will be rebuilt as a two-lane road located in the district center, connecting with Beishan Road to the north, with a total length of 409 m. The total width would be 35 m and design width of the carriageway 7 m (**Figure IV-36**).

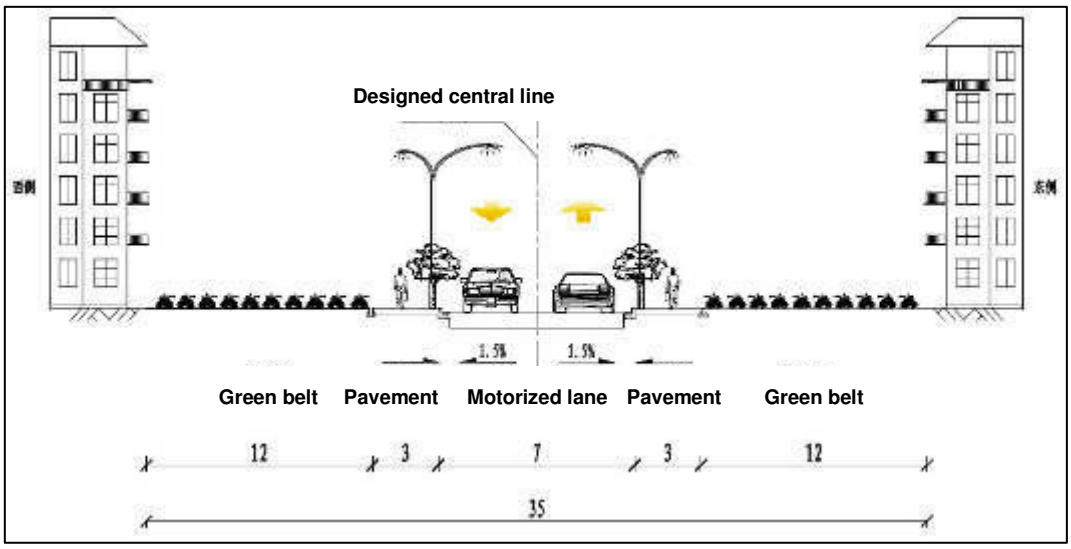


Figure IV-36: Cross-section of Jiaotong Street (JX)

Riverbank road is located between Huangni River and Hongqi Lake, with a total length of 1.51 km and width of 6 m. The road has been designed primarily for pedestrian use with landscape enhancement, granite finishing and street lighting. However, the road will also be designed to accommodate vehicles allowing emergency access especially during floods.

(ii) **Municipal facilities.** All related utilities such as traffic safety facilities, drainage pipes/outlets, lighting and landscaping will be included in the road construction works.

(iii) **Flyover**. The new Gongqu Flyover will cross over Huangni River, Pit's railway, and S206 Road. It will comprise a 330 m bridge, and a ramp for a right turn from S206 Road to Xiaohengshan. The bridge has been designed to avoid the need for any pier in the Huangni River channel, minimizing impacts to flood capacity and also ecological impacts. An existing small bridge crossing the river will be connected to the flyover, serving as a passage for left turning vehicles from Xiaohengshan to S206 Road (**Figure IV-37**). The main design criteria for the flyover are summarized in **Table IV-11**.

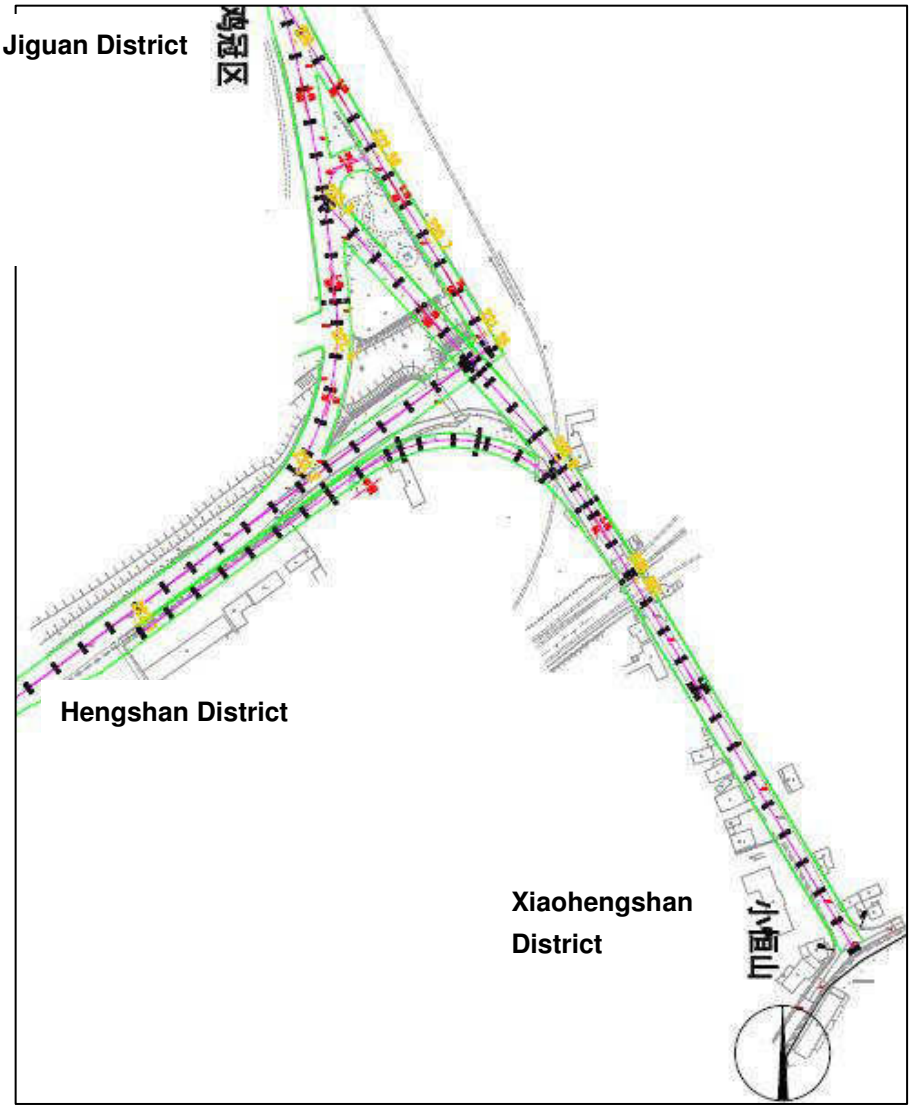


Figure IV-37: Plan of Gongqu flyover (JX)

Table IV-11: Main design standards for Gongqu Flyover (JX)

Parameter	Standard
Design Life (Y)	100
Design Load	Urban- Level A
Structure Safety Level	Level 1
Maximum Longitudinal Gradient (%)	5%
Circular curve radius for main bridge (m)	500
Circular curve radius for ramp (m)	75
Design of cross-section width (m)	0.5(L)+15+0.5(R)
Structural form of main girder	Pre-stressed concrete box

F. Qitaihe

96. The engineering components in Qitaihe are presented in the **Figure IV-38**, and described in the following sections.

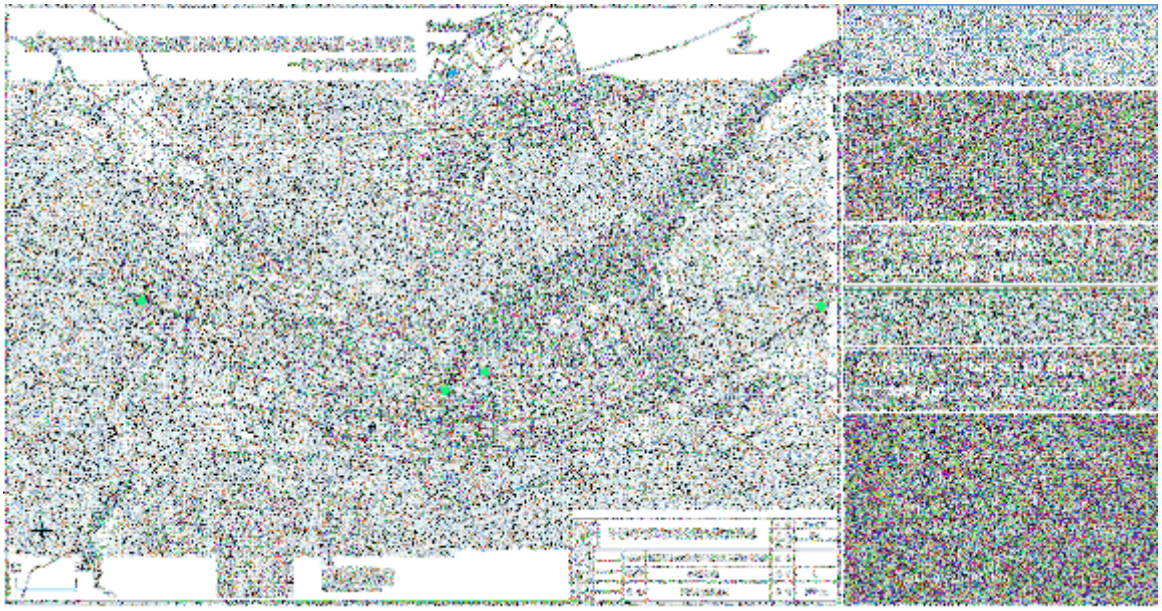


Figure IV-108: Layout of proposed engineering components in Qitaihe

1. QH 2.1 Green Food and Pharmaceutical Biofermentation Industrial Park – Infrastructure and Business Support Facilities

97. The Green Food and Pharmaceutical Biofermentation Industrial Park is located in the Economic Development Zone of Qitaihe city, north of Wenhui Street and west of Xinjin Road. The first phase has been constructed, occupying a total area of 2 km^2, and eventually the park will cover a total area of 5 km^2. The proposed layout of the Park is shown in **Figure IV-39**.

Figure IV-39: Layout of green food and pharmaceutical bio-fermentation industrial park (QH).

98. The project will facilitate development of the remaining phases of the industrial park by rebuilding and widening two internal park roads: Jingwu Road and Weiyi Road. The roads will

be 40 m wide with dual car lanes and a 10 m central median to provide improved landscaped environment. The road design is summarized in **Tables IV-12** and **IV-13**, and a typical section is provided in **Figure IV-40**. Related utilities, including drainage pipelines, sewer, water distribution pipe, heat supply pipe and communication line will be constructed along with the roads.

Table IV-12: Summary of roads to be constructed at Green Food and Pharmaceutical Bio-fermentation Industrial Park (QH)

Name of item	Number of car lanes	Width of red line (m)	Total length (Km)
Weiyi Road	4	40	0.85
Jingwu Road	4	40	1.3

Table IV-23: Main road design criteria (QH)

Name of Item		Unit	Value in Code
Design Speed		Km/h	40
Minimum circular curve radius	Regular value (without super elevation)	m	150
	Limit value (with super-elevation)	m	85
Minimum circular curve radius without adjustment curve		m	500
Minimum length of adjustment curve		m	35
Minimum length of horizontal curve		m	110

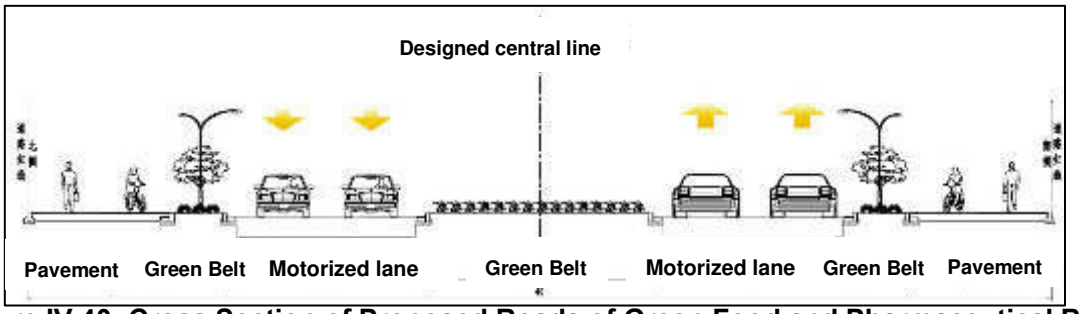


Figure IV-40: Cross Section of Proposed Roads of Green Food and Pharmaceutical Bio-fermentation Industrial Park (QH)

99. In addition to the roads, construction of other infrastructure at the park will include two buildings with total floor area of 7200 m^2 to provide business services for the industrial park, water and stormwater pipelines (39 km), one pumping station, heating, lighting (820 lamps), electricity transmission (7 km), heating pipelines (2 km), boiler (75 tons) room and one heat exchange station.

2. QH 3.1 Mining Remediation and Environmental Rehabilitation

100. The Taoshan Residential District of Qitaihe City is located between the National Road S308 and the Woken River. In the past, the Taoshan District supported a number of villages as well as intensive coal mining activities. Coal mining has caused subsidence issues across the district, and all villagers have been resettled and village housing demolished.

101. The project will assist in rehabilitation of the Taoshan District through remediation of a 10.4 ha waste rock dump site, and a former village housing area of about 11.3 ha (**Figure IV-41**). The basic premise of these works will be to transfer waste rock from the former site to

fill and stabilize areas affected by subsidence at the latter site.

Figure IV-41: Mining remediation and environmental rehabilitation site at Taoshan residential district (QH)

102. Works will comprise the following items:

(i) Sampling at the waste rock dump site will be undertaken (both within the dumped rock piles and in the underlying soil/groundwater) to identify potential contaminants in the waste rock as well as any existing soil and groundwater pollution at the site.

(ii) Any remaining abandoned houses and other structures at the former village will be demolished. Topsoil at both sites will be removed and stored in a top soil dump for later use in the remediation work. The underlying soil type is clay, and a layer of clay 3-4 m thick would be retained across both sites to prevent leachate entering the groundwater. Waste rock will be transported to the former village for fill. Every 500 mm of waste rock fill will be covered with 300 mm clay to minimize issues with leachate.

(iii) Surface drainage from the former village will be collected by a newly constructed drainage channel with total length of 692 m. The concrete channel will be 500*500 mm (length*width), and built on top of a 100 mm clay layer to prevent accidental leakage into the waste rock below.

(iv) Both sites will be greened/reforested after the remediation is complete. The former dumpsite will remain as forested land in the long-term. The former village area is being considered for partial industrial redevelopment in the long term, although assessment of potential long-term re-use of the site will be subject to further study outside the scope of this Project.

(v) A total of five subsidence monitoring stations will be installed in the former village area, in addition to eight groundwater monitoring stations (six along the site boundary and two within the project area) to assess potential contamination. During construction, monthly subsidence monitoring will be conducted, and groundwater monitoring will be conducted twice during wet season and dry season. After construction, monitoring responsibilities will be handed over to the PIU.

3. QH 4.1 Water Treatment Plant Upgrading and Water Supply Distribution System Replacement and Expansion

103. Qitaihe's current water supply infrastructure issues are mainly with its urban area. Currently there are two WTPs in the city, the Shenke WTP and the Water and Drainage Company (WDC) WTP, each with a designed treatment capacity of 100,000 m^3/day. They both take raw water from the Taoshan Reservoir through two water intakes and pumping houses (66,000-110,000 m^3/day for Shenke WTP and 110,000 m^3/day for WDC WTP). The intake for WDC WTP has been in use for more than 20 years and the pumps fail frequently.

104. Recently the raw water quality in the Taoshan Reservoir has been deteriorating mainly from eutrophication, possibly due to intensified farming activity and increasing industrialization in the catchment. While the Qitaihe Government issued the Management Measures on Drinking Water Source of Taoshan Reservoir in 2001 to delineate water source protection zones for the Reservoir, additional organic removal processes are required to meet relevant water quality standards.

105. Both WTPs use traditional treatment processes for surface water (coagulation, flocculation and sedimentation), which mainly target turbidity instead of organics. Furthermore, possibly due to design faults (the design documents are not available), the WDC WTP cannot operate at full capacity otherwise the quality of treated water is compromised. The preliminary assessment is that there was something wrong with the flocculation tank, leading to insufficient mixing time at high flow rates. Currently it is therefore operated at 50% of its full capacity (or at roughly 50,000 m^3/day). At the same time, due to the expansion of the population and economic growth, water demand is increasing, posing pressure on the supply side. In addition, there are no sludge treatment and handling in the WTPs. Any sludge or wastewater from the treatment processes are discharged directly to drainage, which is not compliant with relevant regulations. Therefore both the WTPs are in urgent need of retrofitting and upgrading.

106. Currently there are two sets of distribution systems, namely the municipal network (167 km) and the WDC network (49 km). While the service areas overlap, the two networks are not connected, leading to inefficiencies. The pipelines are in poor condition with frequent leaks and bursts, and according to interviews with the water affairs bureau, the NRW is higher than 50% in the distribution systems.

107. To address these issues, this project component will improve the urban water supply system through an integrated approach, including retrofit of the water intakes by replacing the lifting pumps, upgrading of the WTP, retrofitting of the distribution system, and improvements to the NRW control.

108. For the Shenke WTP, the works will include installation of a new pre-oxidation contact tank, lifting pumping house, active carbon filter, chlorine dosing room, sludge handling facility and laboratory (equipment); upgrading the flocculation tank, inclined sedimentation tank and V-filter; and replacing pumps in the clean water pumping house. The works are summarized in **Table IV-14** below, and the proposed layout of the upgraded WTP shown in **Figure IV-41**.

Table IV-34: Proposed quantity of Shengke WTP (QH)

No.	Item	Nature	Proposed activity
1	Pre-ozonation tank and distribution well	New	Works + Equipment
2	Sedimentation room	Retrofit	Works + Equipment
3	Filter room	Retrofit	Works + Equipment
4	Lifting pump room and ozonation contact tank	New	Works + Equipment
5	AC filter	New	Works + Equipment

No.	Item	Nature	Proposed activity
6	Clean water reservoir	Existing	Equipment
7	Distribution PS	Existing	Equipment
8	Chlorination room	Existing	Equipment
9	Ozone generation room	New	Equipment + works
10	Drainage equalization tank	New	Works + Equipment
11	Sludge equalization tank	New	Works + Equipment
12	Condensing room	New	Works + Equipment
13	Sludge storage and dewatering room	New	Works + Equipment

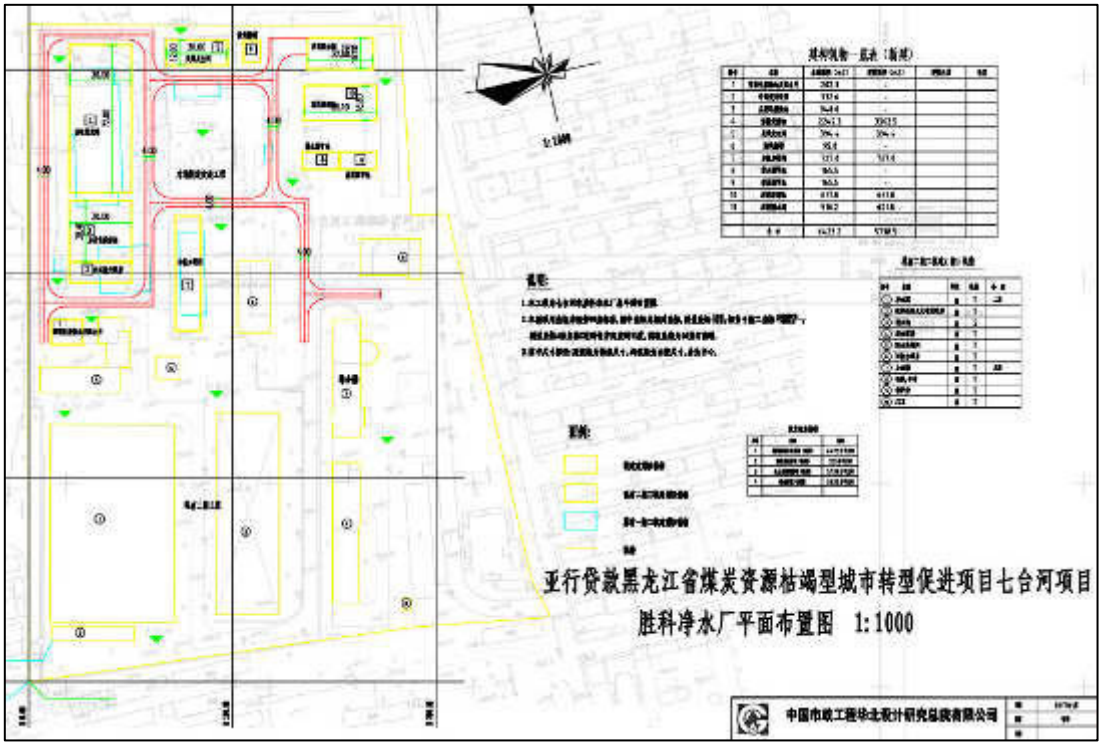


Figure IV-42: Proposed layout of Shingle WTP (QH)

109. For the WDC WTP, because the layout of existing facilities are not optimized and some key treatment units are not functioning properly due to design faults, most of the existing treatment facilities will be demolished. A new pre-oxidation tank, flocculation and sedimentation tank, V-filter, lifting pumping house, active carbon filter, clean water reservoir, chemical dosing room, sludge handling facility and laboratory (equipment) will be provided. The works are summarized in **Table IV-15** below, and the proposed layout of the upgraded WTP shown in **Figure IV-43**.

Table IV-15: Proposed works at the WDC WTP (QH)

No.	Item	Nature	Proposed activity
0	Intake pumping house	Existing	Equipment
1	Pre-ozonation tank and distribution well	New	Works + Equipment
2	Sedimentation room	New	Works + Equipment
3	Filter room	New	Works + Equipment
4	Lifting pump room and ozonation contact tank	New	Works + Equipment
5	AC filter	New	Works + Equipment
6	Clean water reservoir	New	Equipment

No.	Item	Nature	Proposed activity
7	Distribution PS	Retrofit	Equipment
8	Chlorination room	New	Equipment
9	Ozone generation room	New	Equipment + works
10	Drainage equalization tank	New	Works + Equipment
11	Sludge equalization tank	New	Works + Equipment
12	Condensing room	New	Works + Equipment
13	Sludge storage and dewatering room	New	Works + Equipment

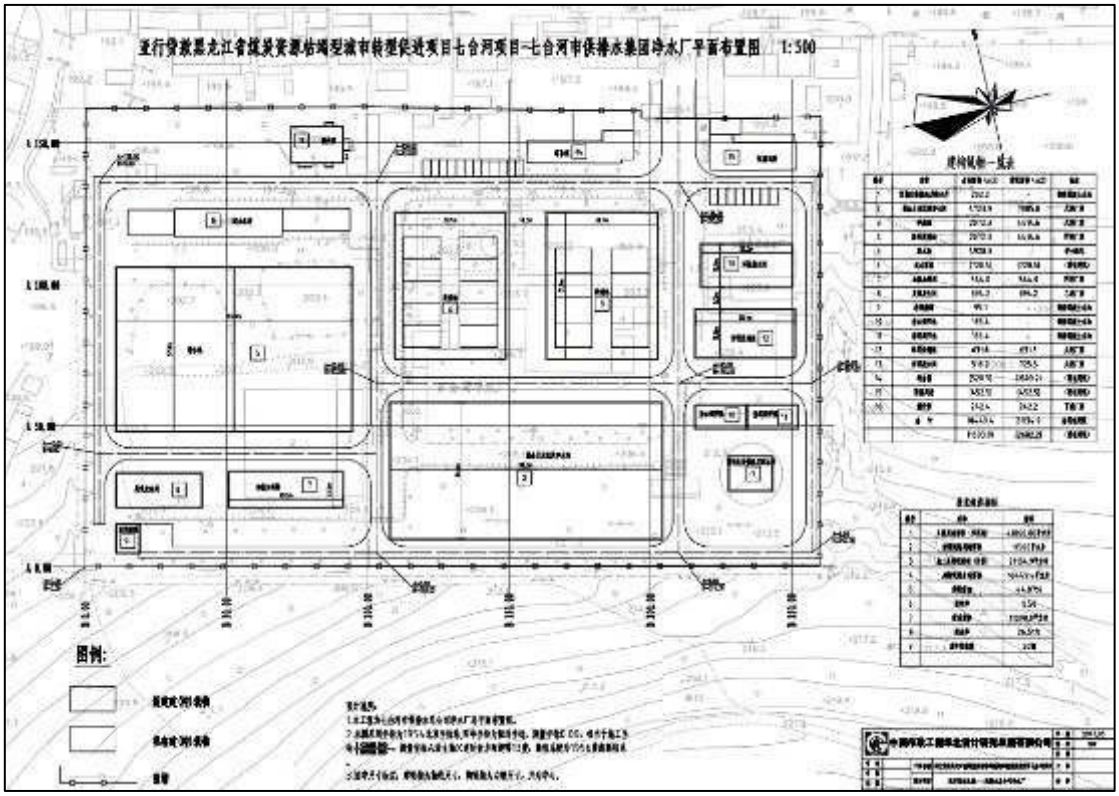


Figure IV-43: Proposed layout of WDC WTP (QH)

110. For the distribution system, the works include retrofitting of 17.8 km pipelines in the central urban area, 15.3 km of new pipeline in Jinsha new district, 26.9 km new pipeline and a new pumping station in Western Mine area, 31 km of new pipeline and a new pumping station in Longhu Mine area, retrofitting of 13 lifting pumping houses in urban areas, and various water meters. The layout is illustrated in **Figure IV-44** below.

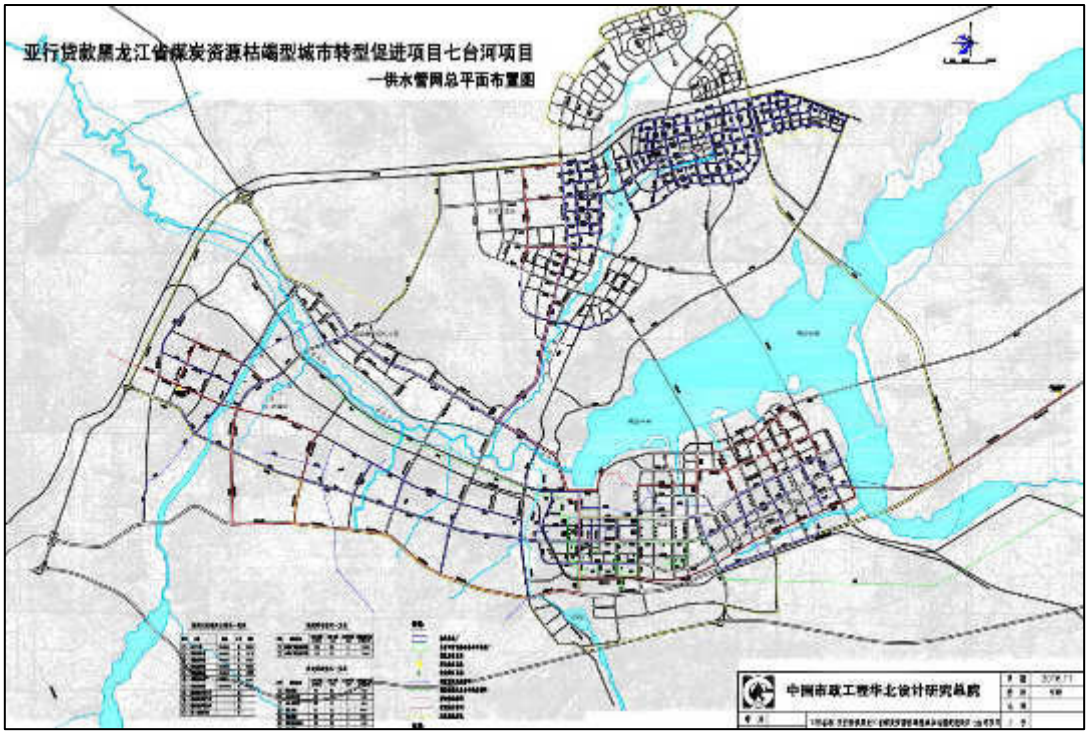


Figure IV-44: Proposed layout plan of urban water distribution system (QH)

4. QH 4.2 Sustainable and Clean Fuel Public Transport Improvements

111. This component includes procurement of 209 full electric buses, which will replace the existing diesel bus fleet by 2021. The component also includes 84 passenger information display system boards in bus stops, construction of three operation centers with bus garages and e-charging stations, and improving and expanding the function of the existing bus management and dispatching operation system for the bus company. To support the acquisitions under the project, the city government has committed to implement a peak hour bus priority lane along major corridors and improve bus stop congestion black spots.

G. Shuangyashan

112. The engineering components of Shuangyashan is illustrated in **Figure IV-45**, and described in the following sections.

Figure IV-45: Layout of proposed engineering components in Shuangyashan

1. SY 2.1 Industrial Parks-Infrastructure and Business Support Facilities

113. Both the Middle and Small Enterprises (MSE) Business Park and China-Russia Business & Trade Park are located in the Shuangyashan Economic Development Zone (SEDZ). The SEDZ was established in 1993 with approval of HPG. In 2014, the SEDZ was upgraded to a national level development zone with State Council approval. In the past 20 years, the SEDZ has contributed to the economic boost and industrial transformation of Shuangyashan. However, the supporting infrastructure has only been partially built, and lack of road infrastructure in particular is hindering further development of the entire SEDZ.

114. At the MSE Business Park, the project will include construction of 15 standardized workshop buildings. These will comprise three buildings of 4,278 m^2 area, six buildings of 2,846 m^2 area, and six buildings of 1,551 m^2 area. Additional works will include providing internal roads/car-parking areas of 40,000 m^2, construction of a 1,500 m^2 heating centre, and construction of electricity distribution and fire protection facilities area of 1,000 m^2.

115. The China-Russia Business & Trade Park covers an area of 194.15 ha. The project will include construction of one arterial road and four secondary roads servicing the park, together with related municipal utilities (traffic safety facilities, water supply pipes, drainage pipes, heating pipes and power supply). The roads are summarized in **Table IV-16** and a layout plan provided in **Figure IV-46**. Typical cross-sections are provided in **Figure IV-47**.

Table IV-46: Summary of new road components for the China-Russia Business Park (SY)

Road Name	Location	Length	Width
Jingmao Avenue	North to south from NO.1 Road to Yirao Road	1.49 km	40 m
Wusi Road	North to South from China-Russia North Road to Yirao Road	2.206 km	30 m
Extension of China-Russia North Road	East from Wusi Road	0.6 km	30 m
Maoyi South Road	East to West from Yingbin Avenue to Jiusan Road	1.4 km	40 m
No.1 Road	East to West from Fushuang Road to Yingbin Avenue	1.7 km	50 m

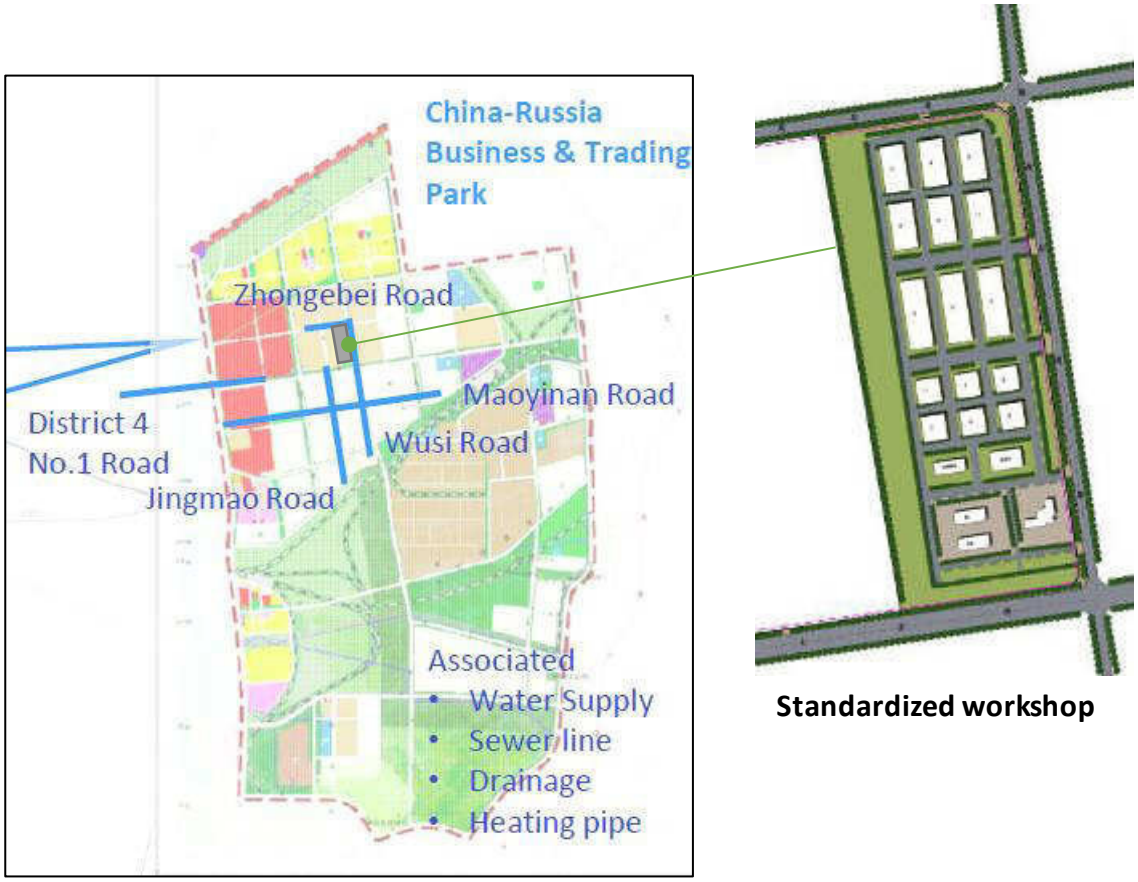
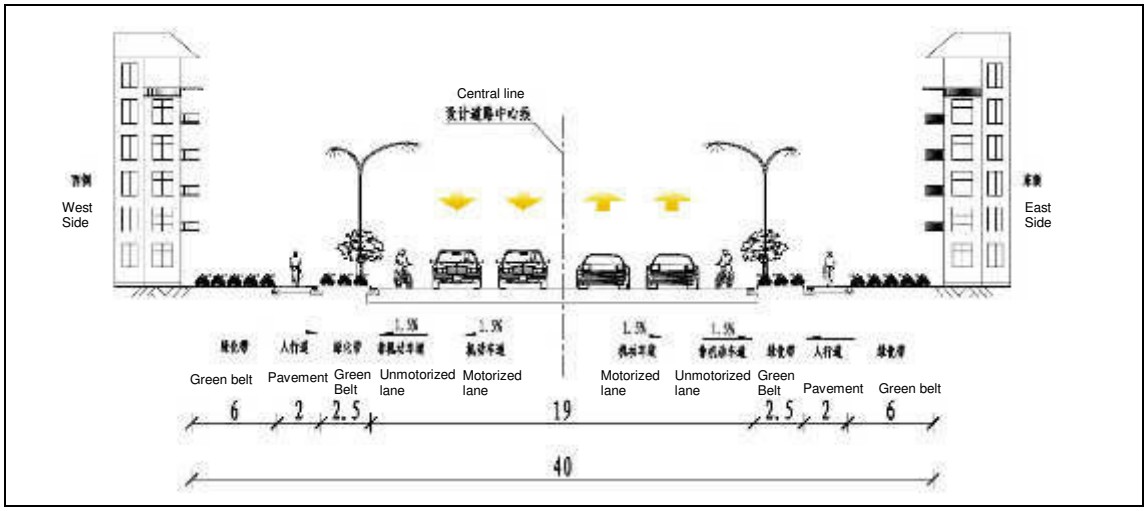
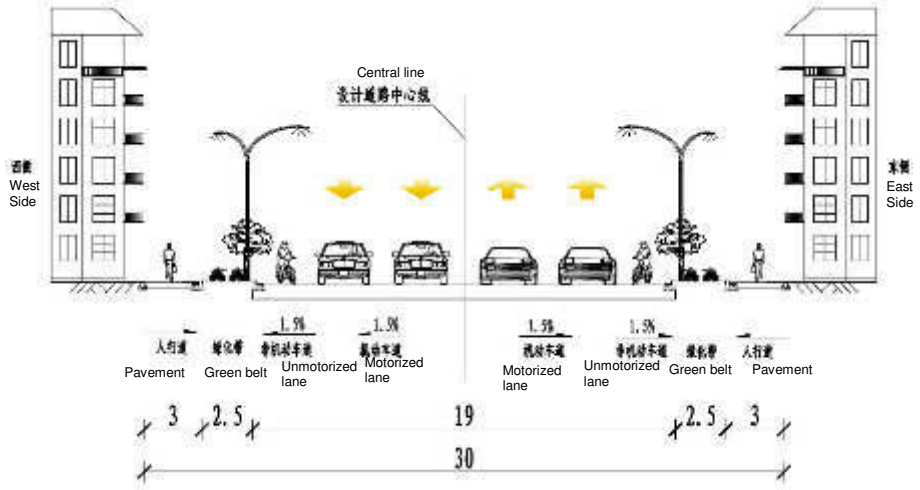


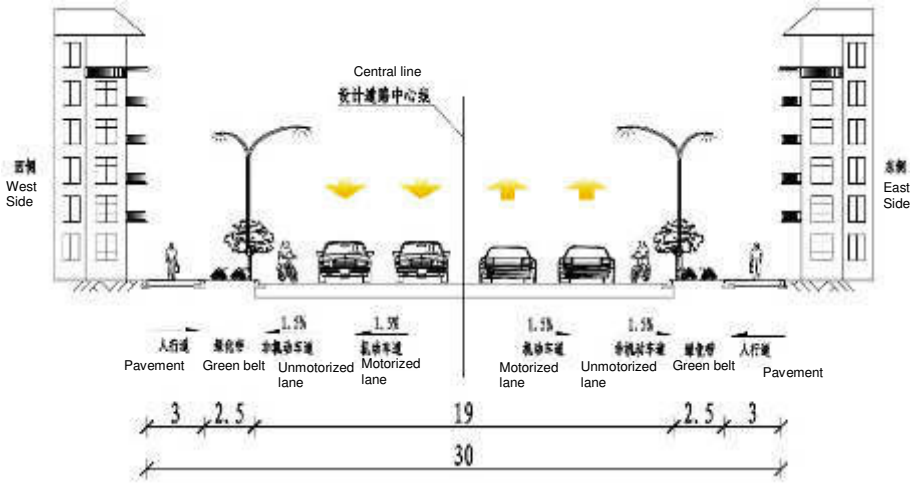
Figure IV-46: Proposed road layout for the China-Russia Business Park (SY)



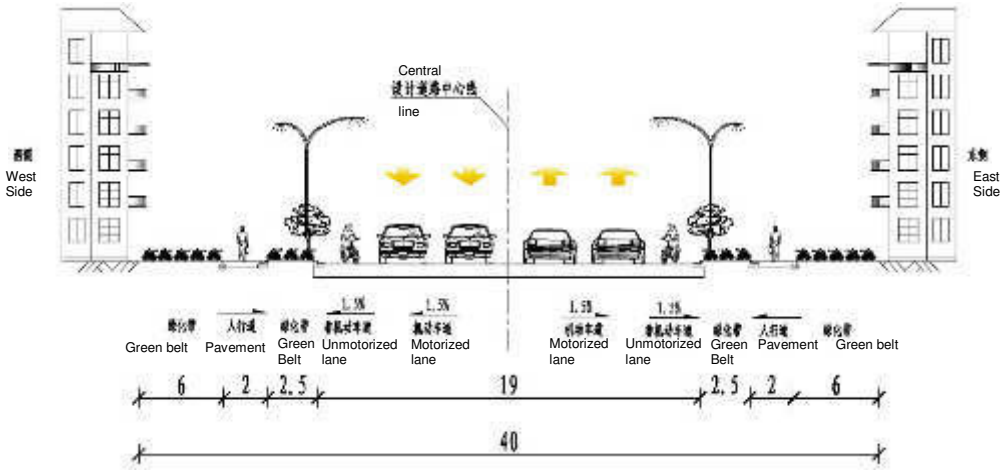
Jingmao Avenue



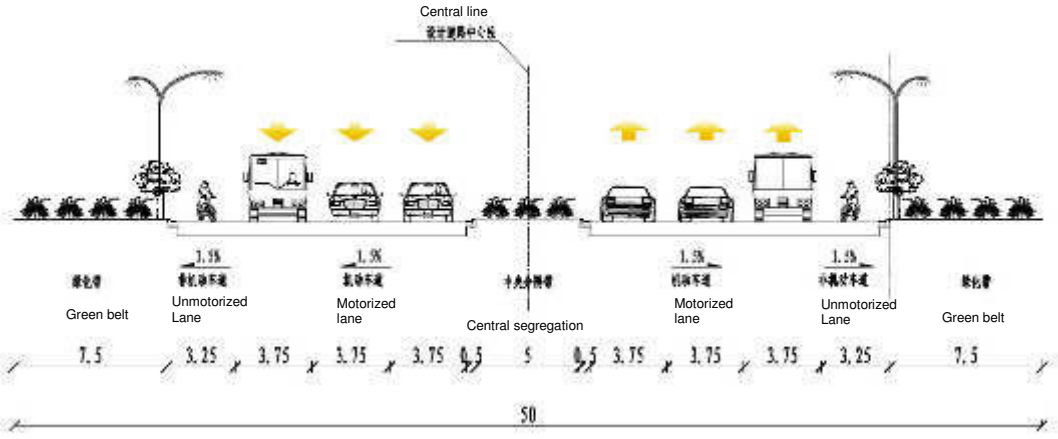
Wusi Road



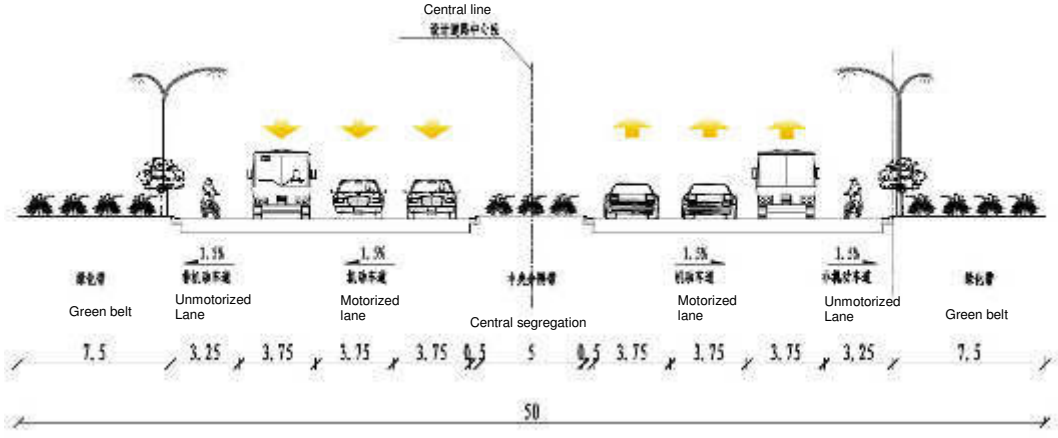
Extension of China-Russia North Road



Maoyi South Road



NO.1 Road (Type A)



NO.1 Road (Type B)

Figure IV-47: Cross-sections of proposed China-Russia Business Park roads (SY)

2. SY 3.1 Waste Rock Dump-site Remediation/ Safe Closure and Management of Former Mines

116. The former mining and industrial area of Lingdong District includes a valley near to the south east of the district steel mill. Previously, small coal mines and brick factories operated in the valley, and they have impacted the local environment primarily due to dumping of waste rock. The dumping areas are located on the eastern face of the valley, while a small village area is located on the opposite face. Residents of the village will be resettled by 2017 under a previous city government initiative not included in this project.

117. The core area to be rehabilitated comprises 117 ha of land that can be divided into three sections: i) a 24.7 ha area impacted by dumping of waste rock and brick fragments, ii) a 50 ha area joining to the north of the first area, and impacted by dumping of slag from the nearby steel mill, and iii) a 42 ha area comprising the former village area to the west of areas (i) and (ii). The valley also contains previously rehabilitated land that has been reforested, and

will be retained and improved under the current project.

118. The plan for remediation of this mining area will be divided into three phases (as shown in **Figure IV-48**). Only Phase 1 will be financed by the ADB loan:

(i) **Phase 1** will include development of a plan and actions to manage the clean-up the area from waste rocks brick fragments, over a total area of 24.7 ha. Material from the localized small dump sites will be removed and used in other areas where fill is required. Usable top soil will be identified and stored in a top soil dump for later reuse. 6.10 ha of existing forestry land related with the site will be improved through planting of more trees. The final land use of the restored area is subject to further confirmation, but agricultural uses (particularly raising of livestock) is being considered. Planning and implementation of these end-uses will not form part of the ADB-funded work.

(ii) **Phase 2** is planned to include an expansion of the agricultural area to north. Forested areas connecting Phases 1 and 2 will be improved through additional tree planting. Dumped waste-rock in this area will be removed and the dump-sites prepared for later agricultural use. Further roads and pathways are planned for site development.

(iii) **Phase 3** is planned to include demolition of the former village, and to prepare this area for future agricultural use, including provision of road access. Future agricultural use would be limited to raising livestock in buildings with concrete lined floors, avoiding any potential contamination impacts.

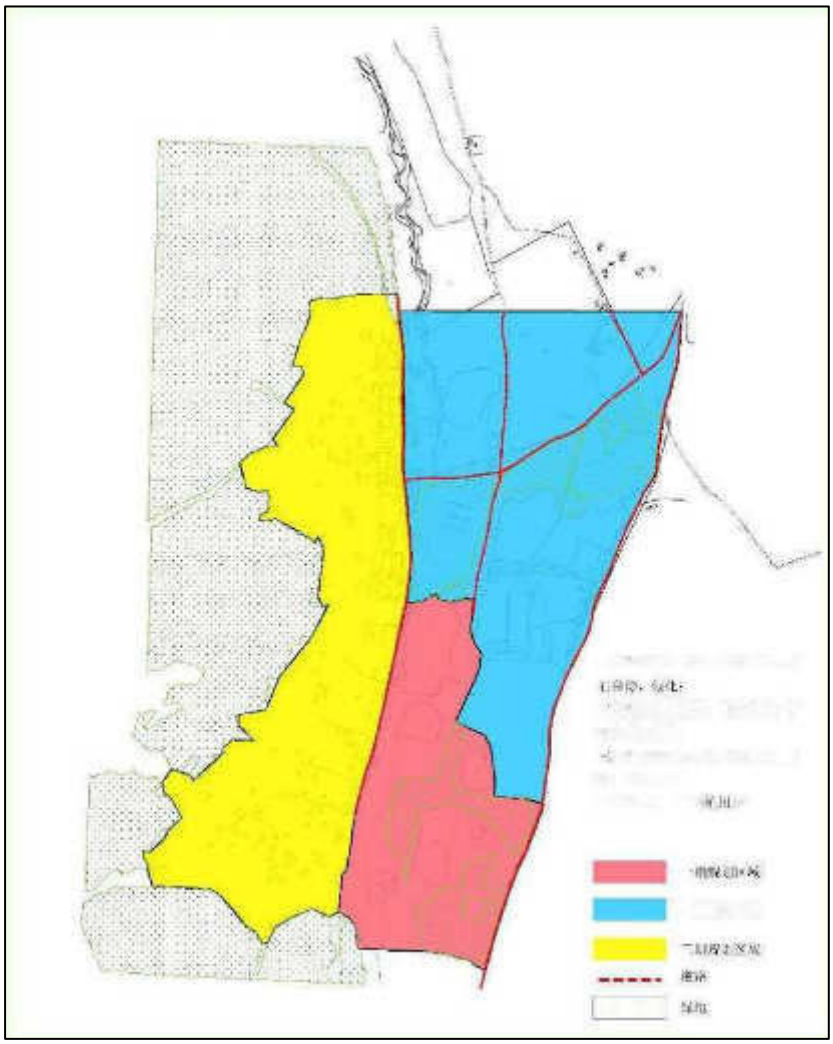


Figure IV-48: Phased mining remediation in Lindong district (SY)
(Red – phase 1, Yellow - phase 2, Blue – phase 3)

3. SY 4.1 Urban Regeneration and Urban Infrastructure (Water Supply, Wastewater Collection and Stormwater Drainage)

119. Management of the urban water supply, sewerage and drainage system of Shuangyashan faces a number of issues:

- The East Ring Road District (which includes existing and planned residential developments) and the High-speed Railway Station District (which includes planned mixed-use developments) are not covered by the existing water supply network.
- The Jianshan District still relies on CSO in some areas. This system discharges to an interceptor pipeline along the Anbang River under normal conditions, but excess wastewater enters the river directly during storm events, causing significant pollution issues. Furthermore, in some areas the drainage system is under capacity, causing flooding issues. Finally, there are multiple management entities for the drainage system, and delineation of roles and responsibilities is unclear.
- Lingdong District requires major reconstruction due to significant subsidence from historical mining activities. Many parts of the town are being or will be rebuilt, and these areas currently have no functional sewer system.

120. This component will address the above issues through the following measures: (i) improvement of water supply system, (ii) improvement of the sewer system in Lingdong district. (iii) Improvement of the sewer system in Jianshan district; and (iv) improvement of the drainage system in Jianshan District.

121. **Water Supply System.** Improvements to the water system will include construction of 28.8 km of water pipelines; three new pumping stations (two with capacity of 15,000 m^3/day, and one with a capacity of 3000 m^3/day); two clean water reservoirs (with storage capacity of 3000 m^3 and 4000 m^3), and other related facilities including drainage pipelines for the WTP, new laboratory, flow meters at key intersections, and a SCADA System. The two 15,000 m^3/day pumping stations are needed for the pipeline to the High Speed Railway Station District, and the 3000 m^3/day pumping station will service the East Ring Road District. For the East Ring Road District, a reservoir of 3,000 m^3 capacity will be built at Yishanshan. In the WTP, a reservoir of 4,000 m^3 capacity will be built. The layout for key features of the improvements is shown in **Figure IV-49**, and key quantities are summarized in **Table IV-17**.