Draft Environmental Impact Assessment

May 2017

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

Part 2

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

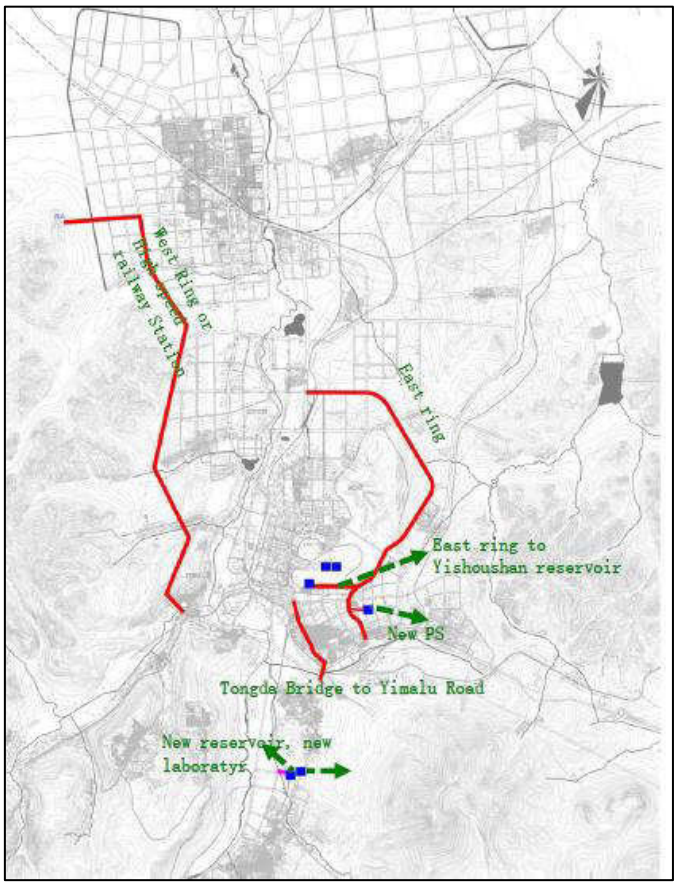

Figure IV-49: Location of proposed water supply infrastructure (SY)

Table IV-57: Summary of proposed water supply infrastructure (SY)

No.	Item	Specification	Quantity
1	East Ring to Yishoushan pipeline	Ductile Iron, DN500	1,800 m
2	East Ring pipeline	Ductile Iron, DN500	10,000 m
3	Tongda Bridge to Yimalu Road	Ductile Iron, DN800	4,000 m
4	West Ring to High Speed Railway Station	Ductile Iron, DN500	13,000 m
5	West Ring pumping station	15,000 m^3/day	2 sets
6	East Ring pumping station	3,000 m^3/day	1 set
7	Yishoushan Reservoir	3000 m^3	1 set
8	Hancong WTP reservoir	4000 m^3	1 set
9	In-WTP drainage pipe	Concrete DN1000	1,000 m

122. **Sewerage and Drainage Pipelines.** 25.5 km and 53 km of sewerage pipelines will be constructed in the Lingdon and Jianshan Districts respectively, and 61.6 km of drainage pipelines will be constructed in Jianshan District. The proposed layout of this infrastructure is shown in **Figure IV-50** to **IV-52** and key quantities summarized in **Table IV-18**.

123. Shuangyashan city has a sponge city programme that will collect the first flush of stormwater from streets and roads. However, this programme is not included under the ADB project.

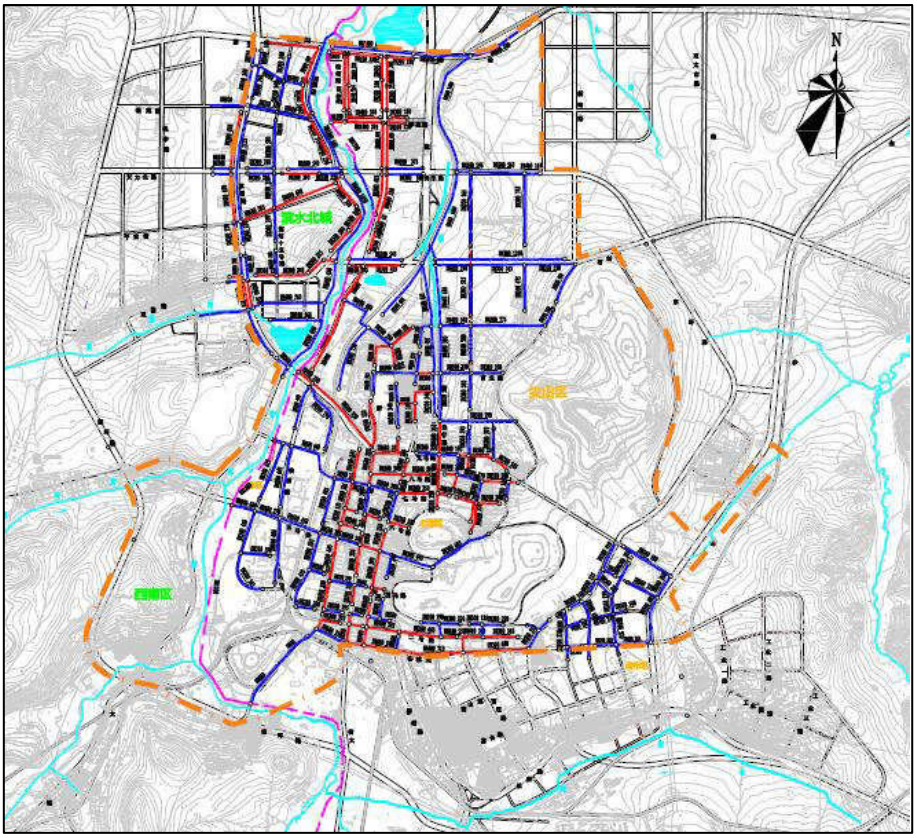

Figure IV-50: Location of proposed sewer system in Jianshan District (SY)

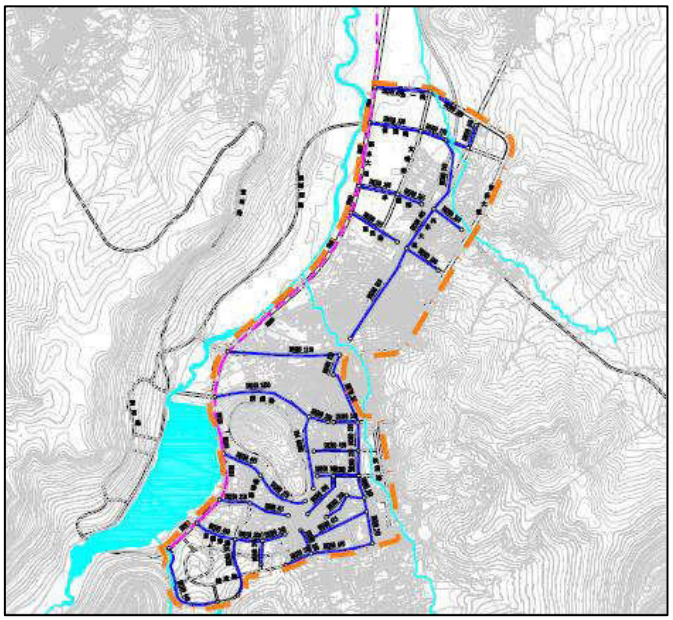

Figure IV-51: Location of proposed sewerage system in Lingdong District (SY)

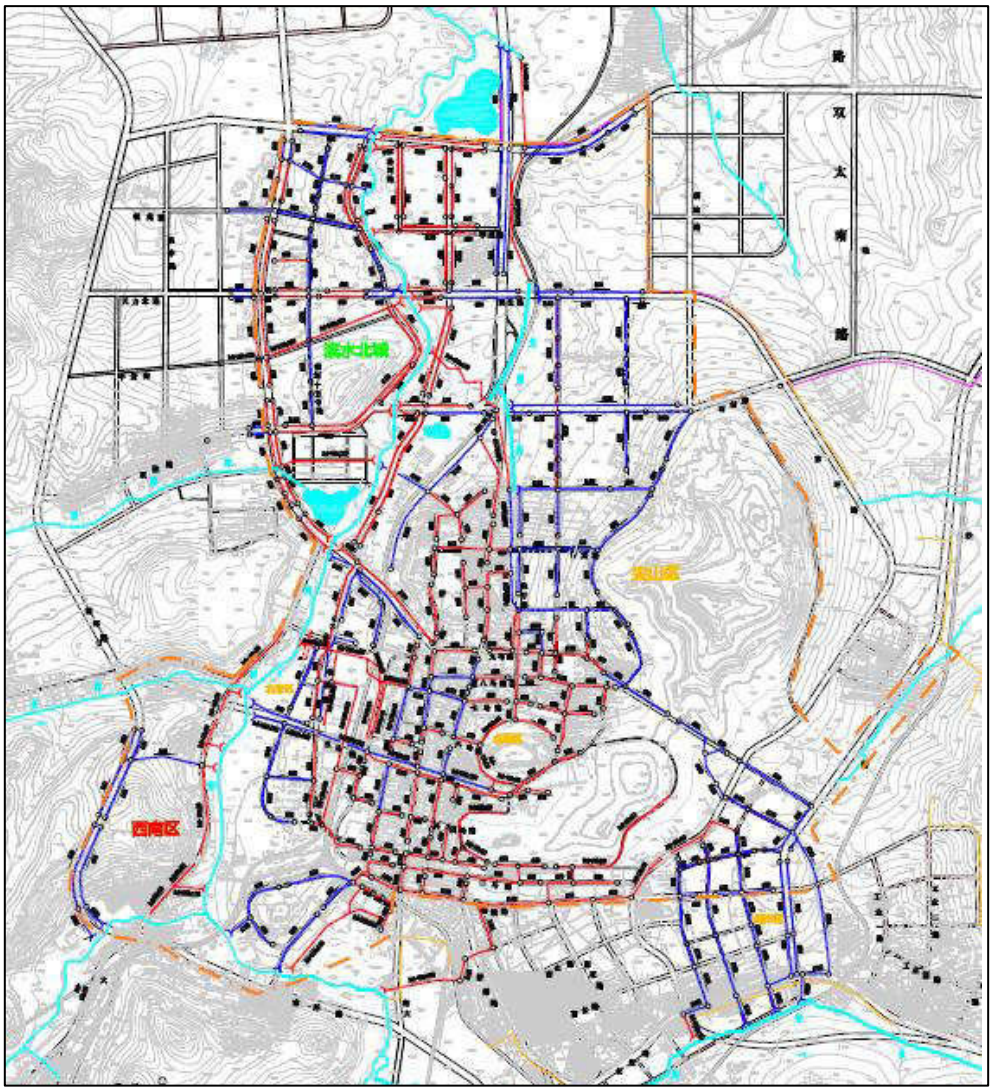

Figure IV-52: Location of proposed drainage system in Jianshan District (SY)

Table IV-68: Summary of proposed sewer and drainage pipelines (SY)

No.	Location	Pipeline	Size	Length (m)
1	Jianshan District	Sewer	D300-D1200	52,928
2	Jianshan District	Drainage	D600-D2000	58,145
2	Jianshan District	Drainage trench	1000*1888 – 3000*1500	3,943
3	Lingdong	Sewer	D300-D600	25,540

4. SY 4.2 South Ring Road and Tunnel

124. Road infrastructure improvement works in Shuangyashan will comprise three elements, Southern Ring Road upgrading, construction of Yunfeng Tunnel, and construction of Xinxing Avenue Flyover. The location of these works are shown in **Figure IV-48**.

a. South Ring Road

125. Construction of the South Ring Road, with two lanes of 9 m width, commenced in 2003 and was completed in 2005. Due to sub-standard design, materials and construction, the concrete surface of the ring road has been heavily damaged, and therefore provides poor and unsafe driving conditions. The project will include reconstruction of a 3.75 km section of

the ring road as a city arterial. Starting at Anbang Avenue in the west and ending at Xiaodi Road in the east, the section will be widened to 50 m with 4 lanes and an asphalt concrete surface. The works will include construction of two bridges (Nanfu Bridge,106 m long; and Yaodi Bridge, 43 m long) as well as municipal facilities including traffic safety facilities, water supply and drainage pipes, landscaping works and street-lighting. The main design criteria for these works are summarized in **Table IV-19**. A typical section of the improved road is provided in **Figure IV-53**.

Table IV-79: Main design standards for South Ring Road (SY)

Name of Item		Unit	Standard
Design Speed		Km/h	80
Minimum circular curve radius	Without super-elevation	m	1296
	With super-elevation	m	500
Minimum length of adjustment curve		m	80
Minimum length of horizontal curve		m	232
Superelevation slope		%	4

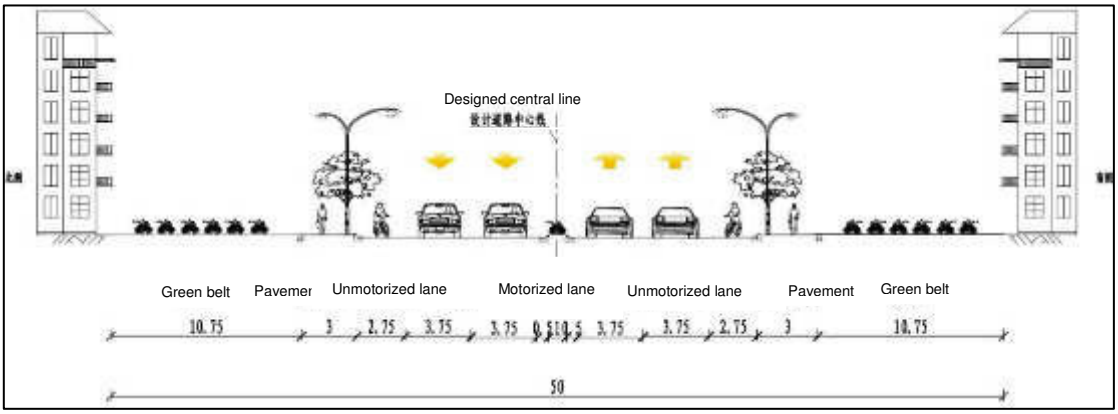

Figure IV-53: Cross-section of South Ring Road SY)

b. Yunfeng Tunnel

126. Areas to the east of Shuangyashan are mountainous, and as a consequence the road networks linking the city to the eastern hinterland are relatively poor. The proposed Yunfeng Tunnel would connect Wenhua Road in the city centre and the East Ring Road in the suburbs. This will facilitate traffic flow from the outer suburbs to city center directly, aiding the development of the city as a whole.

127. The project would include construction of approach roads of 1.4 km and a tunnel of 0.94 km. Approximately 200 m of the tunnel length would be constructed by 'cut and cover', with the remainder constructed using a combination of boring and blasting. The main design criteria for these works are summarized in **Table IV-20**. A typical section of the approach road is provided in **Figure IV-54**, and the tunnel arrangement in **Figure IV-55**.

Table IV-20: Main design standards for proposed Yufeng Tunnel (SY)

Name of item	Standard
Design Speed (Km/h)	60 (Arterial)
Design Life (Y)	100
Width of car lanes (m)	2*3.5=7.0
Lateral Clearance (m)	0.5
Clear Height (m)	5.0
Structure	Separated double tunnels

Figure IV-54: Cross-section of approach roads for Yufeng Tunnel (SY)

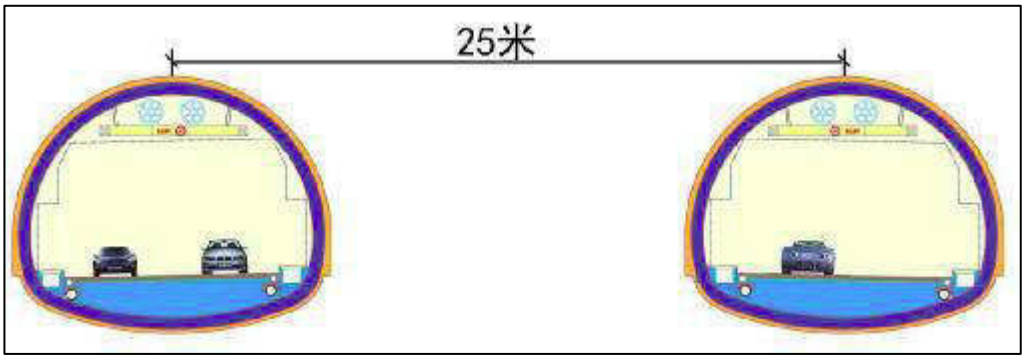

Figure IV-55: Alignment of sub-tunnels of Yufeng Tunnel (SY)

c. Xinxing Avenue Flyover

128. The Xinxing Avenue is a North-South arterial road that runs through the centre of Shuangyashan. It ends at Yima Road in a T-junction where the railway station is located. Not only does the T-junction create a bottle-neck, but the railway in this area separates the city downtown to the north and suburbs to the south. Construction of a flyover at Xinxing Avenue will relieve traffic pressure at the T-junction as well as facilitating connectivity to the southern suburbs.

129. The works will start at Xinxing Avenue/ Sanma Road, pass over Yima Road, railway and Yuanlin Road, and end at the South Ring Road. The total length of the main road is 1470 m with a bridge of 571 m. The section from the starting point of the bridge to the junction with the ramp will have four lanes. The section from the junction of the ramp to the ending point of the bridge will have six lanes with width of 50 m. Other facilities will include: street-lighting, water supply and drainage, landscaping, and traffic facilities. The main design criteria for these works are summarized in **Table IV-21**. A plan of the flyover is shown in **Figure IV-56**, and sections of various parts of the road/bridge are shown in **Figure IV-57 to Figure IV-60**.

Table IV-21: Main design standards for Xinxing Avenue Flyover Bridge (SY)

Name of item	Standard
Design Speed (Km/h)	40 (Arterial)
Design Axle Load	City Level A
Width (m)	28 (over railway part)/23 (regular part)
Structure	Box girder and pier with double columns

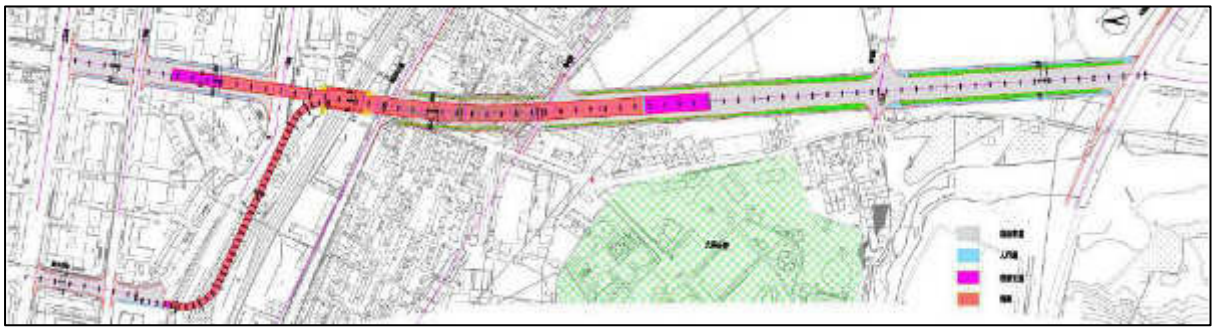

Figure IV-56: Plan design of Xinxing Avenue Flyover (SY)

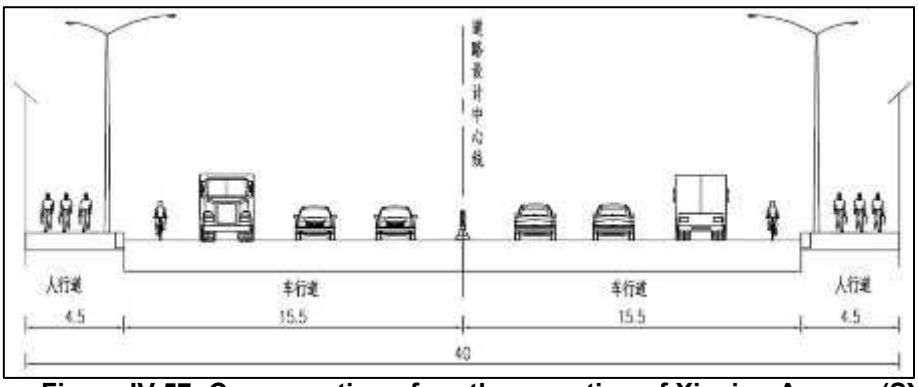

Figure IV-57: Cross-section of northern portion of Xinxing Avenue (SY)

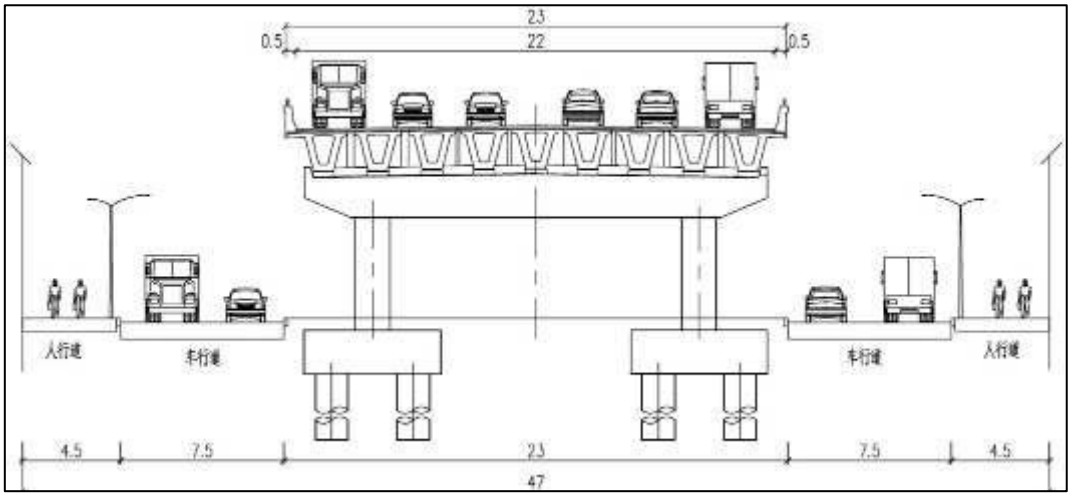

Figure IV-58: Cross-section of Xinxing Avenue Flyover approach road (SY)

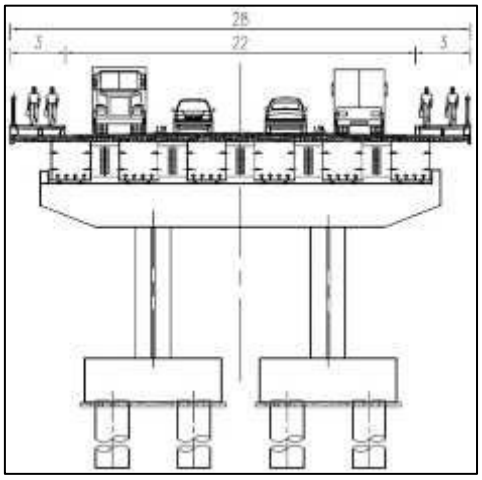

Figure IV-59:Cross-section of the Xinxing Avenue Flyover (SY)

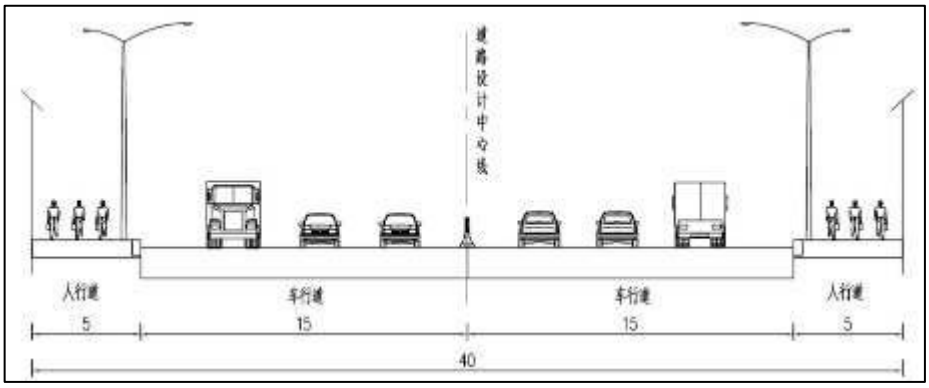

Figure IV-60: Cross-section of the southern portion of Xinxing Avenue (SY)

H. Associated Facilities

130. Existing infrastructure servicing the four cities that will interface with the project are summarized in the **Table IV-22** below. The PPTA consultant undertook a brief due diligence review on all those existing facilities and found all of them were properly operated.

Table IV-22: Project associated facilities

Project Component	Infrastructure Element	Associated Facility
Output 2 - Key infrastructure and SME facilities non-coal industrial parks in the project cities constructed		
HG 2.1 Infrastructure and business support facilities	Water supply	Water supply will be from Hegang Municipal WTP, which has a design capacity of 86,000 m^3/d under operation. It delivers water to the industrial park through a DN500 gravity pipe.
	Wastewater treatment	A 20,000 m^3/d wastewater treatment in the southwest of the industrial park is planned to put into operation prior to this subcomponent.
	District heating	Regional heating is provided by the Wanyuan Thermal Power Plant under operation, which uses rice hulls as biomass fuel and has a capacity of 6000 kW.
JX 2.1 Infrastructure and business support facilities	Water supply	The industrial park WTP was built in 2012. It has a capacity of 5,000 m^3/d, and is supplied by raw water from Muling River.
	Wastewater treatment	The industrial park WWTP is under construction, to be completed by 2017. It has a design capacity of 5,000 m^3/d and treatment standard of Class 1A.

Project Component	Infrastructure Element	Associated Facility
	District heating	The industrial park heat supply station is under construction, to be completed by 2017.
QH 2.1 Infrastructure and business support facilities	Water supply	7700 m^3/d raw water for the WTP will be abstracted from Taoshan reservoir with available water resource (see subchapter F under Chapter VI)
	Wastewater treatment	The construction of a WWTP with capacity of 20,000 m^3 is planned on June 2017 under another domestic project. The effluent is designed to satisfy with Class 1A.
	District heating	A CHP (combined heat and power) plant within the industrial park is under construction. This will be connected to the Datang Thermal Power plant
SY 2.1 Infrastructure and business support facilities: MSE Business Base and China-Russia Business & Trading Park	Water supply	Intake water from Songhua river through a water abstraction project constructed in 2008. Daily water supply capacity is 250,000 m3/d with available water resource
	Wastewater treatment	The Anbang River Basin WWTP is operated by Shuangyashan Longjiang Environmental Protection and Water Company. The plant was built in October 2010 with design capacity of 50,000 m^3/d, Class 1B.
	District heating	Datang (Shuangyashan) plant with capacity of 2*200 MW operated since 2006.
HG 2.2 infrastructure (WWTP)	Sludge disposal	Identified as hazardous solid waste and will be handled by certificated third party.
JX 2.2 infrastructure (WWTP)	Sludge disposal	Baochuan Sanitary Landfill site, constructed in 2005 with capacity of 800 t/d, total capacity of 9.85 million cubic meters. The usage lifetime is 25 years.
Output 4 – Integrated urban infrastructure and services in the project cities improved		
HG 4.1 Integrated river rehabilitation and clean-up from mining and ecosystem based adaptation	Dredged Sediment Disposal	Hegang Sanitary Landfill site, came into operation since September 2016 with designed capacity of 950 t/d and lifetime of 10 years.
HG 4.2 Utilities improvements and urban regeneration	District heating	Longmei Hegang Thermal Power Plant: phase I was operated since 1988, and phase II was operated since 1997. The total capacity is 2*25 MW+2*50 MW; Lida waste rock thermal power plant of Longmei, which uses waste rock as fuel. The total capacity is 2*50MW.
JX 4.2 Utilities improvements and urban regeneration: water supply and drainage pipes	Water Supply	Chaoyang WTP: built in 2016 with capacity of 150,000 m^3/d; Jixi No3 WTP. The design capacity is 80,000 m^3/d, however, due to the design failure, the actual capacity is only 52,000 m^3/d. This plant will be upgrade under the project.
	Wastewater treatment	There are four WWTPs in Jixi (one in each district). Jiguan District WWTP: 10 m^3/d, Class 1A Hengshan District WWTP: 20,000 m^3/d, Class 1B; Didao District WWTP, 20,000 m^3/d, Class 1B; Chengzihe District WWTP, 20,000 m^3/d, Class 1B.
JX 4.2 Utilities improvements and urban regeneration: water supply improvement (No.3 WTP)	Water source	The water source is Hada reservoir. Hada reservoir was built in 1971, and has an active capacity of 48.31 million m^3. (see subchapter F under Chapter VI)
	Sludge disposal	Baochuan Sanitary Landfill site, constructed in 2005 with capacity of 800 t/d, total capacity of 9.85 million cubic meters. The lifetime is estimated at 25 years.
QH 4.2 Utilities improvements and urban regeneration	Water source	Water source is Taoshan reservoir. The reservoir has a catchment area of 2043 km^2, and an average runoff of 305 million m^3 per year. The reservoir has a total capacity of 518 million m^3 and designed available capacity of 417 million m^3. Currently the Phase II of

Project Component	Infrastructure Element	Associated Facility
		the reservoir development has completed, to provide 85 million m^3 per year of raw water to the city. (see subchapter F under Chapter VI)
	Sludge disposal	Taoshan District Sanitary Landfill, constructed in 1988. Additional 600,000 m^3 capacity was provided in 2011.
SY 4.2 Utilities improvements and urban regeneration	Water supply	Hanconggou WTP, upgraded in 2015 to a capacity of 80,000 m^3/d.
	Wastewater treatment	The Anbang River Basin WWTP is operated by Shuangyashan Longjiang Environmental Protection and Water Company. The plant was built in October 2010 with design capacity of 50,000 m^3/d, meeting Class 1B discharged standards.
QH 4.3 Road rehabilitation, public and non-motorized transport improvements	Battery disposal	Batteries will be returned to the manufacturer as per PRC Regulations.
SY 4.3 Road rehabilitation, public and non-motorized transport improvements	Spoil disposal from tunnel	Spoil and waste rock generated during tunneling works will be used for quarry rehabilitation on Shuangyashan mountain, which is approximately 7 km from the project site.

V. BASELINE ENVIRONMENT

A. Sub-regional Environmental Setting

131. Heilongjiang Province is located in the northeast of the PRC, at the highest latitudes and the northernmost end of the country. It borders Russia across the Heilong River, to the west it adjoins the Inner Mongolian Autonomous Region, and to the south is Jilin Province. It covers an area of 454,000 km^2, accounting for 4.7% of the nation's total area. Under its jurisdiction are 13 prefectures and cities, 66 countries, 1,211 townships and 14,488 villages. There are four municipal cities included in the project:

- **Hegang City** is located in the northeast part of Heilongjiang Province, spanning from latitude 47° 04′ −48° 9′ N to longitude 129° 40′ −132° 31' E, and has an administrative area of 14,784 km^2. Bordering prefecture-level cities are Jiamusi (SE) and Yichun (W).
- **Jixi City** is located at the southern edge of the Sanjiang or Three Rivers Plain. The city is located within latitude 44° 51'−46° 36' N and longitude 130° 24'−133° 56' E, and has an administrative area of 22,351 km^2. Much of the prefecture area sits within the conjunction region between the Changbai Mountains and the Wanda Mountains.
- **Qitaihe City** is located in the east of Heilongjiang River, middle and upstream of Weiken River, at 45°16' – 46°37 ' N and 130° 25'-131° 44' E. It is about 430 km from Harbin, the capital of Heilongjiang Province.
- **Shuangyashan City** sits in the northeast Heilongjiang Province, within latitude 46° 20'−47°54' N and longitude 130° 54'−131° 46' E, and has an administrative area of 22,483 km^2

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132. **Geography**. The elevation of Heilongjiang is higher in the northwest, north and the southeast, and lower in the northeast and southwest. In the northwest are the Greater Hinggan Mountains, and in the north, the Lesser Hinggan Mountains. In the southeast are the ridges of Zhangguangcai, Laoye and Taiping, and the Wanda Mountain range. Hilly and mountainous land accounts for 70% of the province area, with mountain heights ranging from 300 to 1780 m above sea level. Plains, lying 50-250 m above sea level, account for the remaining 30% of the province area. The Nenjiang River and Songhua Rivers run across the province from south to north, forming the Sanjiang (three-river) Plain in the northeast and the Songnen Plain in the southwest. In the southeast, there is the Xingkai Lake.

133. The geography of the four project cities is described below:

- **Hegang** is situated in the transition area from the Sanjiang Plain to the Lesser Hinggan Mountains. The terrain of Hegang is high in the northwest and low in the southeast, with the mountainous northwest accounting for 72% of the total city area.
- The name of **Jixi** means at west of Jiguan (cock's comb) Mountain. Jixi is rich in mineral resources such as coal, graphite and marble. Graphite reserves in the city amount to 780 million tons, the highest for any city in Asia.
- **Qitaihe** city is located in an area of hilly topography, with high elevation in the Southeast and lower elevations in the Northwest. Qitaihe is rich in minerals including coal, gold and graphite. Qitaihe has a total coal reserve of 5.3 billion tons, ranking third after Shuangyashan and Jixi in Heilongjiang Province.
- The name of **Shuangyashan** means a 'pair-of-duck' mountains, and refers to two peaks northeast of the city. The city lies in the foothills of the Wanda Mountain range to the south (160-500 m above sea level) and a valley plain to the north (150-200 m above sea level). Shuangyashan is rich in coal, magnetite and marble, with proven coal reserves of 11 billion tons (ranking first out of 13 prefecture and prefecture-level cities in Heilongjiang Province), and magnetite reserves exceeding 120 million tons (ranking first in

Heilongjiang Province).

134. **Soil**. Heilongjiang has highly productive soils, being one of the world's three major black soil zones. 67.6% of its total farmland of 210 mill ha is cultivated on either black soil land, marshland or black calcium soil. The distribution of soils in the four cities area is shown in **Figure V-1**.

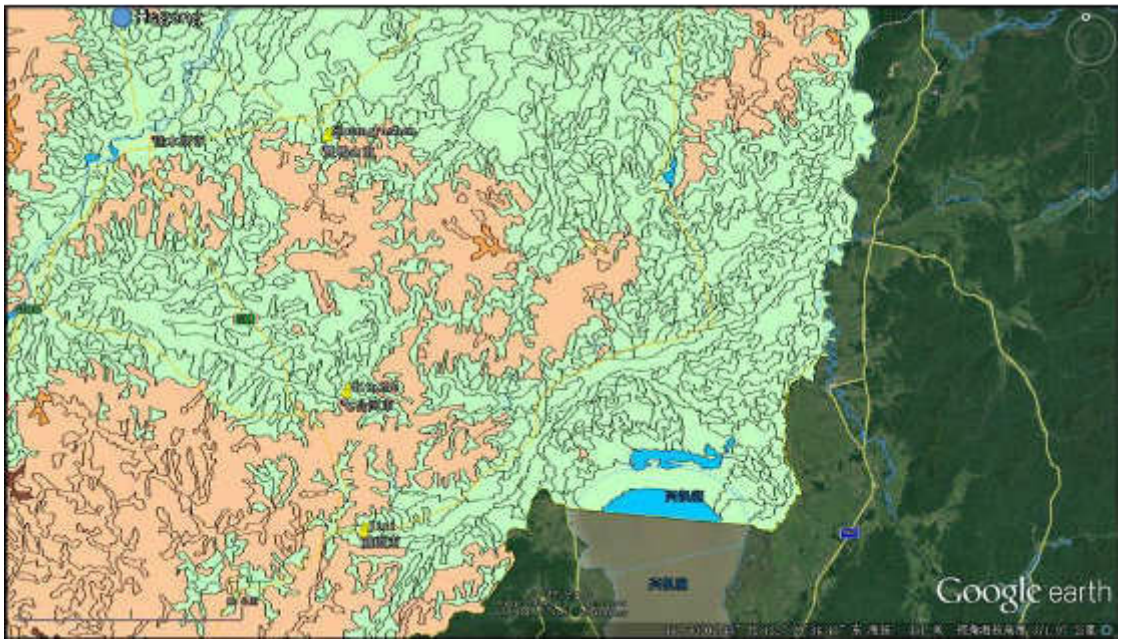

Figure V-1: Soils of the four cities

(green = phaeozems; orange = luvisols) Source: ISRIC-World Soil

135. **Hydrology.** Heilongjiang is one of China's water-rich provinces. Its numerous rivers form five systems: the Heilong River, Wusuli (Ussuri) River, Songhua River, Nenjiang River and Suifeng River. There are about 6,000 lakes and reservoirs in the province, covering more than 800,000 ha. As shown in **Figure V-2**, about 70% of rainfall of the yearly rainfall (which averages 521 mm) is concentrated in the short wet summer (June-August).

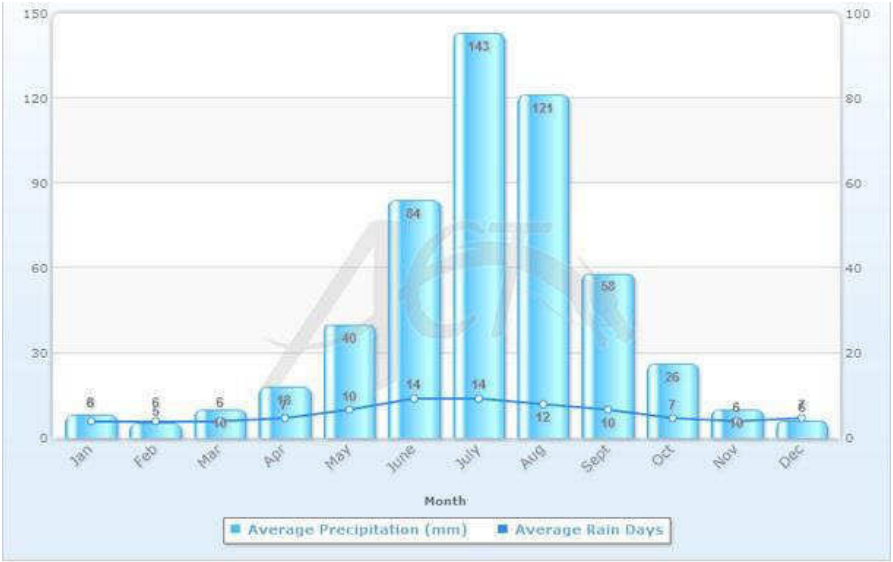

Figure V-2: Average annual precipitation in Heilongjiang

136. Driven by the climate, rivers in the province exhibit a distinct seasonality, with low flow during the winter season (when many smaller rivers becoming frozen solid), and high flow/floodplain inundation in the summer months due to snow melt and higher precipitation. The natural hydrology of many rivers in the province has been altered due to the construction of numerous reservoirs for water supply, flood control and hydro-power generation. **Figure V-3** shows the location of the four project cities in relation to the Heilongjiang River system.

Figure V-3: The Heilongjiang (Amur) river system

137. The Qitaihe City Government issued the Management Measures on Drinking Water Source of Taoshan Reservoir in 25 September 2001. Jixi Government released similar Management Measures on Drinking Water Source of Jixi in 19 March 2007. These regulations delineate water source protection zones and proscribe permitted/banned activities within each zone. The protection zones comprise: (i) a Prohibited Zone (Grade I Zone); (ii) a Protection Zone (Grade II zone); and (iii) a Buffer Zone. The Grade I Zone comprises the reservoir itself and all land within 100 m of the reservoir; together with rivers flowing into the reservoir, 1000 m upstream from the entrance to the reservoir and 100 m wide both sides of this river section. The applicable water quality standard is Class II of GB3838-2002. In the Grade I zone:

- Any new, reconstruction or expansion project not relevant to water supply is forbidden. All existing coal mine, sand and quarry sites shall be closed. All existing coking plants and brick plants should be relocated.
- No sewage discharge is permitted, and all existing wastewater outfalls shall be demolished;
- No dumping or storage of industrial waste or domestic solid wastes.
- No agricultural, aquaculture and fishery activities; no deforestation activities. All cultivated land should be changed back to forest.
- No storage and usage of pesticide and chemical fertilizer.
- No swimming or tourism;
- No storage or use of detergents containing phosphorus.

138. The project will involve river and lake rehabilitation works in two cities, Hegang and

Jixi. The river system in Hegang is shown in **Figure V-4**. The rivers generally flow from north to south. The Shitou River, Qianjin Creek and Xiaoheli River are all tributaries of the Heli River, which eventually discharges to the Songhua River, a major tributary of the Heilongjiang River.

- The Shitou River is located in the east of the city. It has a total length of 45 km with a bankful width of 20 m to 30 m. Discharge in the river is highly seasonal, with flow rates ranging from 73 m^3/s in the wet season to 0.2 m^3/s in the dry season.
- The Qianjin Creek is a small channel with a total length of 6.6 km and a bankful width of 10 m to 20 m. It is a tributary of the Xiaoheli River.
- The watershed of the Xiaoheli River is 289 km^2 with a total length of 60.2 km. It flows from north to south in the west of the city to Heli River, then discharges into Wutong River.
- The Heli River is the second largest river in Hegang City, which flows from north to south in the west of the city, then into the Wutong River. Its total length is 69.3 km. The maximum flow rate is 240 m^3/s and the minimum flow is 0.385 m^3/s.

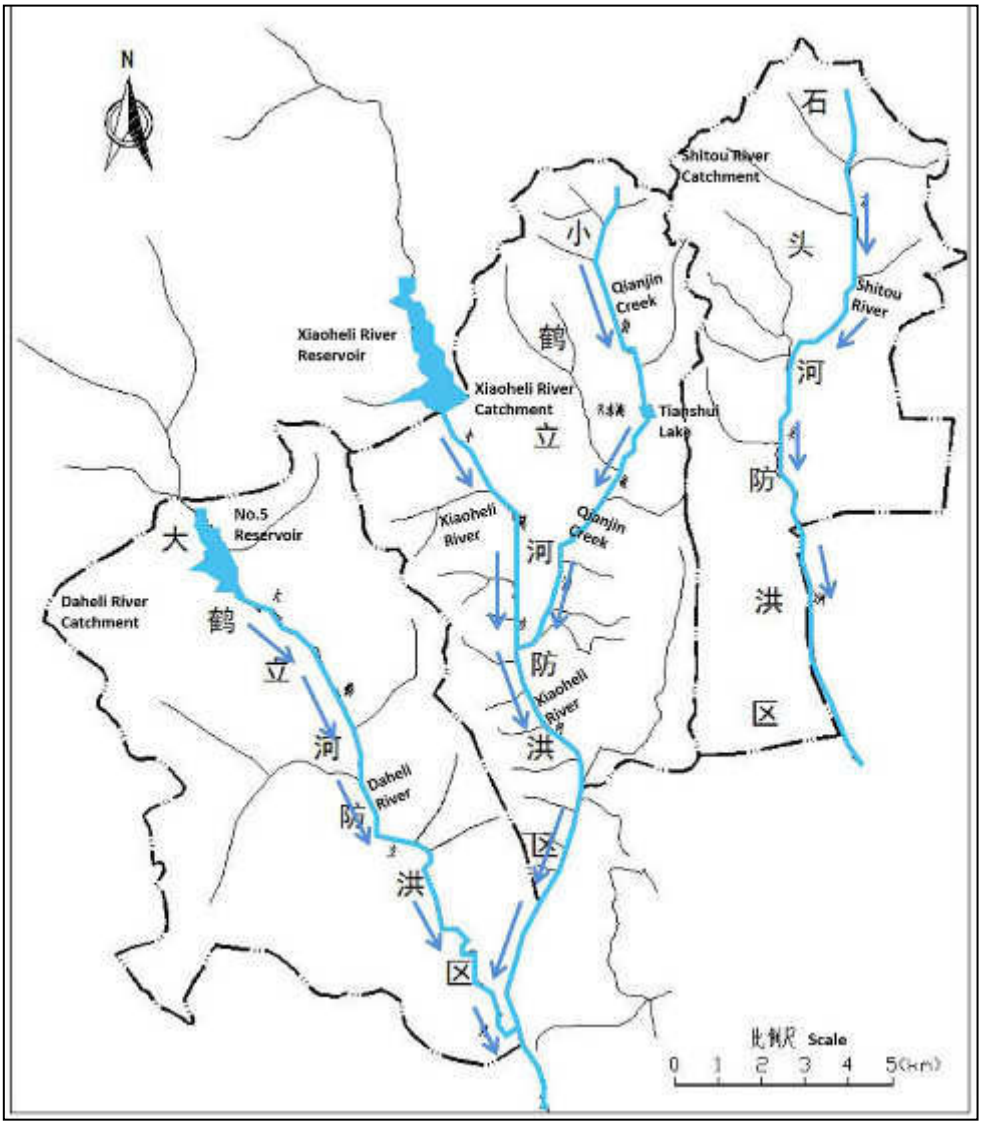

Figure V-4: The Hegang river system (HG)

139. **Figure V-5** shows the river system in Hengshan District of Jixi, including Huangni River, Anle Creek and Hongqi Lake. The Huangni River originates in the Minzhu township, passing through Hongqi township, then converging with the Dashitou river in Jidong County. It has a total length of 50 km and catchment area of 362.9 km^2. The upper reaches of the river

run through mountainous and hilly topography, becoming flatter downstream of the Andong Bridge. Anle Creek is a small tributary of the Huangni River that drains the hills to the west of Hengshan District, joining the Huangni River in the urban district close to the railway bridge.

140. The Huangni River is prone to flooding, especially in spring (due to snow melt in the catchment) and summer (due to heavy rainfall events). It is observed that the river has been silted up in many locations, reducing the flow carrying capacity and leading to flooding.

Figure V-5: River system in Hengshan District (JX)

B. Physical Environment

141. **Ambient air quality**. The PRC ranks air quality into two classes according to the Ambient Air Quality Standards (GB3095-2012). For the current project, all areas fall under Class II category for residential, commercial, educational, industrial and rural areas. For projects that are not expected to generate substantial long-term air quality impacts, it is common practice to use monitoring data from local EPB's routine ambient air quality monitoring locations for EIA in the PRC, which provides a longer term perspective on the

ambient air quality of the area, although the data collected is more general in nature. Data from the urban areas of three of the four cities is presented in **Table V-1** (no data is available from Qitaihe).

Table V-1: General daily average air quality monitoring data (March 2017) (mg/m^3)

City	PM10	SO_2	NO_2	PM2.5	CO	O_3
Hegang	0.059	0.009	0.018	0.030	0.7	0.082
Jixi	0.086	0.011	0.020	0.055	1.4	0.072
Qitaihe	No data available					
Shuangyashan	0.062	0.013	0.024	0.042	0.9	0.079
Class II Standard (daily average)	0.15	0.15	0.08	0.075	4	0.16 (max.8-hour average)

142. Specific ambient air quality baseline monitoring is conducted for EIA in the PRC where projects have the potential to cause longer-term impacts during the operation phase. Typically, the daily average concentration levels of total suspended particulates (TSP) and/or particulate matter with diameter $\leqslant$ 10 μm (PM_{10}), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) are measured on seven consecutive days in the project area. Baseline ambient air quality monitoring was undertaken in early 2017 by local institutes conducting DEIA for project components involving development of roads, WWTP and WTP. Monitoring was conducted within/along the boundary of proposed works areas, as well as at nearby potential sensitive receptors, as per the requirements of GB3095-2012. Parameters monitored included 24-hr average TSP and or PM_{10}, SO_2 and NO_2; 1-hr average SO_2 and NO_2; and for the wastewater treatment plants, 24-hr H_2S, NH_3 and odor. Data collected for the current project is summarized in **Table V-2**.

Table V-2: Project specific baseline ambient air quality monitoring data

Administrative Unit	Component	Location	Date	Concentration (mg/m³)												
				PM_{10}	$PM_{2.5}$	TSP	SO_2		NO_2		CO		NH_3	H_2S	Odor
				24-h	24-h	24-h	1-h	24-h	1-h	24-h	1-h	24-h	24-h	24-h	24-h
Hegang	HG 2.1 Industrial park infrastructure	A1 Xier Road	2017/02/25 - 2017/03/03	/	/	0.130 - 0.139	0.005 - 0.017	0.011 - 0.013	0.008-0.025	0.013 -0.02	0.3-0.9	0.525 - 0.600	/	/	/
		A2 Xinjie Road	2017/02/25 - 2017/03/03	/	/	0.099 - 0.112	0.004 - 0.015	0.009 - 0.012	0.006-0.026	0.013 - 0.020	0.3-0.8	0.433 - 0.600	/	/	/
		A3 Lvyuan Road	2017/02/25 - 2017/03/03	/	/	0.111 - 0.128	0.006 - 0.017	0.011 - 0.014	0.006-0.024	0.012 - 0.017	0.3-0.7	0.425 - 0.575	/	/	/
		A4 Lvyuan Road	2017/02/25 - 2017/03/03	/	/	0.114 - 0.121	0.007 - 0.019	0.012 - 0.015	0.007-0.023	0.013 - 0.019	0.3-0.9	0.475 - 0.575	/	/	/
	HG 2.2 Luobei Industrial Park WWTP	A1 Dongsheng Village	2017/02/25 - 2017/03/03	/	/	0.092 - 0.099	0.008 - 0.014	0.011 - 0.012	0.007-0.016	0.012 - 0.015	/	/	0.004L-0.007	0.001L-0.002	<10
		A2 Gongqing Farm	2017/02/25 - 2017/03/03	/	/	0.095 - 0.112	0.008 - 0.014	0.010 - 0.012	0.008-0.018	0.012 - 0.015	/	/	0.004L-0.008	0.001L-0.003	<12
		A3 proposed sites	2017/02/25 - 2017/03/03	/	/	0.095 - 0.103	0.007 - 0.015	0.010 - 0.012	0.008-0.017	0.012 - 0.015	/	/	0.004L	0.001L	<10
	HG 3.1 Lingbei Open Cast Mine	A1 Dongxing Road	2017/02/25 - 2017/03/03	/	/	0.116 - 0.136	0.006 - 0.018	0.012 - 0.014	0.007-0.026	0.013 - 0.020	/	/	/	/	/
		A2 Center of the mining pit	2017/02/25 - 2017/03/03	/	/	0.102 - 0.108	0.005 - 0.016	0.009 - 0.011	0.006-0.022	0.014 - 0.019	/	/	/	/	/
		A3 Hongtaiyang shop (near the mining pit）	2017/02/25 - 2017/03/03	/	/	0.122 - 0.126	0.006 - 0.019	0.013 - 0.014	0.009-0.023	0.013 - 0.019	/	/	/	/	/
	HG 4.3 Road Rehabilitation and non-motorized transport improvements	A1 4th street of Xijiefang Road	2017/02/25 - 2017/03/03	/	/	0.136 - 0.153	0.006 - 0.017	0.011 - 0.014	0.007-0.024	0.013 - 0.019	0.3-0.8	0.5-0.6	/	/	/
		A2 Tiexi Road	2017/02/25 - 2017/03/03	/	/	0.132 - 0.140	0.006 - 0.018	0.011 - 0.014	0.006-0.025	0.012 - 0.019	0.3-0.8	0.5	/	/	/

Administrative Unit	Component	Location	Date	Concentration (mg/m³)												
				PM_{10}	$PM_{2.5}$	TSP	SO_2		NO_2		CO		NH_3	H_2S	Odor
				24-h	24-h	24-h	1-h	24-h	1-h	24-h	1-h	24-h	24-h	24-h	24-h
		A3 Yima Road	2017/02/25 - 2017/03/03	/	/	0.132 - 0.140	0.006 - 0.018	0.012 - 0.013	0.007-0.023	0.012 - 0.018	0.3-0.8	0.5-0.6	/	/	/
Jixi	JX 2.2 Jiguan WWTP	A1 Dongtai Village	2017/3/5-2017/3/12	0.05-0.064	/	0.077 - 0.087	0.017 - 0.043	0.02-0.027	0.01-0.025	0.018 - 0.021	/	/	0.01L	0.001L	10L
		A2 Proposed site	2017/3/5-2017/3/12	0.056 - 0.063	/	0.078 - 0.086	0.014 -0.03	0.021 - 0.027	0.014-0.023	0.017 - 0.021	/	/	0.01L	0.001L	12-16
		A3 Hongxing Village	2017/3/5-2017/3/12	0.055 - 0.067	/	0.076 - 0.087	0.018 - 0.041	0.024 - 0.029	0.013-0.022	0.015 - 0.021	/	/	0.01L	0.001L	10L
	JX 4.3 Jiaotong Street and flyover bypass	A1 one story house at the crossing of Beishan road and Jiaotong street	2017/2/17-2017/2/23	0.085 - 0.101	0.043 - 0.060	/	0.031 - 0.044	0.035 - 0.040	0.042-0.062	0.049 - 0.055	0.9-1.5	1.1-1.4	/	/	/
		A2 one story house of Baoquanwei	2017/2/17-2017/2/23	0.092 - 0.105	0.043 - 0.053	/	0.031 - 0.045	0.036 - 0.041	0.042-0.062	0.049 - 0.052	0.8-1.2	0.9-1.1	/	/	/
Qitaihe	QH 2.1 Industrial park infrastructure	A1 Jianshaqu	2017/3/8-2017/3/14	/	/	0.086 - 0.142	/	/	0.005-0.054	0.012 - 0.038	0.4-1.2	0.5-1.0	/	/	/
		A2 Center of the proposed road	2017/3/8-2017/3/14	/	/	0.101 - 0.157	/	/	0.002-0.058	0.004 - 0.039	0.4-1.2	0.5-0.9	/	/	/
Shuangyashan	SY 3.1 Waste rock dump site remediation/safe closure and management of former mines	A1 North boundary of the site	2017/2/21-2017/2/27	0.058 - 0.074	/	0.104 - 0.139	0.017 - 0.027	0.018 - 0.026	0.011-0.028	0.015 - 0.027	/	/	/	/	/
		A2 East boundary of the site	2017/2/21-2017/2/27	0.056 - 0.075	/	0.104 - 0.134	0.015 - 0.031	0.017 - 0.030	0.014-0.026	0.014 - 0.030	/	/	/	/	/
		A3 West boundary of the site	2017/2/21-2017/2/27	0.062 - 0.073	/	0.106 - 0.134	0.016 - 0.042	0.016 - 0.034	0.015-0.038	0.014 - 0.026	/	/	/	/	/
		A4 Xinyi Village	2017/2/21-2017/2/27	0.068 - 0.084	/	0.118 - 0.142	0.016 - 0.048	0.027 - 0.047	0.010-0.029	0.014 - 0.024	/	/	/	/	/
		A1 Shuanghe Village	2017/2/21-2017/2/27	0.07-0.082	/	0.126 - 0.140	0.025 - 0.036	0.025 - 0.032	0.022-0.036	/	/	/	/	/	/

Administrative Unit	Component	Location	Date	Concentration (mg/m³)											
				PM_{10}	$PM_{2.5}$	TSP	SO_2		NO_2		CO		NH_3	H_2S	Odor
				24-h	24-h	24-h	1-h	24-h	1-h	24-h	1-h	24-h	24-h	24-h	24-h
		A2 Near the EPB	2017/2/21-2017/2/27	0.078 - 0.115		0.125 - 0.148	0.022 - 0.071	0.04-0.049	0.017-0.061	/	/	/	/	/	/
		A3 Near Lingdong branch of Mining Design Institute	2017/2/21-2017/2/27	0.093 - 0.103	/	0.031 - 0.042	0.031 - 0.042	0.036 - 0.040	0.032-0.048	/	/	/	/	/	/
	SY 4.3 South Ring Road	A1 Anshan Community	2017/3/9-2017/3/15	/	/	0.076 - 0.097	/	/	0.006-0.015	0.007 - 0.009	0.13 - 0.39	0.14-0.18	/	/	/
		A2 Shuangyashan Welfare Home	2017/3/9-2017/3/15	/	/	0.071 - 0.089	/	/	0.006-0.015	0.007 - 0.009	0.12 - 0.38	0.1-0.16	/	/	/
	SY 4.3 Xinxing Avenue	A1 Zhongxinzhan Community	2017/3/9-2017/3/15	/	/	0.069 - 0.090	/	/	0.005 L-0.010	0005-0.006	0.35 - 0.54	0.42-0.51	/	/	/
		A2 Transportation Branch of Mining Hospital	2017/3/9-2017/3/15	/	/	0.023 - 0.060	/	/	0.005 L-0.009	0.005 - 0.006	0.39 - 0.57	0.45-0.57	/	/	/
		A3 Beixiu Community	2017/3/9-2017/3/15	/	/	0.069 - 0.090	/	/	0.005 L-0.008	0.004 - 0.006	0.34 - 0.56	0.44-0.56	/	/	/
	SY 4.3 Yunfeng Tunnel	A1 Jianshe Plaza	2017/3/9-2017/3/15	/	/	0.039 - 0.064	/	/	0.006-0.021	0.008 - 0.010	0.23 - 0.49	0.13-0.20	/	/	/
Class II	GB 3095-2012			0.15	0.075	0.3	0.5	0.15	0.08	0.2	4	10	N/A	N/A	N/A
WBG EHS standard	Interim target			N/A	0.075 - 0.150			0.050 - 0.125	N/A				N/A	N/A	N/A
	AQG			N/A	0.05			0.02	0.2				N/A	N/A	N/A

143. Air quality data collected by local EPB indicates air quality in the four cities (except Qitaihe, where no data is available) complied with Class II air quality standards and WBG's EHS interim targets. Air quality data collected during surveys conducted as part of DEIA showed that concentrations of the parameters measured on the days and locations shown complied with Class II air quality standards and WBG's EHS interim targets. Most sites complied with the less stringent 1-hour NO_2 AQG standard, but not with the more stringent 24-hr SO_2 standard.

144. **Acoustic environment.** Noise standards in the PRC are prescribed in Ambient Acoustic Environment Standard (GB 3096-2008), which categorizes five functional categories based on their tolerance to noise pollution (see **Table II-8**). For the current project, components were either considered category 2 (areas with mixed residential and commercial functions) or category 4a (areas adjacent to major roads and marine traffic noise).

145. Specific noise baseline monitoring is conducted for EIA in the PRC where projects have the potential to cause longer-term impacts during the operation phase. Typically, baseline noise monitoring for EIA in the PRC consists of noise level measurements at sensitive receptors once in the day time and once in the night time each day for two consecutive days. Baseline noise measurements were undertaken in early 2017 by local institutes conducting DEIA for project components involving development of roads, WWTP and WTP. Monitoring was conducted within/along the boundary of proposed works areas, as well as at nearby potential sensitive receptors, as per the requirements of GB 3096-2008. Noise data collected for the current project is summarized in **Table V-3**.

Table V-3: Baseline noise monitoring data

Component	Activity	Location	Date	Day 1		Day 2	
				Day	Night	Day	Night
Hegang							
HG 2.1	Industrial Park Roads and Related Utilities	Xiyi Road	2017/2/28-29	55.7	48	49.3	43.5
		Xisan Road	2017/2/28-29	52.6	40.2	39.8	38.6
		Lvyuan Road 1#	2017/2/28-29	53.8	46.9	46.7	42.2
		Lvyuan Road 2#	2017/2/28-29	53.6	39.9	40.1	36.9
HG 2.2	Luobei WWTP	East Boundary	2017/2/26-27	36.2	34	36.8	34.9
		South Boundary	2017/2/26-27	41.6	34.8	42.3	34.1
		West Boundary	2017/2/26-27	39	34.2	36.6	34.8
		North Boundary	2017/2/26-27	41.4	37	41.1	35
HG 3.1	Mining rehabilitation	East Boundary	2017/2/26-27	35.4	33.6	38.4	35.4
		South Boundary	2017/2/26-27	36.8	34.1	38.7	36.1
		West Boundary	2017/2/26-27	35.9	34.2	36.5	33.2
		North Boundary	2017/2/26-27	43.7	36.6	40.8	36.4
HG 4.3	Road rehabilitation, public and non-motorized transport improvements	Front Building, East of Xijiefang Road	2017/2/28-29	58	48.7	55	46.9
		South of Xijiefang Road	2017/2/28-29	59	49.3	55.7	47.5
		East of Nanfendou Street	2017/2/28-29	59.3	49.4	57.9	49.7
		West of Nanfendou Street	2017/2/28-29	59.7	48.5	57.1	48.4
		South of Tiexi Road	2017/2/28-29	59.2	49.5	59	49.4
		North of Tiexi Road	2017/2/28-29	59	49.7	59.5	49.7
		South of Hubei Road	2017/2/28-29	56	46.2	55.7	45.1
		North of Hubei Road	2017/2/28-29	55.7	47.1	58.1	45.3
		East of Yima Road	2017/2/28-29	59.9	49.5	59.5	49.7
		West of Yima Road	2017/2/28-29	59.6	49.7	59.2	49.3
		South of Tianxiang Road	2017/2/28-29	59.7	49.1	59.6	49.1
		North of Tianxiang Road	2017/2/28-29	59.9	49.4	58.9	47.9
Jixi							
JX 2.1	Hengshan Industrial park road	K2+000, 3.5 m to the central line of the road	2017/2/21-22	42.7	36.4	43.9	36.5
		K2+000, 20 m to the central line of the road	2017/2/21-22	41	36	42.2	36.1

Component	Activity	Location	Date	Day 1		Day 2	
				Day	Night	Day	Night
		K2+000, 40 m to the central line of the road	2017/2/21-22	39.4	35.5	40.5	35.7
		K2+000, 60 m to the central line of the road	2017/2/21-22	38.6	35.4	39.8	35.4
		K2+000, 80 m to the central line of the road	2017/2/21-22	37.6	35.4	38.9	35.2
		K2+000, 120 m to the central line of the road	2017/2/21-22	37.1	35.3	38.3	35.1
		K0+250	2017/2/21-22	38.4	35.7	39.6	35.5
JX 2.2	Jiguan WWTP	North Boundary	2016/8/8-9	51	47.8	53.3	48.5
		East Boundary	2017/3/5-6	52.4	43.7	53	43.4
		South Boundary	2017/3/5-6	52	43.9	52.6	43.5
		West Boundary	2017/3/5-6	53.2	43.4	53	43.3
		North Boundary	2017/3/5-6	55.7	43.9	55.6	44
JX 4.3	Jiaotong Street and bypass bridge	N1 Nearest Building (1st floor) of Qijie group	2017/2/19-20	57.9	48.7	57.3	47.9
		N1 Nearest Building (3rd floor) of Qijie group	2017/2/19-20	57.5	48.6	57.1	47.7
		N1 Nearest Building (5th floor) of Qijie group	2017/2/19-20	57.4	48.4	56.9	47.5
		N2 Nearest Building (1st floor) of Henghsan Community	2017/2/19-20	58.2	49.3	57.6	48.5
		N2 Nearest Building (3rd floor) of Henghsan Community	2017/2/19-20	58.1	49.1	57.2	48.3
		N2 Nearest Building (5th floor) of Henghsan Community	2017/2/19-20	57.8	48.9	57	48.1
		N3 Nearest Building (1st floor) of Zhengfu Community	2017/2/19-20	49.5	44.4	50.3	45.1
		N3 Nearest Building (3rd floor) of Zhengfu Community	2017/2/19-20	49.3	44.2	49.9	44.8
		N3 Nearest Building (5th floor) of Zhengfu Community	2017/2/19-20	49.2	44.1	49.8	44.7
		N4 Nearest Building (1st floor) of Hengshan Primary School	2017/2/19-20	50.2	44.6	51.3	44.9
		N4 Nearest Building (3rd floor) of Hengshan Primary School	2017/2/19-20	49.8	44.4	50.9	44.6
		N5 Corssing of Beishan Road and Jiaotong Street	2017/2/19-20	47.6	43.3	47.8	43.5
		N6 South of Beishan Road	2017/2/19-20	48.1	43.7	48.3	43.9
		N7 North of Flood control channel	2017/2/19-20	54.7	44.8	55.2	44.5
		N8 One story house at north of Baoquanwei when train passing	2017/2/19-20	65.8	48.1	65.4	55.9
		N8 One story house at north of Baoquanwei when no train passing	2017/2/19-20	58.2	56.2	58.3	47.9
		N9 One story house at north of Baoquanwei when train passing	2017/2/19-20	58.6	48.4	58.3	49.1
		N9 One story house at north of Baoquanwei when no train passing	2017/2/19-20	56.4	48.1	56.6	46.9
		N10 One story house at south of Baoquanwei when train passing	2017/2/19-20	58.3	49.1	57.8	56.9
		N10 One story house at north of Baoquanwei when no train passing	2017/2/19-20	56.4	47.2	49.6	47
		N11 Baoquanwei Background	2017/2/19-20	46.2	37.1	47.3	38.8
JX 4.2	No.3 WTP	East Boundary of the WTP	2016/8/8-9	59.1	48.9	59.6	49.2
		South Boundary of the WTP	2016/8/8-9	51.7	48.6	53.2	48.1
		West Boundary of the WTP	2016/8/8-9	51.2	49.5	52.8	48.8
		North Boundary of the WTP	2016/8/8-9	50.1	47.8	53.3	48.5
Qitaihe							

Component	Activity	Location	Date	Day 1		Day 2	
				Day	Night	Day	Night
QH 2.1	Industrial Park Roads and Related Utilities	First row residential building	2017/3/8-9	45.2	42.3	46.5	42.5
		Second row residential building	2017/3/8-9	44.1	42	45.6	42.1
		Middle line of the proposed road	2017/3/8-9	46.7	43.8	47.1	43.4
Shuangyashan							
SY 2.1	Industrial Park Infrastructure	West boundary of the standardized workshop	2017/2/22-23	50.1	43.5	51.2	45.3
		East boundary of the standardized workshop	2017/2/22-23	49.2	44.1	50.5	44.2
		North boundary of the standardized workshop	2017/2/22-23	50.6	44.8	50.4	44.3
		South boundary of the standardized workshop	2017/2/22-23	51.2	44.2	52.1	46.3
SY 4.2	Urban infrastructures	N1 Shop at Bama Road	2017/2/22-23	52.4	43.5	53.4	42.6
		N2 Cuifeng Community	2017/2/22-23	53.1	43.2	53.6	43.9
		N3 Crossing	2017/2/22-23	58.6	47.8	58.1	47.2
		N4 Community	2017/2/22-23	52.1	42.9	52.4	43.2
		N5 Agricultural Bank	2017/2/22-23	56.4	46.1	55.6	46.3
SY 4.3	South ring road	N1 Anshan Community (first row of buildings)	2017/3/9-10	65.3	53.8	65.5	54.1
		N2 Anshan Community (second row of buildings)	2017/3/9-10	57.7	47.8	58.4	48.1
		N3 Anshan Community(first row of buildings)	2017/3/9-10	63.7	52.2	64.1	53.9
		N4 Anshan Community(third row of buildings)	2017/3/9-10	55.4	45.3	55.7	49.3
		N5 Anshan Community(first row of buildings)	2017/3/9-10	64.9	53.4	65.2	52.4
		N6 Anshan Community(third row of buildings)	2017/3/9-10	54.8	46.1	58.5	47.2
		N7 Shuangyashan Social Wefare House(first floor of the first row building)	2017/3/9-10	50.5	40.9	50.2	43.6
		N7 Shuangyashan Social Wefare House(first floor of the first row building)	2017/3/9-10	50.4	40.8	50	43.4
		N7 Shuangyashan Social Wefare House(third floor of the first row building)	2017/3/9-10	50.2	40.6	49.7	43.1
		N8 Fu'an Village (first row of building)	2017/3/9-10	62.7	52.3	62	53.4
		N9 Fu'an Village (second row of building)	55.4	42.8		56.4	45.7
		N10 Yaodi Village	2017/3/9-10	52.1	40.3	51.9	40.5
		20 m to the road shoulder	2017/3/9-10	58	47.8	56.4	47.6
		40 m to the road shoulder	2017/3/9-10	54.4	45.7	55	45.1
		60 m to the road shoulder	2017/3/9-10	51.9	43.4	54.1	43.6
		80 m to the road shoulder	2017/3/9-10	50.9	42.2	51.4	42
		120 m to the road shoulder	2017/3/9-10	50	40.9	50.2	41.2
	Xinxing Avenue	N1 Zhongxinzhan Community (1st floor of Building 1)	2017/3/9-10	63	52.2	65.5	50.3
		N1 Zhongxinzhan Community (3rd floor of Building 1)	2017/3/9-10	65.3	53.8	65.2	50.5
		N1 Zhongxinzhan Community (5th floor of Building 1)	2017/3/9-10	66.5	51.3	64.1	50.5
		N1 Zhongxinzhan Community (7th floor of Building 1)	2017/3/9-10	66.3	50.5	67.9	51.3
		N2 Zhongxinzhan Community (1st floor of Building 2)	2017/3/9-10	57.7	45.3	58.4	48.9
		N2 Zhongxinzhan Community (3rd floor of Building 2)	2017/3/9-10	55.8	47.8	54.1	49.7
		N2 Zhongxinzhan Community (5th floor of Building 2)	2017/3/9-10	59.5	43.4	55.7	49.3

Component	Activity	Location	Date	Day 1		Day 2	
				Day	Night	Day	Night
		N2 Zhongxinzhan Community (7th floor of Building 2	2017/3/9-10	58	42	58.6	48.1
		N3 1# Community (1st floor)	2017/3/9-10	56	46.3	58.5	45.1
		N3 1# Community (3rd floor)	2017/3/9-10	54.8	46.1	56.4	44.4
		N3 1# Community (5th floor)	2017/3/9-10	54.4	49.3	58.5	47.2
		N3 1# Community (7th floor)	2017/3/9-10	55.4	42.8	59	52.4
		N4 Environmental monitoring station of Shuangyashan Mining Group (1st floor)	2017/3/9-10	62.7	53.4	64.1	53.9
		N4 Environmental monitoring station of Shuangyashan Mining Group (3rd floor)	2017/3/9-10	61.7	53.8	61.7	54.8
		N5 Railway transportation office building of Shuangyashan Mining Group (1st floor)	2017/3/9-10	63.7	52.4	69.5	50.5
		N5 Railway transportation office building of Shuangyashan Mining Group (3rd floor)	2017/3/9-10	62.1	49.7	67.9	52
		N5 Railway transportation office building of Shuangyashan Mining Group (5th floor)	2017/3/9-10	62.2	52.3	65.5	53.4
		N6 Mining Group Hospital	2017/3/9-10	66.1	53.4	67.1	54.1
		N7 Zhongtian Hospitals (1st floor)	2017/3/9-10	62.2	50.7	59.9	51.9
		N7 Zhongtian Hospitals (3rd floor)	2017/3/9-10	62.7	54.4	59.7	52.3
		N7 Zhongtian Hospitals (5th floor)	2017/3/9-10	63.8	51.9	60.5	51.1
		N7 Zhongtian Hospitals (7th floor)	2017/3/9-10	64.9	52.3	62	50.5
		N8 Residents Committee of Beixiu Community	2017/3/9-10	53.4	42.2	56.2	45.7
		N9 Beixiu Community (near the elderly care house)	2017/3/9-10	55.4	42.8	51.3	48.5
		N10 2# Community	2017/3/9-10	59.8	41.2	55.8	47.6
		20 m to the road shoulder	2017/3/9-10	58	47.8	56.4	47.6
		40 m to the road shoulder	2017/3/9-10	54.4	45.7	55	45.1
		60 m to the road shoulder	2017/3/9-10	51.9	43.4	54.1	43.6
		80 m to the road shoulder	2017/3/9-10	50.9	42.2	51.4	42
		120 m to the road shoulder	2017/3/9-10	50	40.9	50.2	41.2
	Yunfengshan Tunnel	N1 Construction Plaza (front building, 1st floor)	2017/3/9-10	65.3	53.8	65.2	52.4
		N1 Construction Plaza (front building, 3rd floor)	2017/3/9-10	65.2	53.7	65	52.3
		N2 Yunfeng Community (#1 Building, 1st floor)	2017/3/9-10	53.4	44.9	54.1	45.1
		N2 Yunfeng Community (#1 Building, 3rd floor)	2017/3/9-10	53.3	44.8	54	45
		N2 Yunfeng Community (#1 Building, 5th floor)	2017/3/9-10	53.2	44.7	53.8	44.9
		N2 Yunfeng Community (#1 Building, 7th floor)	2017/3/9-10	53	44.5	53.7	44.7
		N2 Yunfeng Community (#1 Building, 9th floor)	2017/3/9-10	52.9	44.4	53.6	44.6
		N2 Yunfeng Community (#1 Building, 11th floor)	2017/3/9-10	52.8	44.3	53.4	44.5
		N2 Yunfeng Community (#1 Building, 13th floor)	2017/3/9-10	52.6	44.1	53.2	44.3
		M3 Construction Bank Community (1#Building,1st floor)	2017/3/9-10	62.1	52.2	65.2	52

Component	Activity	Location	Date	Day 1		Day 2	
				Day	Night	Day	Night
		M3 Construction Bank Community (1#Building,3rd floor)	2017/3/9-10	62	52.1	65	51.9
		M3 Construction Bank Community (1#Building,5th floor)	2017/3/9-10	61.9	52	64.9	51.8
		M4 Construction Bank Community (2#Building,1st floor)	2017/3/9-10	51.9	42.8	51.4	45.1
		M4 Construction Bank Community (2#Building,3rd floor)	2017/3/9-10	51.8	42.7	51.3	45
		M4 Construction Bank Community (2#Building,5th floor)	2017/3/9-10	51.6	42.5	51.2	44.8
GB 3096-2008 Category 2 Standard				60	50	60	50
GB 3096-2008 Category 4a Standard				70	55	70	55
WBG EHS Standard				55	45	55	45
Exceed WBG EHS Standard							
Exceed GB 3096-2008 Class II Standard							

146. Monitoring results show that ambient noise levels at industrial park sites were typically low and in compliance with requirements for Environmental Quality Standards for Noise (GB3096-2008) Class II as well as the more stringent requirements of WBG EHS Standards. Many sites and nearby sensitive receptors for project components in more urban areas typically did not meet the requirements, largely as a result of proximity to roads and railways.

147. **Surface water quality.** The PRC's Environmental Quality Standard for Surface Water (GB3838-2002) defines five water quality categories for different environment functions (**Table II-9**). Category I presents the best water quality and Category V the worst water quality. Only Category I to Category III water quality can be used for potable purpose. Water quality measurements were undertaken in early 2017 (which is in the dry season) by local institutes conducting DEIA for river rehabilitation and wastewater treatment project components, as per the requirements of GB 3838-2002. The data are summarized in **Table V-4**.

Table V-4: Baseline surface water quality monitoring data

City	River	Sample Location	Date	pH	NH_3-N	COD	BOD_5	TPH	SS	Imn	VOC	Sulfide	TP	DO
Hegang	HG 2.2 Yadan River	500 m to the upstream of Yadan River	2017/2/25	8.09	0.053	16.9	3.65	0.33	/	/	0.0003L	0.02L	0.0036	14.6
			2017/2/26	7.98	0.056	1.66	3.66	0.34	/	/	0.0003L	0.02L	0.0035	13.8
			2017/2/27	8.02	0.055	16.9	3.85	0.33	/	/	0.0003L	0.02L	0.036	13.9
		500 m to the midstream of Yadan River	2017/2/25	8.02	0.081	17.1	3.8	0.38	/	/	0.0003L	0.02L	0.0037	13.4
			2017/2/26	7.94	0.099	1.69	3.92	0.39	/	/	0.0003L	0.02L	0.0037	13
			2017/2/27	7.94	0.088	17.1	3.96	0.39	/	/	0.0003L	0.02L	0.037	13
		500 m to the downstream of Yadan River	2017/2/25	7.98	0.11	17.3	4.1	0.43	/	/	0.0003L	0.02L	0.0039	12.3
			2017/2/26	7.88	0.14	1.75	3.99	0.45	/	/	0.0003L	0.02L	0.00	11.60
			2017/2/27	7.91	0.11	17.50	4.12	0.46	/	/	0.0003L	0.02L	0.04	12.40
	HG 4.1 Heli River	W1 500 m upstream bridge at industrial zone	2017/2/25	7.86	5.006	92	23.5	0.06	64	27.1	/	/	/	/
			2017/2/26	7.83	5.034	91	23.3	0.06	68	26.4	/	/	/	/
		W2 crossings at Junde Road	2017/2/25	7.91	5.334	102.1	24.6	0.07	72	30.7	/	/	/	/
			2017/2/26	7.88	5.349	102.6	24.8	0.07	76	30.6	/	/	/	/
		W3 500 m downstream of gasoline station	2017/2/25	7.75	6.177	105.4	25.2	0.07	76	31.3	/	/	/	/
			2017/2/26	7.78	6.234	106.1	25.9	0.07	80	31.5	/	/	/	/
	HG 4.1 Qianjin Creek	W4 500 m upstream of Xinhong Bridge	2017/2/25	7.89	3.949	98.2	24.5	0.6	40	29.5	/	/	/	/
			2017/2/26	7.86	3.977	97.1	24.4	0.64	44	29.8	/	/	/	/
		W5 Qianjin Creek near Tongda Road	2017/2/25	7.93	4.091	104	27.8	0.65	48	31.7	/	/	/	/
			2017/2/26	7.91	4.12	108	26.5	0.61	52	30.2	/	/	/	/
		W6 500 m downstream at Junction of Xiaoheli River	2017/2/25	7.95	3.906	111	29.6	0.62	56	37.4	/	/	/	/
			2017/2/26	7.93	3.934	110	28.4	0.64	56	38.6	/	/	/	/
	HG 4.1 Xiaoheli River	W7 500 m upstream of Heyi road	2017/2/25	7.82	3.977	99.1	24.1	0.61	52	30.7	/	/	/	/
			2017/2/26	7.84	3.977	99.6	23.6	0.63	56	30.4	/	/	/	/
		W8 Crossing at Xingdong Road	2017/2/25	7.88	4.149	105	26.6	0.64	56	31.3	/	/	/	/
			2017/2/26	7.91	4.177	104	26.5	0.62	60	30.6	/	/	/	/
		W9 500 downstream at junction of Heli River	2017/2/25	7.73	5.063	108	27	0.63	64	32.8	/	/	/	/
			2017/2/26	7.76	5.091	108	26.8	0.65	68	33.1	/	/	/	/
	HG 4.1 Shitou River	W10 500 upstream of Zijian Road	2017/2/25	7.79	1.354	39.1	7.8	0.46	11	11.9	/	/	/	/
			2017/2/26	7.75	1.354	39.3	8.05	0.48	9	11.1	/	/	/	/
		W11 Yanhe Community	2017/2/25	7.6	3.097	102	20.8	0.51	29	30.6	/	/	/	/
			2017/2/26	7.72	3.326	106	20.2	0.44	26	28.9	/	/	/	/
		W12 500 downstream of Nanyi Bridge	2017/2/25	7.58	3.611	120	23.4	0.47	40	36.6	/	/	/	/
			2017/2/26	7.62	3.669	121	23.8	0.48	38	38.3	/	/	/	/
Jixi	JX 2.2 Kuangling River	W1 500 upstream of the Jiguan WWTP	2017/3/5	7.04	0.325	16.3	6.4	0.16	/	5.9	/	/	0.34	/
			2017/3/6	7.15	0.348	17.8	6.9	0.16	/	5.6	/	/	0.35	/
			2017/3/7	7.08	0.336	16.9	6.7	0.16	/	6.1	/	/	0.36	/
		W2 500 downstream of the Jiguan WWTP	2017/3/5	7.11	1.45	31.5	9.5	0.14	/	8.3	/	/	0.35	/

City	River	Sample Location	Date	pH	NH_3-N	COD	BOD_5	TPH	SS	Imn	VOC	Sulfide	TP	DO
			2017/3/6	6.92	1.48	30.6	9.1	0.16	/	8.2	/	/	0.36	/
			2017/3/7	7.13	1.43	30.3	10.2	0.17	/	8.5	/	/	0.36	/
		W3 500m upstream of the junction with Muling River	2017/3/5	7.19	1.21	11.6	3.6	0.04L	/	6.6	/	/	0.28	/
			2017/3/6	7.25	1.19	10.7	4.1	0.04L	/	6.9	/	/	0.27	/
			2017/3/7	7.08	1.23	10.2	3.9	0.04L	/	6.8	/	/	0.26	/
		W4 500m downstream of the junction with Muling River	2017/3/5	7.12	1.27	10	4.6	0.04L	/	7.2	/	/	0.1	/
			2017/3/6	7.03	1.3	13.5	4.9	0.04L	/	7	/	/	0.11	/
			2017/3/7	6.91	1.24	14.7	4.2	0.04L	/	7.3	/	/	0.10	/
	Muling River	W5 500m upstream of the junction with Kuangling River	2017/3/5	6.81	1.36	77.7	23.4	0.04L	/	7.6	/	/	1.59	/
			2017/3/6	6.94	1.39	74.5	25.2	0.04L	/	7.8	/	/	1.52	/
			2017/3/7	6.87	1.34	76.9	24.6	0.04L	/	7.5	/	/	1.47	/
	JX 4.1 Hongqi lake		2016/12/29	6.30	0.37	39.00	5.86	0.29		6.36	0.0003L	0.02	2.69	4.20
	JX 4.1 Huangni River		2016/12/29	7.76	0.16	26.00	4.02	0.54		4.37	0.0003L	0.01	0.99	12.20
	JX 4.1 Anle Creek		2016/12/29	6.98	1.18	117.00	15.80	0.37		20.30	0.0003L	0.04	3.40	5.40
SYS	SY 4.1 Anabng River (500 m upstream of Nanfu Bridge)		2017/3/9	6.82	6.06	12.3	4.90	0.015	6	6.34	/	/	/	/
	SY 4.1 Anabng River (500 m upstream of Nanfu Bridge)		2017/3/10	6.83	6.70	14.4	4.94	0.019	7	6.41	/	/	/	/
	SY 4.1 Anabng River (500 m upstream of Yaodi Bridge)		2017/3/9	7.18	7.99	5.14	1.24	0.296	10	6.89	/	/	/	/
	SY 4.1 Anabng River (500 m upstream of Yaodi Bridge)		2017/3/10	7.20	8.35	6.57	1.28	0.307	12	7.20	/	/	/	/
	SY 4.1 Anabng River (3000 m downstream of Yaodi Bridge)		2017/3/9	7.04	1.91	29.4	8.03	0.01L	5	5.97	/	/	/	/
	SY 4.1 Anabng River (3000 m downstream of Yaodi Bridge)		2017/3/10	7.06	2.08	32.3	8.07	0.01L	6	7.14	/	/	/	/
	GB 3838-2002 (Category III)			6-9	1.0	20	4	0.05	/	6	0.005	0.2	0.2	5
	GB 3838-2002 (Category IV)			6-9	1.5	30	6	0.5	/	10	0.01	0.5	0.3	3
	GB 3838-2002 (Category V)			6-9	2.0	40	10	1.0	/	15	0.1	1.0	0.4	2
	UNEP Standard: Extreme Impairment (category 4)			< 5	0.1	/	>10	>0.19	/	/	/	/	/	/
				pH	NH_3-N	COD	BOD5	TPH	SS	Imn	VOC	Sulfide	TP	DO
	Exceedance of Category IV	Exceedance of Category III	Exceedance of Category V											

148. All rivers in Hegang and Jixi selected for rehabilitation under the project had very poor water quality, in most cases not meeting requirements for Category 5 (GB 3838-2002) or the standard for UNEP Category 4 (extreme impairment), due to high ammonia, COD and BOD_5. These rivers have been polluted by untreated domestic and industrial wastewater from urban areas. Yadan River is adjacent to the Luobei WWTP. Water quality in the river is relatively good, meeting the relevant standard of Category III. In Jixi City, treated wastewater from the Jiguan WWTP will discharge into Kuangling River and then flow into Muling River. The applicable standards for Muling River and Kuangling River are Category IV. High COD, BOD_5, TP and permangate index (I_{mn}) were detected both rivers. The South Ring Road of Shuangyashan (Component 4.1) will cross the Anbang River, and Xinxing Avenue is about 110 m west of Anbang River, therefore the water quality of Anbang River was tested. The water quality target for Anbang River is Category IV. However, ammonia levels (resulting from untreated sewage) far exceed the Category IV standard.

149. **Groundwater quality.** Groundwater data was collected from the area around one mine rehabilitation site (Lingbei Mine in Hegang) during the current DEIA (due to classification of other projects, baseline data collection was not required for DEIA purposes. Groundwater quality data will be collected in subsequent detailed design stages). Data was collected according to the Technical Guidelines for Environmental Impact Assessment - Groundwater Environment (HJ610-2016), and the results are shown in **Table V-5**.

Table V-5: Baseline groundwater quality monitoring around Lingbei Mine (HG)

Parameter	Monitoring Station			Class III	Unit
	Hegang national mine park	Dong Shan primary school	South side community		
Temperature	4.5	7.2	9.0	n/a	C
Well Depth	2	70	70	n/a	M
Water table	0.5	30	35	n/a	M
pH	7.17	7.57	7.10	6.5-8.5	-
Ammonia nitrogen	0.327	0.081	0.441	0.2	mg/L
I_{Mn}	2.64	2.62	2.64	3.0	mg/L
Total dissolved solids	798	83	868	1000	mg/L
Volatile phenol	0.0003L	0.0003L	0.0003L	0.002	mg/L
Total hardness	49.9	54.5	51.1	450	mg/L
Nitrate	2.62	0.90	2.86	20	mg/L
Nitrite	0.007	0.004	0.008	0.02	mg/L
Sulfate	246	23	228	250	mg/L
Cyanide	0.002L	0.002L	0.002L	0.05	mg/L
Fluoride	0.05L	0.05L	0.05L	1.0	mg/L
Chloride	169	12.9	183	1.0	mg/L
Chromium (hexavalent)	0.008	0.005	0.010	0.05	mg/L
Iron	0.126	0.038	0.139	0.3	mg/L
Mn	0.05	0.01	0.06	0.1	mg/L
Arsenic	0.007L	0.007L	0.007L	0.05	mg/L
Mercury	0.00002L	0.00002L	0.00002L	0.001	mg/L
Lead	0.002L	0.002L	0.002L	0.05	mg/L
Cd	0.005	0.00005L	0.006	0.01	mg/L
Zinc	0.65	0.13	0.72	1.0	mg/L
Copper	0.62	0.11	0.68	1.0	mg/L
Fecal coliform	<3	<3	<3	3	/L

150. The results show that aside from slight exceedance in ammonia concentrations, groundwater meets class III standards around the Lingbei mine. This indicates that existing

mining activities have not had substantial impacts on local groundwater resources.

151. Groundwater sampling was also undertaken around the Luobei and Jixi WWTP in April 2017. A total of 15 groundwater samples were taken for Luobei WWTP, including four confined water samples (C1-C4) and 11 aquifer samples (A1-A11). Groundwater samples for Jiguan WWTP were taken at seven sites, including four drinking water wells in Dongtai Village and Hongxing Village (JC01-04), and three samples (JC 05-07) at the plant boundary. The groundwater table ranges from 2.20 m to 9.08 m. Both sites detected high concentrations of iron, manganese and nitrogen **Table V-6** and **V-7**). The DEIA considered these results as a consequence of natural geological conditions: Jixi and Luogang are rich in graphite resources, which are usually accompanied by iron, manganese and nitrogen.

Table V-6: Baseline groundwater quality monitoring around Luobei WWTP (HG 2.2)

Detection points	C1	C2	C3	C4	A 1	A2	A 3	A4	A 5	A 6	A7	A8	A9	A 10	A 11	Unit
Water table	5.20	6.50	9.50	6.20	1.50	1.80	1.40	9.50	3.40	4.40	1.40	6.10	5.90	1.40	1.10	m
K^+	1	1.14	0.755	1.14	3.13	10.8	4.18	3.57	1.38	3.05	10.5	1.82	1.73	1.38	1.43	mg/L
Na^+	14.3	11.3	1.74	9.39	24.6	18.4	7.72	28.8	8.56	8.12	23.6	4.76	20.4	10.8	23.7	mg/L
Ca^{2+}	68.7	70.2	7.08	52.8	66.4	182	52.6	82.6	54.3	70.2	143.3	50.6	63.6	68.2	71.2	mg/L
Mg^{2+}	8.7	16.9	0.8	3.86	12.5	8.64	8.26	16.8	12.7	8.64	28.6	12.2	6.1	12.4	10.4	mg/L
$CO3^{2-}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	mg/L
$HCO3^-$	72.3	166	31	79.7	133	72.3	114	134	115	151	112	59	65	116	112	mg/L
Chlorides (Cl-)	10L	10L	10L	14.9	24.7	34.4	44.2	54	63.8	73.6	83.4	93.1	103	113	122	mg/l
Sulfate ($SO4^{2-}$)	182	133	8L	96.6	146	388	22.5	168	35.3	18.9	356	19.8	18.9	10.3	35.5	mg/l
pH	6.63	6.79	7.27	6.82	6.57	6.5	6.88	6.72	6.89	7.03	6.75	7.23	6.55	6.66	6.67	-
Ammonia nitrogen	0.078	0.085	0.035	0.04	0.128	0.043	0.12	0.11	0.043	0.123	0.12	0.038	0.04	0.34	0.23	mg/L
Nitrate (N)	1.48	0.027	0.577	1.28	6.08	0.323	0.808	0.927	1.17	2.41	3.6	0.508	2.54	0.446	0.806	mg/L
Nitrite (N)	0.003L	0.004	0.003L	0.003L	0.03	0.014	0.03	0.025	0.028	0.045	0.003L	0.02	0.037	0.045	0.093	mg/L
Volatile phenol	0.002	0.001	0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.002	0.002	0.002	0.001	0.002	0.002	mg/L
Cyanide	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	0.004L	mg/L
Arsenic	0.3L	0.17	0.3L	0.3L	0.3L	0.3L	0.3L	0.3L	0.3L	0.3L	0.3L	1.51	0.3L	3.54	1.55	μg/L
Mercury	0.26	0.04L	0.04L	0.04L	0.5	0.27	0.53	0.21	0.05	0.11	0.04L	0.28	0.36	0.1	0.16	μg/L
Detection points	Deep 1	Deep 2	Deep 3	Deep 4	Dive 1	Dive 3	Dive 4	Dive 7	Dive 8	Dive 9	Dive 10	Dive 11	Dive 12	Dive 13	Dive 14	mg/L
Chromium (hexavalent)	0.004	0.004	0.014	0.006	0.022	0.025	0.023	0.029	0.025	0.018	0.014	0.006	0.004	0.014	0.042	mg/L
Total hardness	254	204	182	170	273	433	289	287	152	166	110	242	148	138	170	mg/L
Fluoride	0.94	0.7	0.214	0.184	0.124	0.191	0.276	0.209	0.304	0.239	0.188	0.109	0.085	0.231	0.149	mg/L
Total dissolved solids	348	316	144	158	440	980	194	370	180	187	184	400	156	108	168	mg/L
Salt permanganate index	1.34	2.13	2.16	1.81	2.15	2.46	2.65	2.57	2.88	2.64	2.47	1.61	2.54	2.4	2.57	mg/L

Lead	0.021	0.036	0.032	0.022	0.029	0.047	0.037	0.044	0.043	0.047	0.041	0.026	0.025	0.037	0.042	mg/L
Cd	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	mg/L
Iron	0.21	0.2	0.32	0.17	0.16	0.18	0.16	0.16	0.19	0.12	0.11	0.11	0.07	0.82	0.11	mg/L
Mn	0.02	0.05	0.01	0.02	0.33	0.77	0.12	1.73	0.22	0.39	0.05	0.03	0.06	0.27	0.34	mg/L
Total coliform	<3	<3	3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	(/L)
Total bacteria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(/100mL)

Table V-7: Baseline groundwater quality monitoring around Jiguan WWTP (JX 2.2)

Parameters	JC 01#	JC 02#	JC 03#	JC 04#	JC 05#	JC 06#	JC 07#	Unit
Water table	4.21	4.15	3.23	4.00	2.20	8.85	9.08	m
pH	7.81	7.36	7.42	6.57	6.80	6.62	6.69	-
Total hardness	158.29	133.71	467.27	165.80	175.86	128.12	160.79	mg/L
Total dissolved solids	359.73	291.03	894.15	404.04	397.31	290.63	390.73	mg/L
Nitrate	0.44	42.99	102.39	1.92	0.74	28.69	1.40	mg/L
Nitrite	< 0.004	< 0.004	0.072	0.064	0.064	< 0.004	0.007	mg/L
Ammonia	0.60	<0.02	0.04	0.68	0.76	<0.02	1.12	mg/L
Salt permanganate index	0.99	0.91	1.48	0.91	1.07	0.99	0.99	mg/L
Sulfate	3.20	30.50	162.50	3.30	3.20	40.00	3.10	mg/L
Chloride	17.66	20.31	120.04	6.17	11.49	27.37	12.37	mg/L
Carbonate	3.00	0.00	0.00	0.00	0.00	0.00	0.00	mg/L
Bicarbonate	228.81	103.73	262.37	262.37	262.37	94.58	256.27	mg/L
Volatile phenol	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/L
Cyanide	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/L
Fluoride	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/L
Potassium	0.82	0.87	1.16	1.10	1.13	1.12	1.18	mg/L
Sodium	21.03	17.79	60.05	20.58	25.02	19.72	25.23	mg/L
Calcium	55.33	43.27	166.99	56.33	55.33	41.24	56.33	mg/L
Magnesium	5.49	6.71	12.81	6.71	7.32	6.71	4.89	mg/L
Iron	1.68	0.68	0.48	8.80	2.96	1.00	2.60	mg/L
Mn	0.767	<0.01	0.156	0.876	0.749	0.505	0.717	mg/L
Copper	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	mg/L
Lead	0.0096	0.0018	<0.001	<0.001	0.0010	<0.001	<0.001	mg/L
Zinc	0.0035	0.0078	0.0079	0.0095	0.0328	0.0068	0.0307	mg/L
Mercury	0.000171	0.000146	0.000146	0.000187	0.000306	0.000182	0.0003854	mg/L
Chrome	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	mg/L
Cd	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/L
Arsenic	0.00066	<0.0005	<0.0005	0.00593	0.00584	0.00150	0.00643	mg/L
Total bacteria	1	2	0	48	14	40	76	(/L)
Total coliform	0	0	0	0	0	0	0	(/100mL)

152. **River sediment quality.** The PRC does not have standard for sediments in freshwater or marine waterbodies. However, it is common practice to use standards relating to soil or sludge (from WTP/WWTP) quality depending on any planned reuse of the river sediments (**Table II-10**). Environmental Quality Standard for Soils (GB15618-1995) can be used to assess sediment quality if the sediment will be disposed on land and used for future agricultural or planting uses. Some EIA reports in the PRC have also used Control Standards for Pollutants in Sludge for Agricultural Use (GB 4284-84), or if the dredged sediment will be disposed of at a landfill, Disposal of sludge from municipal wastewater treatment plant - Quality of sludge for co-landfilling (GB23485-2009). **Table V-8** shows the baseline sediment quality monitoring results at selected locations in the project area.

Table V-8: Baseline river sediment quality monitoring data

Project City	River	Location	Sampling Date	pH	Ni	Cd	Cu	Pb	Zn	As	Hg	Cr[13]	Benzex	DDT
Hegang	HG 4.1 Heli River	S1 500 m upstream bridge at industrial zone	2017/2/25	7.76	0.10L	0.10L	108	60.5	205	11.6	0.53	61.2	Not detected	Not detected
			2017/2/26	7.77	0.10L	0.10L	103	60.3	212	10.9	0.55	60.5	Not detected	Not detected
		S2 crossings at Junde Road	2017/2/25	7.78	0.10L	0.10L	127	68.7	258	12.8	0.6	63.1	Not detected	Not detected
			2017/2/26	7.77	0.10L	0.10L	125	66.4	261	12.6	0.61	63.2	Not detected	Not detected
		S3 500 m downstream of gasoline station	2017/2/25	7.7	0.10L	0.10L	82.8	64.9	190	10.2	0.59	62.3.2	Not detected	Not detected
			2017/2/26	7.69	0.10L	0.10L	85.7	65.2	193	10.3	0.56	62.6	Not detected	Not detected
	HG 4.1 Qianjin Creek	S4 500 m upstream of Xinhong Bridge	2017/2/25	7.77	0.10L	0.10L	110	50.2	297	10.7	0.68	71.3	Not detected	Not detected
			2017/2/26	7.78	0.10L	0.10L	109	51.3	295	10.6	0.62	71.2	Not detected	Not detected
		S5 Qianjin creek near Tongda Road	2017/2/25	7.52	0.10L	0.10L	65.2	47	168	8.36	0.73	106.1	Not detected	Not detected
			2017/2/26	7.6	0.10L	0.10L	67.4	48.2	171	8.41	0.69	105.4	Not detected	Not detected
	HG 4.1 Xiaoheli River	S6 500 m downstream at Junction of Xiaoheli River	2017/2/25	7.6	0.10L	0.10L	74.9	44.1	140	9.51	0.83	122.1	Not detected	Not detected
			2017/2/26	7.62	0.10L	0.10L	75.6	44	139	9.66	0.84	122.5	Not detected	Not detected
		S7 500 m upstream of Heyi road	2017/2/25	7.58	0.10L	0.10L	74.2	60.5	160	10.9	0.85	119.7	Not detected	Not detected
			2017/2/26	7.56	0.10L	0.10L	76.7	61.2	154	10.4	0.9	119.6	Not detected	Not detected
		S8 Crossing at Xingdong Road	2017/2/25	7.25	0.10L	0.10L	62.2	55.4	121	10.9	0.31	71.4	Not detected	Not detected
			2017/2/26	7.3	0.10L	0.10L	63.5	53.2	123	10.8	0.35	70.5	Not detected	Not detected
	HG 4.1 Junction of Xiaoheli and Heli River	S9 500 downstream at junction of Heli River	2017/2/25	7.3	0.10L	0.10L	154	107	412	11.5	0.33	83.4	Not detected	Not detected
			2017/2/26	7.32	0.10L	0.10L	155	105	431	11.3	0.34	85.1	Not detected	Not detected
	HG 4.1 Shitou River	S10 500 upstream of Zijian Road	2017/2/25	7.33	0.10L	0.10L	60.8	9.92	293	10.9	0.35	67.4	Not detected	Not detected
			2017/2/26	7.36	0.10L	0.10L	61.2	9.62	284	11	0.33	66.5	Not detected	Not detected
		S11 Yanhe Community	2017/2/25	7.46	0.10L	0.10L	46	5.73	109	13.8	0.81	70.2	Not detected	Not detected
			2017/2/26	7.44	0.10L	0.10L	48.3	5.62	105	13.6	0.79	71.0	Not detected	Not detected
		S12 500 downstream of Nanyi Bridge	2017/2/25	7.5	0.10L	0.10L	52.8	164	107	14.2	0.77	78.7	Not detected	Not detected
			2017/2/26	7.33	0.10L	0.10L	53.6	158	101	14.1	0.74	78.9	Not detected	Not detected
Jixi	JX 4.1 Huangni River	1# Minzhu Bridge	2016/12/29	8.05	55.4	0.03	18	0.1L	72.8	4.69	0.037	0.004L	0.00038	0.00742
		2# Tielu Bridge	2016/12/29	7.97	14.8	0.03	11.2	0.1L	79	4.23	0.283	0.007	0.00038	0.00742

[13] The unit is mg/L for rivers in Jixi city.

Project City	River	Location	Sampling Date	pH	Ni	Cd	Cu	Pb	Zn	As	Hg	Cr[13]	Benzex	DDT
		3# Ganshi Bridge	2016/12/29	7.86	22.7	0.01	18.8	0.1L	89.4	4.39	0.153	0.006	0.00038	0.00742
	JX 4.1 Anle Creek	1#Baqixiangyuan Bridge	2016/12/29	7.72	17.3	0.02	16.8	0.1L	113	4.91	0.499	0.009	0.00038	0.00742
Class II (mg/kg), Environmental Quality Standard for Soils (GB15618-1995)				>7.5	60	0.6	100	350	300	20	1	250	0.5	0.5
				6.5-7.5	50	0.3	100	300	250	25	0.5	300	0.5	0.5
				<6.5	40	0.3	50	250	200	30	0.3	350	0.5	0.5
Class III (mg/kg) Environmental Quality Standard for Soils (GB15618-1995)				>6.5	200	1	400	500	500	30	1.5	400	1	1
GB/T 23485-2009, Disposal of sludge from municipal wastewater treatment plant - Quality of sludge for co-landfilling				---	200	20	1500	1000	4000	75	25	1000	---	---

153. The results show that the sediment pollution for most parameters meet Class II Environmental Quality Standard for Soils (GB 15168-1995). However zinc (Zn) and copper (Cu) content was slightly elevated at five of the sampling stations in Hegang. Copper and Zinc contamination of aquatic systems can result from various sources. In this instance, domestic wastewater discharge, coal-burning power plant, mining activities and manufacturing processes involving metals are probable sources. Nevertheless, all sediment samples meet the standard for disposal of sludge at a landfill site (GB/T 23485-2009).

154. **Soil.** Soil quality in the PRC is divided into three classes according to the Environmental Quality Standard for Soils (GB 15618-1995). For the current project, only one component (HG 3.1 – Remediation of open pit mine / waste-rock dump site rehabilitation) was considered as a Category A EIA under PRC legislation, and therefore required soil contamination sampling. Limited samples were also collected at one other component site (JX 2.2 – Jixi City wastewater treatment and discharge infrastructure in the industrial park of Jiguan District). Others project components are either category A and relatively remote from residential areas, or are classed as category B, and therefore do not require collection of soil quality data. **Table V-9** shows the baseline soil quality monitoring results at selected locations at components HG 3.1 and JX 2.2.

Table V-9: Baseline soil quality monitoring

Component	Location	Date	pH	Sulfide	Fe	Mn	Hg	Zn	As	Cd	Cr6+	Cu	Pb	Ni
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
HG 2.1 Waste rock dump site rehabilitation	T1 North of the pit	2017/2/27	/	1.05	26.7	12.6	0.28	140	15.4	2.29	36.7	28.6	39.5	/
	T2 North of the pit	2017/2/27	/	0.94	36.2	14.9	0.32	133	15.6	2.32	63.3	28.2	39.3	/
	T3 Middle of the pit	2017/2/27	/	0.86	56.9	21.7	0.37	122	24.8	1.96	57.8	29.3	52.2	/
	T4 Middle of the pit	2017/2/27	/	0.96	54.7	20.1	0.37	91	21.2	2.12	67	27.6	51.5	/
	T5 South of the pit	2017/2/27	/	1.06	37.8	15.1	0.41	133	23.5	1.98	49.2	26.3	51	/
	T6 South of the pit	2017/2/27	/	0.97	28.4	9.9	0.34	102	20.4	2.03	57.4	31.9	49.9	/
JX 2.2 Jiguan WWTP	Proposed site	2017/3/5	7.77	/	/	/	0.04	202.4	5.38	0.11	32	58	39.4	28.8
Class II, Environmental Quality Standard for Soils (GB15618-1995)			>7.5	/	/	/	1	200	20	0.6	250	100	350	60
			6.5-7.5	/	/	/	0.5	250	25	0.3	300	100	300	50
			<6.5				0.3	300	30	0.3	350	50	250	40
Class III, Environmental Quality Standard for Soils (GB15618-1995)			>6.5				1.5	500	30	1	400		500	
	Exceedance of Class II													
	Exceedance of Class III													

155. The test results show that cadmium (Cd) levels in the Hegang mine rehabilitation site significantly exceeded Class III standards. Heavy metals (including Cd) are common contaminants in open cast mine pits.

C. Biological Resources

156. **Regional ecological resources.** Heilongjiang Province as a whole includes globally significant ecological resources, including a large portion of the Amur-Heilong River Basin that supports rivers, floodplains and wetlands of international conservation importance. These include the Sanjiang Plain: an area of 108,900 km^2 at the confluence of the Heilongjiang, Songhua, and Wusuli rivers.

157. Heilongjiang Province supports some 2100 plant species. Flooding and a high water table inhabit forest development in the lower lying areas, and typical natural vegetation here includes marsh and swamp meadow. In the marsh, the dominant plant species include *Carex appendiculata*, *Deyeuxia angustifolia*, *Carex meyeriana*, *Carex lasiocarpa*, *Phragmites australis*, *Carex pseudocuraica*, and *Glyceria spiculosa*. Typical companion species include *Cicuta virosa*, *Spiraea salicifolia*, *Sanguisorba parviflora*, *Caltha palustris*, *Lysimachia davurica*, *Comarum palustre*, *Menyanthes trifoliata*, *Equisetum fluviatile*, *Iris laevigata*, *Lysimachia thyrsiflora*, *Carex limosa*, and *Stachys baicalensis*. In the swamp meadow, dominant plant species include *Aluns cremastogyne*, *D. angustifolia*, *Deyeuxia langsdorffii*, *Calamagrostis epigeios*, *P. australis*, *C. appendiculata*, *C. schmidtii*, *C. lasiocarpa*, *B. fruticosa*, and *Salix rosmarinifolia*. The main companion species include *S. salicifolia*, *Vicia cracca*, *Filipendula palmate*, *Galium verum*, *S. baicalensis*, *Lythrum salicaria*, *L. davurica*, *C. palustris*, and *Sanguisorba parviflora*.

158. Mixed temperate forests occur above the flood plain at elevations of 500 to 1,000 m. Conifers include Korean pine (*Pinus koraiensis*), Fir (*Abies holophylla*), and spruce *Picea obovata*. Broadleaf deciduous species include oaks (*Quercus mongolica*), ash (*Fraxinus mandshurica*), lime (*Tilia amurensis*), birch (*Betula schmidtii*), Manchurian elm (*Ulmus laciniata*), maple (*Acer* spp.), and Manchurian walnut (*Juglans mandshurica*). Shrubs consist of Manchurian filbert (*Corylus mandshurica*) and *Lespedeza bicolor* at lower elevations in the southern region.

159. Wildlife is similarly diverse across the province. Mammals of conservation interest occurring in the region include Siberian (or Amur) tiger (*Panthera tigris altaica*), sable (*Martes zibellina*), Sika deer (*Cervus nippon*), and leopard (*Panthera pardus*), lynx (*Lynx lynx*), musk deer (*Moschus moschiferus*), red deer (*Cervus elaphus*), black bear (*Selenarctos thibetanus*), brown bear (*Ursus arctos*) and goral (*Nemorhaedus goral*).

160. Heilongjiang supports 343 bird species, 29% of the PRC total. Wetlands on the plains of the Amur-Heilong River are globally significant for the migration of tens of thousands of geese and hundreds of thousands of ducks and waders. Endangered species such as Far Eastern curlew (*Numenius madagascarensis*), swan goose (*Anser cygnoides*), and Baikal teal (*Anas formosa*) depend on these areas. Each spring and autumn, birds stop here to feed and rest along the East Asian migration route between nesting areas in the north and wintering grounds in the Yangtze River valley in China and on the Korean Peninsula and the islands of Japan.

161. Due to the cold climate, herpetofauna in Heilongjiang is relatively species poor, with only 12 species of amphibians and 16 species of reptiles found in the Province.

162. The Amur-Heilong River supports about 120 native freshwater fish species, providing critical habitat for 18 species and one genus (*Pseudaspius*) that are endemic to the basin. Common fish species are found in Amur-Heilong tributaries include taimen (*Hucho taimen*), Manchurian trout (*Brachymystax lenok*), and Amur grayling (*Thymallus grubei*).

163. Despite the fact that Heilongjiang still supports valuable ecological resources, these were far more widespread and abundant in the past. Human activities have severely impacted the ecology of the province, with some key issues including:

- Dam construction, water over-abstraction and increased pollution loading from population growth, urbanization, mineral abstraction and industrialization have severely impacted freshwater communities through the region. As an example, anadromous salmon species used to occur in the Songhuajiang and Nenjiang Rivers upstream of Harbin, including tributaries flowing through the project cities. Such species are now limited to the lower reaches of the Heilong River.

- The existing extensive flood plains in the province have been drained for agricultural development. Subsequent urbanization, human disturbance and grass fires are major threats to migratory birds.

- Mature native forests have all but disappeared in the last 50-60 years, impacted by logging, clearance for commercial tree plantation/agriculture and forest fires.

- Plant and wildlife species of conservation interest have been affected by hunting, trapping and over-collection.

164. While these impacts have had a drastic effect on the ecology of Heilongjiang, areas of more well preserved habitat occur in some regions and receive protection through designation as nature reserves or other protected area status. As of 2010, over 200 Nature Reserves were designated in Heilongjiang, covering 6.4 ha million, or 14% of the total land area of the Province.

165. **Project ecological resources**. The various components for this project all occur within or close to major urban developments, have been degraded by various human activities, and are of limited ecological value. No species of recognized conservation interest (i.e., listed as VU, EN or CR on the IUCN red-list or PRC's national or provincial wildlife protection list) were observed during site visits, and are considered unlikely to occur at the sites due to degraded nature of the habitats. No critical habitats (as defined in the SPS, 2009) occur within areas impacts by the project. 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. The following sections discuss the basic ecological characteristics of major project components, which are categorized under Rivers, creeks and lakes; Land rehabilitation components; and Roads/utilities components.

166. **Rivers, creeks and lakes.** There are six rivers/drainage channels and one lake in two project cities (Hegang and Jixi) targeted for rehabilitation under the current project. The rivers and drainage channels are relatively small (all less than <30 m in width) in largely urban areas and have been significantly impacted by human activities. All channels have been subject to flood management improvements, including widening and straightening, with earthen banks partially lined with concrete. Water

quality is very poor (in many cases not meeting Grade V) due to direct discharge of untreated domestic wastewater and untreated wastewater mixed with minerals and sediments discharged by the coal cleaning plants in Nanshan, Xingan and Lingbei. Further impacts result from poor quality urban stormwater discharge (in some instances from CSO) and dumping of domestic solid waste.

167. Vegetation along the channels is limited to common planted trees (e.g., Silver Poplar, *Populus alba*; and Chinese Willow, *Salix matsudana*) and pioneer herbaceous species growing on the constructed banks. Aquatic faunal communities are expected to have low species richness due to poor habitat structure and water quality. The deep anoxic sediments and sewage fungus observed at several of the rivers (e.g., Shitou River and Qianjin Creek) suggests they are unlikely to support any aquatic fauna.

168. Hongqi Lake in Jixi is located within an existing urban park. Water quality in lake is poor (Grade V), but it does include some limited aquatic and emergent vegetation. The lake supports some common aquatic macroinvertebrates such as dragonflies and chironomids, as well as bird species typical of urban park environment (e.g., tree sparrow, *Passer montanus*, magpie, *Pica pica*).

169. Representative photographs of river, creek and lake habitats are shown in **Figure V-6.**

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>HG 4.1 – Shitou River</td><td>HG 4.1 – Qianjin Creek</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>HG 4.1 – Heli River</td><td>HG 4.1 – Xiaoheli River</td></tr>
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JX 4.1 – Anle Gou Creek	JX 4.1 – Huangni River
	
JX 4.1 – Hongqi Lake	

Figure V-6: Representative photographs of river, creek and lake habitats in the four cities

170. **Land rehabilitation components.** There are five mine rehabilitation sites across the four cities that would be remediated under the project, covering a total area of 90.3 ha. These project sites are highly disturbed, largely comprising exposed rock and soil, slag heaps and abandoned/demolished village housing and industrial areas. Vegetation is limited to weedy pioneer species (e.g., *Setaria* sp.), as well as at some locations (e.g., SY 3.1) pioneer tree saplings (ash *F. mandshurica* and birch *B. schmidtii*). At three of the project sites (HG 3.1, JX 3.1 and SY 3.1), some remediation has already been undertaken and newly graded areas planted with conifers (*Pinus sylvestris*, estimated from 2-15 years old). Overall the mine rehabilitation sites are considered of very low ecological value. Representative photographs of habitats at mine rehabilitation components are shown in **Figure V-7.**

	
HG 3.1 – Lingbei Mine (110ha, phase I 48.2 ha)	JX 3.1 – Hengshan District (80 ha)
	
QH 3.1 – Taoshan District waste rock dump site (10.4ha)	QH 3.1 – Taoshan District former residential area (11.4ha)
	
SY 3.1 – Lingdong District (117ha)	

Figure V-7: Representative photographs of habitats at mine rehabilitation components in the Project Cities

171. **Roads and utilities components.** The majority of roads and utilities project components are located in existing urban areas of no significant ecological value. The exception are works associated with existing/planned Industrial Parks, which are in some cases still green-field sites. The majority of the sites are dominated by intensively managed agricultural land used for grain production, which is of low ecological value. The project areas of three components include some woodland plantation habitats: (i) the hillside where the Yufeng Tunnel site at Shuangyashan (SY 4.3) would be located is dominated by immature deciduous plantation; and (ii) the project sites for Central

Ring Road (JX 2.1) and Beishan Road, Jiaotong Street and Bypass Bridge (JX 4.3) in Jixi contain small areas of woodland plantation managed by the Jixi Luhai Forestry Company Ltd. Representative photographs of habitats at roads and utilities components are shown in **Figure V-8.**

	
HG 2.1 – Industrial Park Infrastructure	HG 2.2 – Luobei County Industrial Park WWTP
	
JX 2.1 – Hengshan District Industrial Park Infrastructure	JX 2.2 – Jixi City WWTP
	
JX 4.4 – Hengshan District Roads	QH 2.1 – Industrial Park Infrastructure

SY 2.1 – Industrial Park Infrastructure

SY 4.2 – South Ring Road and Tunnel

Figure V-8: Representative photographs of habitats roads and utilities components in the Project Cities

D. Socio-economic Environment

172. **Population.** The four project cities have high urbanization rates compared with Heilongjiang average and the national average (Error! Reference source not found. **V-10)**, especially the urban centers where the projects will be located. It indicates the projects will be mainly affect urban residents.

Table V-10: Population composition of the four cities in 2015

Project City	Area	Total Pop	%			
		(mil.)	Male	Female	Urban	Rural
Hegang	City	1.06	50.0	50.0	81.4	18.6
	Urban Center	0.65	49.9	50.1	91.3	8.7
Jixi	City	1.81	-	-	64.2	35.8
	Urban Center	0.84	-	-	84.4	15.6
Qitaihe	City	0.83	51.6	48.4	60.6	39.4
	Urban Center	0.50	52.1	47.9	75.4	24.6
Shuangyashan	City	1.47	50.2	49.8	59.2	40.8
	Urban Center	0.49	50.1	49.9	92.9	7.1
Heilongjiang average		38.12	50.3	49.7	58.8	41.2
PRC average		1,374.62	51.2	48.8	56.1	43.9

Source: Statistical Yearbooks of the project cities, and China Statistical Yearbooks

173. **Economic conditions.** The four project city centers have all developed with the coal-mining enterprises being established first, followed by coal and coal-related industries. As a consequence, GDP of the four city centers has been dominated by secondary and related tertiary sectors for several decades. Gross domestic product (GDP) composition (**Table V-11**) shows that compared with Heilongjiang average and the national average, economies of the four city centers are highly reliant on coal-related secondary and tertiary sectors. The overall economic situation in the four cities has been difficult in recent years. Reductions in coal demand and prices have had a substantial impact on the sub-region's economic health.

Table V-11: GDP composition of the four cities in 2015

Project City	GDP	%

	In total (billion)	CNY/person	Primary sector	Secondary sector	Tertiary sector
Hegang City Center	13.1	20,241	9.7	49.8	40.5
Jixi City Center	16.4	19,514	7.3	45.7	47.0
Qitaihe City Center	16.0	30,844	10.8	41.4	47.8
Shuangyashan City	20.6	29,625	28.7	42.5	28.5
Heilongjiang average	1,508.4	39,352	9	40.5	50.5
PRC average	68,550.6	49,992	8.9	40.9	50.2

Source: Statistical Yearbooks of the project cities, and China Statistical Yearbooks

174. **Poverty status.** While there is no nationwide standard, minimum living standard (MLS) is commonly used for measuring urban poverty in the PRC. MLS is determined by local government based on the level of economic development, and is therefore different among cities. The MLSs in the four cities account for less than 3% of the urban per capita disposable income: the MLSs just meet basic living needs of the people in the project areas.

175. Using the current MLSs as urban poverty indicators, there are still more than 7% of the urban people, or 113,507 urban households in the four cities who are poor, and cannot earn enough income to maintain their basic lives, and are reliant on minimum relief funds. The incidence of urban poor people (hereafter urban MLS-people) and numbers of urban poor household (hereafter urban MLS-households) in 2016 in the four project cities are shown in **Table V-12**.

Table V-12: Urban MLS in the four cities in Sept. 2016

Project City	Urban MSL Standards (CNY/Month)	Urban poverty incidence (%)	Urban MLS HH (#)
Hegang City Center	550	13.0	37,300
Jixi City Center	500	7.8	35,256
Qitaihe City Center	500	7.7	17,158
Shuangyashan City Center	500	9.4	23,793
Total	**-**	**-**	**113,507**

Sources: the four project CABs, and http://www.mca.gov.cn

176. **Ethnic minorities.** There are very few ethnic minority peoples in the four project, with less than 2% of the populations of Hegang, Shuangyashan and Jixi, and less than 4% in Qitaihe City. The majority of the ethnic minority peoples are living in counties which are far away geographically from the project locations.

177. **Gender.** Of the total 3.36 million people in the Hegang, Qitaihe and Shuangyashan cities, 49.5% are female (Error! Reference source not found. **V-13)**. No sex-disaggregated population information are available in the Statistics Yearbooks of Jixi City, indicating that gender awareness in the city is low.

Table V-13: Population composition of the four cities in 2015

Project City	Total	%	
	(million)	Male	Female
Hegang	1.06	50.0	50.0
Jixi	Not available		
Qitaihe	0.83	51.6	48.4
Shuangyashan	1.47	50.2	49.8

Source: Statistical Yearbooks of the project cities, and China Statistical Yearbooks

E. Existing Climate and Climate Change

178. **Existing climate.** Heilongjiang Province is one of the coldest regions in the PRC. As shown in **Figure V-9**, the northwest of the province is the coldest, with an annual mean temperature close to -6°C. The southwest of the province and southeast of Jixi are the warmest places in the province with annual mean temperature close to 4.5°C. The west of the province is dry with annual precipitation ranging from 450 mm to 550 mm. The central regions are the wettest with annual precipitation ranging from 600 mm to 750 mm.

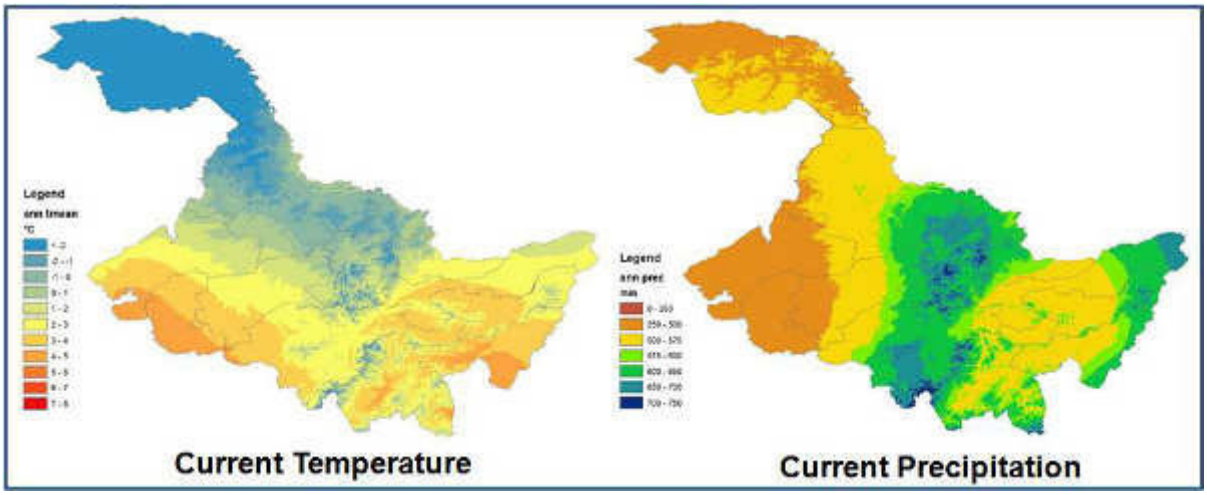


Figure V-9: Current annual mean temperature (left) and precipitation (right) of Heilongjiang Province

179. The east Heilongjiang region is warm in comparison with the northwest. As shown in **Figure V-10**, the annual mean temperature ranges from less than -2°C in the northwest of Hegang to 4.7°C in the south of Jixi. Annual mean temperatures of the four project cities are 1.9°C, 3.3°C, 3.8°C, and 4.3°C for Hegang, Shuangyashan, Qitaihe, and Jixi respectively. The annual precipitation ranges from 550 mm to 700 mm for the region, but the project cities are all located in areas of relatively low precipitation. Hegang is the wettest city with close to 600 mm annual precipitation, whilst all other three cities are in the 500-550 mm range.

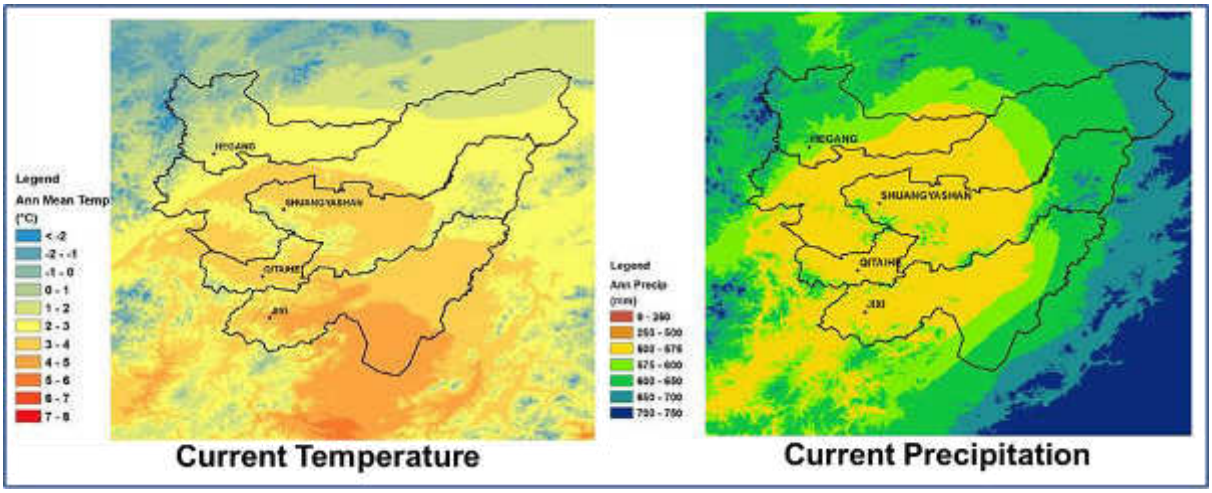


Figure V-10: Current annual mean temperature (left) and precipitation (right) of East

Heilongjiang Region

180. **Observed climate change.** In east Heilongjiang, there is a clear increasing trend in temperature based on observed data from 1950 to 2010. For example, the annual mean temperature in Jixi has increased 1.7°C in the past 50 years (**Figure V-11Figure**). However, precipitation has been fairly stable although there are dry and wet fluctuations (**Figure 11**). The general trend is pointing to a rising temperature and stable or slight increase in precipitation over east Heilongjiang region.

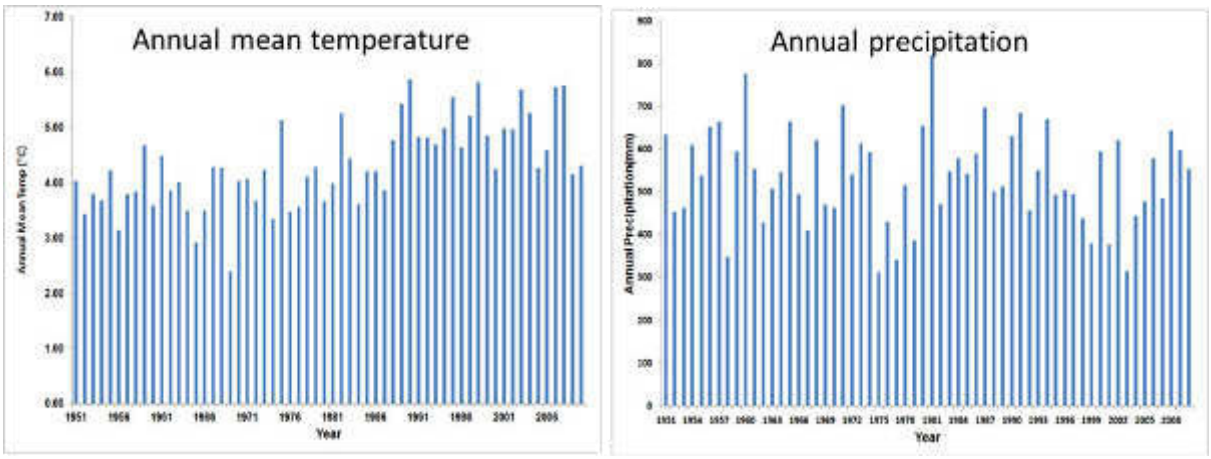


Figure V-11 Annual mean temperature (left) and precipitation (right) from 1951 to 2010 at Jixi

181. **Projected climate change.** Based on coupled model intercomparison project 5 (CMIP5) global climate projections, temperature and precipitation will increase 2.5°C and 3.3°C, and 9.8% and 11.5% in ~2050 in comparison with baseline period 1961-1990 in east Heilongjiang region under the low and high scenarios, respectively. It is also projected that the frequency and intensity of extreme weather events will also increase, although the exact nature of these increases is unclear. Those may include severe snow and rainfall storms, drought and floods caused by greater inter-annual and seasonal climate variability[14].

[14] From CRVA report prepared by PPTA consultant

VI. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Project Environmental Benefits

182. As described in section III, the project will result in multiple environmental benefits. These are repeated below for ease of reference:

(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.

B. Screening of Environmental Impacts Related to Project Implementation and Operation

183. The project outputs were identified through systematic review of the core issues facing the four cities, as summarised ion Figure IV-1. Alternatives for the output were reviewed based on various criteria including cost, ease of implementation and environmental considerations, as described in Section VII. The potential environmental impacts of the preferred project alternatives were subject to initial screening and high level review at the concept paper and PPTA inception stages to (i) identify the

significance of potential impacts from the proposed project components; (ii) remove/modify project components to avoid/minimize potential impacts; (iii) establish the scope of the assessment which assists in focusing on major, critical, and specific impacts; and (iv) enable flexibility in regard to consideration of new issues, such as those that reflect the requirements of the ADB SPS (2009).

184. Screening of environmental impacts resulting from the Project resulted in the following changes: (i) Component SY 3.1 originally included rehabilitation of three additional sites close to the city. This component was removed when it was noted fill material would have to be imported from an external site over 200 km from the rehabilitation site; (ii) the design of river rehabilitation works under HG 4.1 and JX 4.1 design has been improved to incorporate ecological engineering approaches rather than standard gabion or concrete channel bank linings; (iii) The Gonggu flyover (JX 4.3) crosses the Hunagni River, and was designed to require no piers in the riverbed; (iv) Design of the Yunfeng tunnel was considered to reduce overall length of tunneling works; (v) a pilot building level heat exchange program was added in Hegang to further improve the energy efficiency; and (vi) a pilot NRW program was added in Qitaihe to reduce water loss and promote demand side water resources management.

C. Detailed Design and Pre-construction Phase

185. The following environmental measures will be included in the detailed design of facilities by the design institutes:

(i) Safety of pedestrians and cyclists. Design must ensure public health and safety with clearly marked and separate lanes for pedestrians and cyclist, and ensure barrier-free design for disabled people.
(ii) Noise disturbance. Noise reducing surface and other mitigation measures identified in this report and DEIA shall be included in the design.
(iii) Technical design of embankments shall be adaqute and stable enough to withstand the strong force of heavy storm water flow but at the same time maximize the adoption of eco-friendly embankment designs.
(iv) Disposal of dredged sediment. Identify and determine the temporarily storage site with design of drainage system and preliminary treatment system for wastewater; conduct sediment quality test at dredged locations.
(v) Technical design and construction method of the utilities pipes must be adequate to prevent pipe burst.
(vi) Odor removal. Technical design of the WWTPs (Component 2.2) and WTPs (Component 4.2) shall include facility and equipment to remove odor generated during plant operation.
(vii) Technical design of Jiguan WWTP shall include a buffer distance of 100 m to the nearest environmental protection target.
(viii) Technical design of the WWTPs and WTPs shall contain the operational noise from pumps, blowers and other noisy equipment with proper acoustic design of these facilities.
(ix) Technical design of the WWTPs and WTPs shall include sludge drying facility to produce sludge with water content of lower than 60%.
(x) Leachate from waste rock. Waste rock composition testing and analysis will be conducted before any detailed design of land remediation works under component 3.1. If any indicators exceed the thresholds defined in the Hazardous Waste Identification Standard (GB 5085.1-2007), the waste rock is defined as Category II industrial waste. If not, it is defined as Category I industrial waste. The technical design shall comply with the relevant standards for pollution control of general industrial solid waste storage and disposal sites (GB 18599-2001), depending on the composition analysis results. Drainage system shall be designed to be able to divert the sirface runoff immediately to avoid generation of lecahte and landslide.
(xi) Geological survey and soil quality test shall be conducted during design stage for the component 3.
(xii) Underground fire. The sulfur content of waste rock will be tested during design

stage. If the sulfur content is greater than 1.5%, measures to prevent spontaneous combusition shall be designed in line with the Standard for Pollution Control on Storage and Disposal Site for General Industrial Solid Waste (GB 18599-2001).

(xiii) Safety of the waste rock dump sites. Design the profile of the sites (e.g. height and slope angles) to ensure that the final structure is safe, stable and not prone to significant erosion.

(xiv) During detailed design ground water contamination levels will be further assessed, and measures to prevent potential contamination and harm to people and water users will be designed and implemented. Policy dialogue with the government and responsible stakeholders will be carried out during project implementation to promote restoration of groundwater quality to acceptable levels if exceedance of groudwater quality standard is detected.

(xv) Downstream impact casued by Component 4.1 River Rehabilitation activities. During detailed design, additional assessments on possible flood impacts and consultations with downstream communities will be conducted. If necessary, appropriate non-structural measures to mitigate flood risks will be introduced, implemented and supported by the concerned capacity development component of output 5, such as early warning systems and disaster management response mechanisms as required.

186. The following measures will be implemented in the pre-construction phase of the project to ensure the environmental management readiness.

(i) **Institutional strengthening**. (a) A full-time PMO environment officer will be assigned to the project to coordinate EMP implementation, (b) Under the loan consulting services, the PMO will hire a loan implementation environment specialist (LIEC) to provide external support, and (c) An EEM will be contracted through CQS to provide additional, independent environmental monitoring. The terms of reference for these personnel are in the EMP (Attachment 2).

(ii) **Updating the EMP.** In the event of any changes in project design, the EMP will be updated as needed, including mitigation measures and monitoring. This will be the responsibility of the PMO, IAs, and design institutes, with assistance from the LIEC.

(iii) **Training in environmental management.** The LIEC and personnel from the HLJ Environmental Protection Department (EPD) and municipal EPBs will give training in implementation and supervision of environmental mitigation measures to contractors and Construction Supervision Companies (CSCs).

(iv) **Grievance Redress Mechanism (GRM).** The PMO and IAs will implement the project GRM at least two months before the start of construction, to ensure that communities are well informed and have the opportunity to discuss any concerns (further to the public consultations already conducted for this EIA; Section VIII).

(v) **Bidding document and contract documents.** The EMP will be included in the bidding documents and contracts for procurement of civil works. All contractors and subcontractors will be required to comply with the EMP.

(vi) **Contractor obligations.** In their bids, contractors will respond to the environmental clauses for contractual terms and EMP requirements. Prior to construction, each contractor will develop a Site EMP, based on the project EMP (Attachment 2), and assign a person responsible for EHS. The site EMP shall include the following: (a) site drainage and soil erosion protection; (b) dredge spoil holding and treatment sites, material haulage routes, and waste disposal arrangements; (c) spill control and management; (d) health and safety; (e) surface water and groundwater protection; (f) temporary traffic management; and (g) construction site access control. The site EMP will be submitted to the environmental officers of each county PMO for approval, with support of the local EPBs.

187. **Table VI-1** summarizes potential air and noise sensitive receptors consisting of the approximate population of villages, schools and medical clinics in the vicinity of the project components, as described in the DEIA. Some are 5 m or less from the construction activities, especially for the works in urban areas, where works alignment would be very close to existing residential buildings. Most sensitive receptors would be

adversely affected by fugitive dust emissions during construction if no mitigation measures are adopted.

Table VI-1: Air and noise sensitive receptors

Component	Construction Activity	No. of Air & Noise Sensitive Receptors (persons)	Distance to the Construction Site*
Hegang			
HG 2.1	Xiyi Road	200	177 m
	Xisan Road and service centers	No residents within 200 m	n/a
	Lvyuan Road	No residents within 200 m	n/a
HG 2.2	Luobei WWTP	No residents within 200 m	n/a
HG 3.1	Mining rehabilitation	About 800	98-200 m
HG 4.1	Heli River	1100	100-150 m
	Shitou River	2200	100-150 m
	Qianjin Creek	1500	50 m
	Xiaoheli River	5000	50 m
HG 4.2	District heating network	Residents near the pipeline	5-180 m
HG 4.3	Road rehabilitation, public and non-motorized transport improvements	41200	6-191
Jixi			
JX 2.1	Middle ring road and old stage 1 ring road	No residents within 200 m	n/a
JX 2.2	Jiguan WWTP	About 300	100-200 m
JX 3.1	Hengshan District waste rock dumpsite remediation/safe closure and management of former mines	No residents	
JX 4.1	Hongqi Lake	370	35-172 m
	Huangni River & Anle Creek	3917	12-14 m
JX 4.2	Hengshan District community facilities and public space improvement	837	25-130 m
	Water supply and drainage pipeline	Residents along the pipeline	10-50 m
	No.3 WTP upgrading	250	15-150 m
JX 4.3	Jiaotong Street	1746	3-136 m
	Gongqu Flyover	515	9-69 m
Qitaihe			
QH 2.1	Roads and related utilities	No residents within 200m	n/a
QH 3.1	Mining remediation	No residents	n/a
QH 4.2	Upgrading of Shengke WTP and Water &Sewage Company's WTP with replacing and installation of distribution pipes	780	6-200 m
QH 4.3	Sustainable public transport	16298	10-170 m
Shuangyashan			
SY 2.1	Four roads and business service center and standardized workshop	No residents within 200 m. The nearest residents are in 350 m.	
SY 3.1	Waste rock dumpsite remediation	90	30 m
SY 4.2	Water supply, drainage and wastewater networks	Residents along the pipeline	10-50 m
SY 4.3	South Ring Road	146	27.5-136.5 m
	Xinxing Flyover	7652	15-88 m
	Yunfeng Tunnel	1022	12-80 m

*The numbers refer to the closest sensitive receptors to the construction area. Single numbers are used when only one sensitive receptor is located close to the construction area, whereas a range is provided when more than one receptor is found close to the construction area.

188. As the proposed urban roads and flyover are close to the residential area and will result in increased noise during both construction and operation stage. The sensitive receptors need special attention are emphasized here.

Table VI-2: Summary of noise sensitive receivers adjacent to Jixi Gongqu Flyover (JX)

Station number	Current function zone	Distance to the road central line/to the road red line (m)	No. of households	Height difference (m)	Photos
K0+000~ K0+294	Class II	N 77m/N 69m	10	-4.5	
K0+324~ K0+459	Class II	N20m/N12m	39	-4.5	
K0+514~ K0+574.6	Class II	N17m/N9m	99	-4.5	
K0+514~ K0+574.6	Class II	S18m/S10m	68	-4.5	

Table VI-3: Summary of noise sensitive receivers adjacent to Jiaotong Avenue (JX)

Sensitive Receptor	Distance to the road central line/red line	No. of Households	Photo
One-floor house	N25 m	10	/
Government community	E 19 m/15.5m	260	

Sensitive Receptor	Distance to the road central line/red line	No. of Households	Photo
Hengshan District government office building	E 16 m/12.5m	/	
Heng'an Community and Tax Bureau office building	E 140 m/136.5 m	200	
Four floors house	W 6.5 m/3 m	32	
Qijie communities	W 15 m/11.5 m	200	

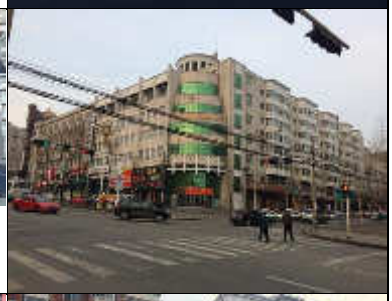
Table VI-4: Summary of noise sensitive receivers adjacent to South Ring Road (SY)

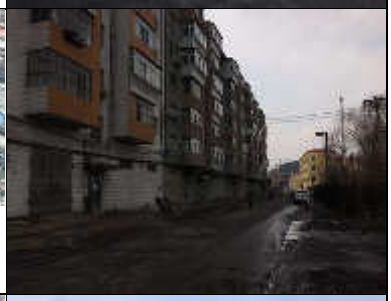
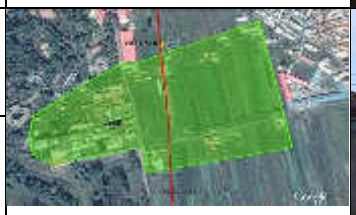
Sensitive receptor	Station number	Distance to the central line/red line		No. of HH	Location
Anshan Community	Right side/K0+000～K0+344	Northside of the railway	3 m/8.5m	2	
		South side of the railway	9 m/4.5 m	1	
			77 m/72.5 m	7	
	Left	10 m/5.5m		7	

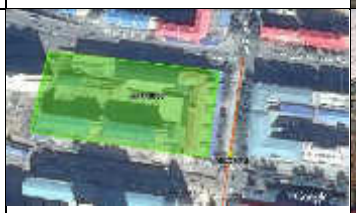
Sensitive receptor	Station number	Distance to the central line/red line	No. of HH	Location
	side/K0+000～K0+255	54 m/49.5 m	8	
	Right side/K0+826～K1+442	11 m/6.5m	24	
		53 m/48.5 m		
	Left side/K1+158～K1+522	9 m/4.5 m	72	
		64 m/59.5 m	27	
Anshan Community (multi-floors)	Left side/K0+936～K0+986	55 m/50.5 m	38	
Hepan Community	Left side/K0+000～K0+133	143 m/138.5 m	252	
Shuangyashan Social Welfare Institute	Left side/K3+163～K3+169	141 m/136.5 m	122 persons	
Fuan Village	Left side/K3+121～K3+164	32 m/27.5 m	1	
		85 m/80.5 m	7	

Sensitive receptor	Station number	Distance to the central line/red line	No. of HH	Location
Yaodi Village	Right side/K3+381～K3+558	137 m/132.5 m	10	

Table VI-5: Summary of noise sensitive receivers adjacent to Xinxing Avenue (SY)

Sensitive receptor	Chainage	Direction/ distance to midline	Location	
Zhongxin community	K0+020 ~ K0+280	East 20m /4.5m East 50.5m /35m		
Heilongjiang Coal Vocational and Technical College	K0+070 ~ K0+090	East 20m /4.5m		
Urban Management Bureau Community	K0+020 ~ K0+090 ZK0+020 ~ ZK0+100	West 72m /56.5m East 34m /25m		
Shuangyashan mining group environmental protection monitoring stations	K0+170 ~ K0+180	West 20m /4.5m		

Sensitive receptor	Chainage	Direction/ distance to midline	Location	
Transportation Division, Shuangyashan mining group	K0+230 ~ K0+290	West 20m /4.5m		
General Hospital of Coal Transport Branch	K0+260 ~ K0+280	West 91m /75.5m		
	ZK0+420 ~ ZK0+440	North 24m /15m		
Beixiu Community	K0+450 ~ K0+880	The East and West 25m/6m		
	ZK0+230 ~ ZK0+260	South 63m /54m		
Beixiu Community	K0+670 ~ K0+680	West 54m /35m		
Shuangkuang group	K0+600 ~ K0+700	West 77m /58m		
Fu'an village	K0+880 ~ K1+330	The East and West 25m/6m		
Fu'an village (Garden Road)	K0+990 ~ K1+110	West 54m /35m		

Sensitive receptor	Chainage	Direction/ distance to midline	Location	
Shuangyashan Land and Resources Bureau	ZK0+030 ~ ZK0+040	East 24m /15m		
Shuangyashan Court	ZK0+050 ~ ZK0+070	East 24m /15m		
Shuangyashan Forestry Bureau	ZK0+070 ~ ZK0+090	East 24m /15m		
Heitu Garden Community	ZK0+020 ~ ZK0+100	West 15m /6m		
East pyramids potential training school (kindergarten)	ZK0+150 ~ ZK0+170	West 25m /16m		
Jinshan international community	ZK0+130 ~ ZK0+200	West 48m /39m		

Sensitive receptor	Chainage	Direction/ distance to midline	Location	
Shuangyashan insurance agency	ZK0+120 ~ ZK0+125	East 12m /3m		
Zhongtian hospital	ZK0+330 ~ ZK0+380	North 12m /3m		

D. Anticipated Impacts and Mitigation Measures during the Construction Stage

1. Physical Impacts and Mitigation – Air Quality

a. General Impacts and Mitigation

189. The main air pollutants associated with construction stage activities for most project components will include (i) fugitive dust emission during earth works; (ii) fumes from asphalt mixing; and (iii) fumes from construction vehicles and PME. Analysis of the likely extent of impacts resulting from these activities is presented in the DEIA, and summarized below.

190. **Fugitive dust**. The DEIA predicted that the impact distance of fugitive dust (TSP) from earth-works and uncovered stockpiles of earth materials in the project would be up to 150 m downwind of the source (i.e., TSP levels would comply with GB 3095-2012 Class II standard of 0.3 mg/m^2 for 24-hr average beyond this distance downwind of the source). For river rehabilitation works, the impact distance is likely to be within 100 m due to higher moisture content of the material.

191. **Asphalt mixing.** The mixing and laying of asphalt will produce fumes containing small quantities of toxic and hazardous chemicals such as volatile organic compounds (VOC) and poly-aromatic hydrocarbons (PAH). Fumes from asphalt mixing stations would impact a larger area, and the DEIA suggested necessary to provide a buffer distance of at least 300 m downwind of the nearest sensitive receptors.

192. **Fumes from PME and vehicles.** The DEIA predicted that major pollutants of excavator and haulage trucks fuel exhaust (SO_2 and NO_2) typically impact an area 15-18 m downwind of the source with a concentration of 0.016 mg/m^3 to 0.18 mg/m^3. While areas affected by exhaust emissions are small and temporary in nature, measures can be adopted to minimize potential impacts to sensitive receivers.

193. The contractor will implement the following air quality control measures to reduce air pollution and dust and odor nuisance:

(i) Routing of access and hauling roads as far from residential areas (and particularly schools and hospitals) as practicable.

(ii) Haulage routes and schedules developed to avoid transport through central urban areas, traffic intensive areas or residential areas. For areas with high-demand on environmental quality, transportation will be arranged at night.
(iii) Regularly check and maintain vehicles. Only vehicles with well maintenance will be used. Vehicles with an open load-carrying case, which transport potentially dust-producing materials, shall have proper fitting sides and tail boards. Dust-prone materials shall not be loaded to a level higher than the side and tail boards, and shall always be covered with a strong tarpaulin.
(iv) Spray water regularly on unpaved haul roads and access roads (at least once a day) to suppress dust; and erect hoarding around dusty activities.
(v) Install wheel washing equipment or conduct wheel washing manually at each exit of the works area to prevent trucks from carrying muddy or dusty substances onto public roads.
(vi) Cover material stockpiles with dust shrouds or tarpaulin. For earthwork management or backfill, measures will include surface press and periodical spraying and covering. The extra earth or dredged material should be cleared from the project site in a timely manner to avoid long term stockpiling.
(vii) Where construction sites are located within 50 m of residential areas, semi-enclosed construction measures will be adopted to minimize dust impacts.
(viii) Minimize the storage time of construction and demolition waste on site by regularly removing to appropriate off-site disposal facilities.
(ix) Site asphalt mixing and concrete batching stations at least 300 m downwind of the nearest air quality sensitive receptor.
(x) Equip asphalt, hot mix and batching plants with fabric filters and/or wet scrubbers to reduce the level of dust emissions.
(xi) Keep construction vehicles and machinery in good working order, regularly service and turn off engines when not in use. Divert PME exhausts away from public areas.
(xii) In periods of high wind, dust-generating operations shall not be permitted within 200 m of residential areas. Special precautions need to be applied in the vicinity of sensitive receptors such as schools, kindergartens and hospitals.
(xiii) Unauthorized burning of construction and demolition waste material and refuse shall be subject to penalties for the Contractor, and withholding of payment.

b. Impacts and Mitigation Related to River Rehabilitation Works

194. In addition to air quality impacts outlined in the preceding sections, the DEIA predicted that potential odor impact from dredged sediment during river rehabilitation works at Hegang and Jixi will affect a limited up to 30 m downwind of the source. To mitigate this impact, the following measures would be implemented:

(i) All dredged sediment storage or disposal facilities will be sited at least 50 m from the nearest air quality sensitive receptor.
(ii) Dredged sediment will be transported in closed tank wagons to contain odor and prevent leakage during transit.

c. Summary

195. The mitigation measures specified to address construction phase air quality impacts are defined in the EMP. Contractors will be required to ensure compliance with relevant PRC emission standards. These will be supervised by the CSCs (present onsite) and verified with monitoring conducted by the EEM (at least semi-annually during construction period). Air quality monitoring will be carried out by contractors (internal) and a licensed environmental monitoring entity (external, contracted by the EEM) during the construction period. With these measures in place and implemented, air quality impacts during construction would comply with applicable standards.

2. Physical Impacts and Mitigation – Noise and Vibration

a. General Impacts and Mitigation

196. Noise will be emitted by various PME and vehicles used during construction works. According to Standard of Noise Limits for Construction Site (GB12523-2011), the noise limits are 70 dB (A) during daytime and 55 dB (A) during nighttime. 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. For the current project, models recommended in Technical Guideline on EIA Regarding Acoustic Environment (HJ2.4-2009) to predict noise levels have been adopted. Based on the types of PME/vehicles used and their cumulative sound power levels, it is calculated that relevant standards would be met 10 m (daytime) and 50 m (nighttime) from dredging, embankment construction and utilities pipeline installation works; and 60 m (day) and 300 m (night) for road construction works. Although river dredging, embankment construction, utilities pipeline installation and road construction are all linear activities (and therefore construction noise impact is relatively short term in any one particular location), it is likely exceedances would be observed for most other works components, and therefore mitigation measures would be required.

197. The three WTPs to be upgraded are situated close to residential buildings, and will exceed standards within 100 m of works areas. Mitigation measures would therefore be required.

198. For land remediation works, transportation of waste rock will require dumper trucks that will increase local traffic noise, with cumulative noise levels of 80-90 dB (A).

199. Construction of Luobei and Jiguan WWTP will occur in Greenfield sites relatively distant (>100 m) from sensitive receptors, and are not expected to cause significant noise impact.

200. A summary of construction phase noise impacts is provided in **Table VI-6**. A more detailed description of sensitive receptors adjacent to urban roads (where more significant impacts are expected) is provided in **Tables VI-2 to VI-5**.

Table VI-6: Summary of construction phase noise impacts

Component	Construction Activity	Distance from works area where noise standards will be met	Potential affected sensitive receptors (persons) without mitigation
Hegang			
HG 2.1	Xiyi Road	60 m (300 m)	Yes
	Xisan Road and service centers	60 m (300 m)	No
	Lvyuan Road	60 m (300 m)	No
HG 2.2	Luobei WWTP	100 m	No
HG 3.1	Mining rehabilitation	150 m (400 m)	Yes
HG 4.1	Heli River	10 m (50 m)	Yes
	Shitou River	10 m (50 m)	Yes
	Qianjin Creek	10 m (50 m)	Yes
	Xiaoheli River	10 m (50 m)	Yes
HG 4.2	District heating network	10 m (50 m)	Yes
HG 4.3	Road rehabilitation, public and non-motorized transport improvements	60 m (300 m)	Yes
Jixi			
JX 2.1	Middle ring road and old stage 1 ring road	60 m (300 m)	No
JX 2.2	Jiguan WWTP	100 m	Yes
JX 3.1	Hengshan District waste	150 m (400 m)	No

	rock dumpsite remediation/safe closure and management of former mines		
JX 4.1	Hongqi Lake	50 m (150 m)	Yes
	Huangni River & Anle Creek	50 m (150 m)	Yes
JX 4.2	Hengshan District community facilities and public space improvement	50 m (150 m)	Yes
	Water supply and drainage pipeline	10 m (50 m)	Yes
	No.3 WTP upgrading	100 m	Yes
JX 4.3	Jiaotong Street	60 m (300 m)	Yes
	Gongqu Flyover	60 m (300 m)	Yes
Qitaihe			
QH 2.1	Roads and related utilities	60 m (300 m)	No
QH 3.1	Mining remediation	150 m (400 m)	
QH 4.2	Upgrading of Shingle WTP and Water &Sewage Company's WTP with replacing and installation of distribution pipes	100 m	Yes
QH 4.3	Sustainable public transport	100 m	Yes
Shuangyashan			
SY 2.1	Industrial park roads and standardized workshops	60 m (300 m)	No
SY 3.1	Waste rock dumpsite remediation	150 m (400 m)	Yes
SY 4.2	Water supply, drainage and wastewater networks	10 m (50 m)	Yes
SY 4.3	South Ring Road	60 m (300 m)	Yes
	Xinxing Flyover	60 m (300 m)	Yes
	Yunfeng Tunnel	60 m (300 m)	Yes

201. To mitigate the identified construction noise impacts, contractors will be required to implement the following mitigation measures. Some measures are commonly adopted in the PRC and are applicable best practice for all construction sites and activities, yet they represent good practice, have proven effectiveness, and are also in line with WBG's EHS guidelines.

(i) During daytime construction, the contractor will ensure that: (1) noise levels from equipment and machinery conform to the PRC standard for Noise Limits for Construction Sites (GB12523-2011) and WBG EHS Standards (as shown in **Table II-3**), and properly maintain and repair machinery to minimize noise; (2) equipment with high noise and/or vibration will not be used near village or township areas; only low noise machinery or the equipment with sound insulation will be employed; (3) sites for concrete-mixing plants and similar activities will be located at least 300 m away from the nearest noise sensitive receptor (source from DEIA); and (4) temporary noise barriers or hoardings will be installed around PME if works are conducted within 20 m of noise sensitive receptor.
(ii) No construction will be conducted between the hours of 22:00 to 06:00. If night-time construction is considered essential (i.e., to avoid significant impacts to traffic), any plan should be subject to community consultation.
(iii) Limit the speed of vehicles travelling on site (less than 8 km/h), forbid the use of horns unless in emergencies, minimize the use of whistles.
(iv) Maintain communication with communities near the construction sites, and avoid noisy construction activities during sensitive times of the year (i.e., during school examination

periods for families with children).

(v) Regularly monitor noise levels at construction site boundaries. If noise standards are exceeded by more than 3 dB, equipment and construction conditions shall be checked, and mitigation measures shall be implemented to rectify the situation.

b. Impacts and Mitigation Related to Yufeng Tunnel Construction

202. The Yunfeng tunnel construction has the potential to generate substantial noise and vibration impacts during construction. Methodologies for construction will adopt the New Austrian Tunneling Method (NATM) using drill and blast techniques. The use of explosives would generate intermittent pulsating noise during blasting, with the sound power level of each blast depending on the amount of explosive used. Levels typically range from 110-120 dB(A) for road tunnel construction. The DEIA analysis showed that noise level can only meet Class II standard (*GB3096-2008*) at 410 m from the blasting point (**Table VI-7**).

Table VI-7: Blasting sound level prediction at different distances

Distance to the noise source (m)	1	30	50	100	200	300	400	410	500
Noise prediction (db(A))	113.4	86.6	81.9	75.4	68.4	63.9	60.4	60.0	57.4

203. There are three sensitive receptors (which are residential/commercial properties, no schools and hospital in the area) located within 410 m of the tunnel works area where relevant standards would be exceeded due to blasting works. All three receptors are at the western side of the tunnel. Noise levels at the receptors are shown in **Table VI-8**. Although blasting noise would be transient, the results show that noise standards would be exceeded, and mitigation would be required. In particular, clear communication with affected residents about the timing and duration of blasting activities for Yufeng tunnel construction should be maintained.

Table VI-8: Yufeng tunnel blasting noise impact assessment

Location	Distance from the tunnel entrance to the sensitive receptor			Predicted noise	Photos of the sensitive receptors	Locations of the sensitive receptors and proposed tunnel
	Sensitive receptor	Distance	Height difference			
Tunnel starting	Construction Jianshe Plaza	170 m	6 m	70.1		
	Yunfeng community	150 m	4 m	71.4		

Location	Distance from the tunnel entrance to the sensitive receptor			Predicted noise	Photos of the sensitive receptors	Locations of the sensitive receptors and proposed tunnel
	Sensitive receptor	Distance	Height difference			
	Construction Bank	100 m	4 m	75.4		

204. Blasting activities will cause vibration as well as noise impacts that could be transmitted to nearby structures. According to PRC's Blasting Safety Code (GB 6722-2011), the allowable vibration velocity for road tunnel construction blasting is 2.3 cm/s. Based on this standard, it has been calculated that the maximum weight of explosives can be used at the same time is 67.1 kg for tunnel construction to ensure compliance of with vibration standards at the nearest sensitive receptor. The amount of explosives used shall be strictly controlled within this threshold.

d. Summary

205. The mitigation measures specified to address construction phase noise and vibration impacts are defined in the EMP. These will be supervised by the CSCs, and verified by the EEM. Contractors will be required to ensure compliance with relevant PRC noise standards. Noise monitoring will be carried out by contractors (internal) and a licensed environmental monitoring entity (external, contracted by the EEM) during the construction period. With these measures in place and implemented, noise impacts during construction would comply with applicable standards.

3. Physical Impacts and Mitigation – Surface Water Quality

a. General Impacts and Mitigation

206. General construction phase activities for the majority of project components could result in potential water quality impacts including:

(i) Uncontrolled wastewater and muddy runoff from construction sites and work camps could potentially pollute nearby water bodies. The discharge of supernatant water from the dredged sediment storage or disposal sites could potentially affect the water quality of receiving water bodies.
(ii) Wastewater could be produced from the maintenance and cleaning of PME and vehicles, water from mixing and curing concrete, inappropriate storage and handling of fuel, accidental spills, and disposal of domestic wastewater from construction camps.

207. To address potential water quality impacts from these activities, contractors will implement the following measures:

(i) Portable toilets or small package wastewater treatment plants will be provided on construction sites and construction camps for the workers and canteens. If there are nearby public sewers, interim storage tanks and pipelines will be installed to convey wastewater to those sewers.
(ii) Sedimentation tanks will be installed on construction sites to treat process water (e.g. concrete batching for bridge construction) and muddy runoff with high concentrations of suspended solids. If necessary, flocculants such as poly-acryl amide (PAA) will be used to facilitate sedimentation.

(iii) Construction machinery will be repaired and washed at designated repairing facilities. No onsite machine repair or washing shall be allowed.
(iv) Storage facilities for fuels, oil, and other hazardous materials will be within secured areas with impermeable surfaces, and provided with bunds and cleanup kits.
(v) The contractors' fuel suppliers must be properly licensed, follow proper protocol for transferring fuel, and must be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88).
(vi) Material stockpiles will be protected against wind and runoff waters which might transport them to surface waters.
(vii) Any spills are to be cleaned up according to PRC norms and codes within 24 hours of the occurrence, with contaminated soils and water treated according to PRC norms and codes. Records must be handed over immediately to the PMO and local EPB.
(viii) All process wastewater and muddy runoff from construction sites shall be treated to GB 8978-1996 Class I standard before discharge into the environment.

b. Impacts and Mitigation Related to Land Remediation Works

208. During land remediation works (component 3.1), there is a potential to mobilize sediments during removal/filling of waste-rock. These sediments could discharge into local drainage systems, increasing sediment loading. Furthermore, soils at the Lingbei Mine (HG 3.1) have elevated Cd levels. Heavy metal concentrations at other land remediation sites could also potentially be high (to be monitored prior to construction). Run-off from these sites could therefore result in contamination of local drainage systems.

209. Specific measures will be implemented to control site run-off at land remediation works areas. During the detailed design stage, drainage plans and treatment systems will be designed for these works areas to minimise potential impacts resulting from contaminated site run-off. The specification of these systems will depend on the results of environmental monitoring to be undertaken during the detailed design stage, but a range of passive (e.g., limestone beds/drains, treatment wetlands, permeable reactive barriers) or active (e.g., microbial reactor systems, flocculation and filtration systems) can be considered.

c. Impacts and Mitigation Related to River Works

210. Several works components will involve works in or adjacent to existing river channels, leading to potential water quality impacts in the vicinity of the works as well as downstream areas. These impacts would arise as works disturb bottom sediments and increase suspended solid (SS) concentration in the water column. Furthermore, the works could mobilize contaminants including zinc and copper, which were recorded at slightly high elevations at monitoring stations in Hegang. These impacts will primarily be associated with river rehabilitation works at Hegang and Jixi (under component 4.1), which will require bank modifications and instream dredging. To a lesser extent, impacts could also result from bridge re-construction and river crossing of utilities pipelines. As Gongqu Flyover at Jixi will cross the Huangni River, and South Ring Road in Shungyashan will cross Anbang River, the bored grouting used in the abutment can cause a discharge of sediment and wastewater into the river. To mitigate these impacts, the following measures would be undertaken:

(i) River dredging (using a backhoe) and bank reconstruction works will be conducted 'in the dry' by constructing a coffer dam around the works area.
(ii) Temporary storage of dredged sediments will be held in clearly demarcated storage sites for dewatering.
(iii) Wastewater from dewatering sites will be carefully controlled: water draining from these sites will be treated by sedimentation in consolidation tanks, with wastewater from these tanks returned back to the river only when suspended sediments (SS) are less than 20 mg/L (meeting Class I requirement of GB8978-1996).

Summary

211. The mitigation measures specified to address construction phase water quality impacts are defined in the EMP. Contractors will be required to ensure compliance with relevant PRC water quality and wastewater discharge standards. Water quality monitoring will be carried out by an external licensed environmental monitoring entity (hired by the EEM) during the construction period. With these measures in place and properly implemented, water quality impacts during construction would comply with applicable standards.

4. Physical Impacts and Mitigation – Groundwater

212. During land remediation works under component 3.1, there is a risk that leachate from fill sites will enter and contaminate groundwater resources. The leachate could have high levels of SS, and also be contaminated with heavy metals.

213. The main measure to control potential issues with leachate will lining of proposed fill sites with clay before waste-rock is imported. This will effectively seal the fill site and prevent leachate from entering the groundwater. Monitoring of both the leachate and groundwater surrounding the sites will be conducted in the wet and dry seasons to ensure the effectiveness of this control measure. Leachate monitoring will be conducted by installing DN100 polyvinyl chloride (PVC) pipes into the site as it is being filled. The pipes will be laid at a slope of 5%, so that leachate can be easily collected for sampling and analysis. Full monitoring plans will be developed during the detailed design stage of the project. The indicative subsidence and groundwater monitoring diaram is shown in Figure VI-1.

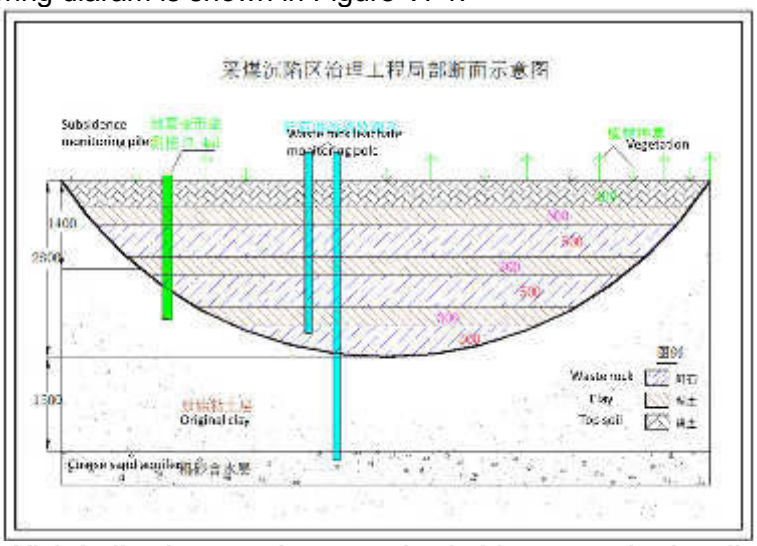


Figure VI-1: Indicative roundwater and subsidence monitoring diagram

214. The above measures are defined in the EMP. Contractors will be required to ensure compliance with relevant PRC water quality and wastewater discharge standards. Water quality monitoring will be carried out by an external licensed environmental monitoring entity (hired by the EEM) during the construction period. The requirement for developing comprehensive leachate monitoring plans are included as a specific project assurance. With these measures in place and properly implemented, ground water quality impacts during construction would comply with applicable standards.

5. Physical Impacts and Mitigation – Solid Waste, Earth Works and Soil Erosion

a. General Impacts and Mitigation

215. Solid waste generated during construction will include construction and demolition (C&D) waste, excavated spoil during earth works (for construction of roads/tunnels,

embankments, wastewater collection pipelines, wastewater treatment plants and river channel widening) and dredged sediment from the rivers, and refuse generated by construction workers on construction sites. If not properly disposed, such wastes will create community health and sanitation problems.

216. **Solid waste.** To minimize adverse impacts from domestic refuse generated by construction workers, refuse will be stored in closed containers and regularly transported off-site for disposal at landfills (see also Occupational Health and Safety Section). None of the C&D waste produced by the project is considered toxic or harmful. It has been confirmed with local government that old heating pipes to be replaced under the project do not contain asbestos, but are made from hand-made polyurethane thermal insulation tile, wrapped with glass fabric and coated with asphalt (primary heating pipes) or polyethylene thermal insulation tile, rock wool, perlite, wrapped with glass fabric cloth (secondary heating pipes). This being the case, C&D waste can be used for filling and foundations of other construction works specified by the municipal and planning departments. Generally, generation and disposal of C&D waste is not anticipated to have adverse environmental impacts. The contractors will implement the following measures to avoid negative impacts from refuse:

(i) Establish enclosed waste collection points on site, with separation of domestic waste and C&D waste.
(ii) Set up centralized domestic waste collection point and transport offsite for disposal regularly by sanitation department.

217. **Earthworks**. Initial estimates of excavation works, reused fill, and surplus soil volumes were estimated for the project components involving major earthworks (**Table VI-9**). The majority of road (components 2.1 and 4.3) and river (component 4.1) projects will generate excess fill which in most cases will be reused for nearby land formation (i.e., levelling of industrial parks) or land remediation works. The land remediation works under component 3.1 will utilize waste rock from various sources, including existing material found on the site and nearby waste-rock dump sites. Clay will be sourced from centralized storage dumps in each of the four cities. Soil Erosion Protection Plans (SEPPs) are being prepared by certified national institutes for all project components, for approval by the Heilongjiang Water Resources Department by the end of 2017. These plans are required for the detailed design stage of the project, and will contain further details of the soil cut and fill, including source of fill required to complete construction works.

Table VI-9: Soil Cut and Fill Balance (m^3)

Component	Excavation	Fill		Balance	Remarks
		Reuse	Borrow		
Hegang					
HG 2.1 Xiyi Road	7033	7033	6184	0	
HG 2.1 Xisan Road	2813	2813	2474	0	
HG 2.1 Lvyuan Road	5120	5120	750	0	
HG 3.1 Lingbei Mine			381257 (rock) 91336 (clay)		
HG 4.1 Rivers	532400 (dredged sediments)	532400			
Jixi					
JX 2.1 Central road (industrial park)	1322713	2368	0	1320345	The spoil will be reused for land leveling within the industrial park
JX 3.1 Hengshan			26000		

Component	Excavation	Fill		Balance	Remarks
		Reuse	Borrow		
District Mine			(rock) 2200 (clay)		
JX 4.1 River	18953 (dredged sediment)				Re-used on-site for embankment construction as possible after proper test.
JX 4.3 Jiaotong Avenue	1445	1445	6935	0	
JX 4.3 Gongqu bridge	5000	2000	0	3000	The spoil will be reused for land leveling in the industrial park
Qitaihe					
QH 2.1 Industrial park roads	19958	19088	5912	870	The spoil will be reused for land leveling within the industrial park
QH 3.1 Taoshan District Land Remediation			187313 (rock) 113528 (clay)		
Shuangyashan					
SY 2.1 Industrial park roads	5328	2259	0	3069	The spoil will be reused for land leveling within the industrial park
SY 3.1 Lindong District mine remediation			207437 (rock) 124462 (clay)		
SY 4.3 Yunfeng tunnel	257342	13986	0	243356	Transport to the Shuangyashan mountain quarry rehabilitation
SY 4.3 Xinxing Avenue	15249.7	15249.7	20770	0	
SY 4.3 South ring road	250488	115694	0	134794	The spoil will be transported to the subsidence area in Jianshan district

218. The contractors will implement the following measures related to earthwork management:

(i) Confirm location of borrow pits, temporary spoil storage and final disposal sites. These facilities will be included in the SEPPs and approved by city EPB and land resources bureaus
(ii) Maximize the reuse of earth cut materials for filling and foundations of other construction works specified by the municipal and planning departments, or transport in enclosed containers to designated disposal site.
(iii) Develop borrow pit and spoil disposal site management and restoration plans, to be approved by the responsible authorities; and obtain permits required for the clearance of excavated earthworks.
(iv) Construct hoardings and sedimentation ponds to contain soil loss and runoff from construction sites.

219. **Soil erosion.** Soil erosion could occur during river dredging, embankment construction, temporary soil storage, and areas temporarily exposed when surface vegetation and soil have been removed. Erosion could also occur during backfilling works for land remediation components, and after construction if site restoration has been inadequate. To minimize soil erosion during construction, the following measures will be implemented by contractors:

(i) Berms or drainage ditches will be constructed around the perimeter of the construction sites to minimize stormwater flow into the sites which would increase soil erosion.
(ii) Stockpiles of spoil and newly backfilled areas will be covered with tarpaulin or similar material to minimize soil erosion.
(iii) Immediately restore and replant temporary works areas upon completion of construction works.

b. Impacts and Mitigation Related to River Rehabilitation Works

220. Initial sampling of sediments at river rehabilitation sites in Hegang suggests some contamination with zinc and copper. To address potential contamination of dredged sediments, a precautionary measure assuming the potential exceedance of pollutant levels will be adopted, requiring the double lining of the soil surface of all (temporary) disposal sites to prevent contaminating the soil and groundwater, and treatment and testing of heavy metals and pesticides of the supernatant water prior to discharge. At Hegang, all dredged material will be disposed of at the local municipal landfill, with dredged material compliant with relevant standard for this disposal method (GB/T 23485-2009). At Jixi, dredged material will be reused for landscaping works. Here, soil quality and leaching tests will be conducted on the dried dredged sediment prior to re-use. Dredged sediment failing the leaching test will not be re-used.

c. Summary

221. The mitigation measures specified to manage solid waste, earth works and soil erosion during the construction phase are defined in the EMP. Contractors will be required to ensure compliance with relevant PRC standards. Monitoring will be carried out by an external licensed environmental monitoring entity (hired by the EEM) during the construction period. With these measures in place and properly implemented, management during construction would comply with applicable standards.

6. Biodiversity Impacts and Mitigation

222. Project operation is expected to make a positive contribution to the environmental management of the four cities, in particular enhancing urban river environments, rehabilitating degraded waste rock dump and mine sites, and improving surface water quality. No species of recognized conservation interest (i.e., listed as VU, EN or CR on the IUCN red-list) were observed during site visits, and are considered unlikely to occur at the project sites due to degraded nature of the habitats. No critical habitats (as defined in the SPS, 2009) occur within areas impacts by the project. 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. Only very minor and short-term impacts to ecological resources are anticipated during the construction phase, as follows.

223. **Land use modification.** Construction works will result in direct and permanent modification of 322.81 ha of land within the footprint of the different project components and 29.56 km of river channels (**Table VI-10** refers). The vast majority (318.21 ha, or 98.58% of

the total) of land permanently affected by the project comprises existing degraded habitats of low ecological value (agricultural land, rural and urban developments and active/abandoned industrial land). Ecological impacts to these habitats considered insignificant. Three components will impact woodland plantation habitats: (i) Cut and cover works for the Yunfeng tunnel (SY 4.3) will affect approximately 0.8 ha of immature deciduous plantation; and (ii) Construction of the Central Ring Road (JX 2.1) and Beishan Road, Jiaotong Street and Bypass Bridge (JX 4.3) will affect 3.84 ha of woodland plantation managed by the Jixi Luhai Forestry Company Ltd. These impacts are considered minor as the habitats affected are of relatively low ecological value (due to young age and low species/structural diversity). Furthermore, these impacts would be fully compensated under the project through the following measures: (i) Areas subject to cut and cover at Yufeng Tunnel will be reinstated following the completion of works; and (ii) the project will include reforestation of 104.6 ha of remediated land and enhancement of 6.1 ha existing reforested land, providing full compensation for the permanent loss of 3.84 ha of woodland plantation at Jixi.

224. Impacts to river and creek habitats are considered minor. All the affected channels have been highly modified and degraded by past human activities, with the channels straightened and banks in most locations lined with concrete. Water quality in the affected sections is poor, and sediments are affected by industrial and domestic wastewater discharges.

Table VI-10: Summary of land use modifications required by the project

Administrative Unit	Permanent changes to existing degraded land*	Permanent changes to plantation habitats	Temporary land changes**	Rivers and Creeks
Hegang	131.25 ha	-	25.58 ha	16.61 km
Jixi	30.9 ha	3.84 ha	27.8 ha	9.65 km
Qitaihe	78.8 ha	-	72.8 ha	-
Shuangyashan	77.26 ha	0.8 ha	44.11 ha	-
Total	**318.21 ha**	**4.6 ha**	**170.29 ha**	**29.56 km**

*Degraded land in this context refers to land significantly modified by human activities, and therefore of limited ecological value. It includes agricultural land, rural and urban developments and active/abandoned industrial land

**Temporary land changes required for works sites, access roads etc., that will be reinstated following the completion of works

225. A total of 170.29 ha of land will be required temporarily during the project construction. For all project construction activities, care will be taken to minimize potential impacts from temporary habitat loss by siting of works areas/storage sites and routing of access roads in areas of low ecological value (e.g., abandoned land/existing disturbed sites). Works sites and other areas associated with protect construction activities (e.g., temporary access routes) will be clearly demarcated. Temporary works areas will be fully reinstated following the completion of works.

226. **Species injury and/or mortality.** Vegetation clearance, dredging, earth works, increased construction traffic, and unauthorized actions of construction staff (e.g. fishing/hunting) could cause injury or mortality to fauna. These impacts are considered minor in scale due to the low probability that species of conservation concern would be affected.

227. **Noise and visual disturbance.** Disturbance to wildlife could result from noise and vibration from construction plant and vehicles and increased human presence and activity in works areas. Given the low ecological value of the habitats in the project area, no significant ecological impacts are anticipated. Nevertheless, the following site practices will be implemented to minimize potential disturbance to people and ecology:

- Construction machinery and vehicles will be well maintained to reduce noise and air

pollution;
- Dust suppression measures (e.g., wheel washing) will be implemented;
- Site run-off control measures (e.g., covering stockpiled soils with tarpaulin, routing site run-off through sediment traps) will be implemented;
- Adequate toilets and litter bins will be provided on construction sites;
- A maximum speed limit for all vehicles of 40 km/h will be enforced;
- Use of vehicle horns will be prohibited, except in emergency situations.

228. **Air pollution.** Construction phase activities could result in localized air quality impacts from dust generation and exhaust emissions from construction plant and vehicles. Air quality degradation can result in ecological impacts through direct particle deposition on plants, and sub-lethal effects of pollutants on plants and animals. These impacts would be minor due to the low ecological value of the habitats and species affected. Any potential impacts would be controlled through standard good site practices.

229. **Water quality.** The water quality downstream of rivers rehabilitation works, as well as waterbodies adjacent to mine rehabilitation sites, could be impacted by proposed construction phase activities. In particular, sediments mobilized by river dredging/embankment and mine rehabilitation works can impact aquatic communities. Other potential sources of water quality pollution could result from spillage or leaking of fuel, oils, cleaning chemical and other material stored or used within works areas. Measures to reduce water quality impacts from dredging works and general construction activities are described in **Section VI.3**. With the implementation of these measures, water quality impacts will be minor and localized in nature.

7. Social Issues

230. The project is classified as category A for involuntary resettlement (SPS, 2009). It is estimated that 156 households (486 persons) will be permanently affected by impacts to collective farm land (908.37 mu). The impacts on the households are found to be marginal since the percentage of loss and annual income loss per capita income are not more than 10%. State-owned construction land will also be permanently occupied (197.25 mu). In terms of temporary impacts due to installation of water supply, drainage, sewer and heating pipelines, 30 mu of collective land (12 households with 42 persons) and 631.65 mu of state-owned construction land will be affected. Impacts on houses are found to be significant since there are about 335 households (974 persons) affected by house demolition (31,704 m^2) and will be required to relocate. Six public and private organizations (1,530 workers) will also be affected by impacts on structures. In addition, 10 stores (32 persons) were also identified as affected.

231. A resettlement plan has been prepared that meets PRC and ADB requirements, to ensure that affected residents receive adequate compensation and/or support. Detailed analyses of impacts to livelihoods, resettlement, and economic analysis are included in these plans, which will be available in Chinese language at the PMO office and ADB website.

8. Community and Worker Health and Safety

232. **Occupational health and safety.** Construction works are by their nature potentially hazardous. Civil works contractors will implement adequate precautions to protect the health and safety of construction workers, including the following measures:

(i) Construction site sanitation: Each contractor shall provide adequate and functional systems for sanitary conditions, toilet facilities, waste management, labor dormitories and cooking facilities.
(ii) The sites will be effectively cleaned and disinfected. During site formation, works areas will be sprayed with phenolated water for disinfection. Other measures shall include (1)

Disinfect toilets and refuse piles and timely removal of solid waste; (2) Conduct rodent pest control at least once every three months, and carry out insect extermination at least twice a year; (3) Provide public toilets in accordance with the requirements of labor management and sanitation departments in the living areas on construction sites, and appoint designated staff responsible for cleaning and disinfection; (4) Work camp wastewater shall be discharged into the municipal sewer system or treated on-site with portable system.

(iii) Occupational safety: (1) Provide safety hats and shoes for all construction workers, (2) Provide safety goggles and respiratory masks to workers on asphalt road paving and tunnel blasting, (3) Provide ear plugs to staff working near noisy PME.

(iv) Food safety: conduct regular inspection and supervision of food hygiene in on-site canteens. Canteen workers must have valid health permits. Institute prompt remedial measures after any incidence of food poisoning.

(v) Disease prevention, health services: (1) All contracted labor shall undergo a medical examination which will form the basis of an (obligatory) health/accident insurance and welfare provisions to be included in the work contracts. The contractors shall maintain records of health and welfare conditions for each person contractually engaged, (2) Establish a health clinic at a location where workers are concentrated, which should be equipped with common medical supplies and medication for simple treatment and emergency treatment for accidents, (3) Specify (by the PIUs and contractors) the person(s) responsible for health and epidemic prevention, and also those responsible for the education on food hygiene and disease prevention to raise the awareness of workers.

(vi) Social conflict prevention: No major social risks and/or vulnerabilities are anticipated as a result of the project. The project construction workers will be engaged locally. Civil works contracts will stipulate priorities to (1) employ local people for works, (2) ensure equal opportunities for women and men, (3) pay equal wages for work of equal value, and to pay women's wages directly to them; and (4) not employ child or forced labor.

233. **Community health and safety.** Temporary traffic diversions, generation of noise and dust on hauling routes, and general hindrance to local access and services are common impacts associated with construction works within or near rural or urban settlements. The project may also contribute to road accidents through the use of heavy machinery on existing roads, temporarily blocking pavements for pedestrians etc. The potential impacts on community health and safety will be mitigated through a number of activities defined in the EMP. The contractors will implement the following measures:

(i) Temporary Traffic management: Traffic control and operation plans will be prepared together with the local traffic police prior to any construction. The plans shall include provisions for diverting or scheduling construction traffic to avoid morning and afternoon peak traffic hours, regulating traffic at road crossings with an emphasis on ensuring public safety through clear signs, controls and planning in advance.

(ii) Information disclosure: Residents and businesses will be informed in advance through various media of construction activities, and provided with the dates and duration of expected traffic disruption.

(iii) Construction sites: Clear signs will be placed at construction sites in view of the public, warning people of potential dangers such as moving vehicles, hazardous materials, excavation etc. and raising awareness of safety issues. Where required, staff will be allocated to help manage construction traffic entering/exiting works areas. Heavy machinery will not be used after day light and all such equipment will be returned to its overnight storage area/position before night. All sites will be made secure, discouraging access by members of the public through appropriate hoarding/fencing as appropriate. In particular, access to land remediation sites (component 3.1) should be strictly controlled to minimise the risks posed by steep, unstable slopes and land subsidence.

234. **Utilities provision interruption**. Construction may require relocation of municipal

utilities such as power, water, wastewater, communication cables. Temporary suspension of services (planned or accidental) can affect the economy, industries, businesses and residents' daily life. Mitigation of impacts on utilities provision will be enacted through a number of measures defined in the EMP, to be incorporated in the tender documents and construction contracts:

(i) Contractors will assess construction locations in advance for potential disruption to services and identify risks before starting construction. Any damage or hindrance/disadvantage to local businesses caused by the premature removal or insufficient replacement of public utilities is subject to full compensation, all at the full liability of the contractor who caused the problem.
(ii) If temporary disruption is unavoidable the contractor will, in collaboration with relevant local authorities such as power company, water supply company and communication company, develop a plan to minimize the disruption and communicate the dates and duration in advance to all affected people. Any potential disruptions should avoid the winter season, when they are likely to have more significant impacts.

E. Impacts and Mitigation Measures during the Operation Stage

235. Impacts and mitigation measures for the operation phase of the project are discussed in the following sections.

1. Impacts Related to the Operation of Wastewater Treatment Plants

e. HG 2.2 Luobei County High-tech Graphite Based Material and E-Mobility Industrial Park WWTP

236. **Effluent discharge.** The WWTP influent water quality has been assessed based on the current and future operations in the industrial park. **Table VI-11** shows the design inflow and discharge standards. The reduction of COD, SS, Chlorides (Cl^-), dissolved solids and salts through the operation of the Luobei WWTP and 100% reuse of treated effluent will be 197.1 t/a, 843.15 t/a, 1708.2 t/a, 4182.9 t/a and 2515.35 t/a respectively.

Table VI-11: Luobei WWTP design inflow and effluent standards

Inflow volume t/a	Pollutant*	Inflow mg/L	Inflow t/a	Effluent mg/L	GB 8978-1996, Class I (see Chapter III)	Effluent t/a	Reduction t/a
2.19×10^6	COD	100	219	10	60	21.9	197.1
	SS	400	876	15	70	32.85	843.15
	Cl^-	800	1752	20	n/a	43.8	1708.2
	Dissolved Solids	2000	4380	90	n/a	197.1	4182.9
	Salt	1200	2592	35	n/a	76.65	2515.35

*As the WWTP will treat industrial wastewater, typical pollutants found in domestic wastewater (e.g., TN, TP) are not included here.

237. **Odor.** Odor generated from wastewater treatment (including regulation tank, sludge dewatering pump house and concentrated water evaporation system) could impact areas within and adjacent to the WWTP. Odor is a composite of pollutants of which NH_3 and H_2S are the key parameters. Two national standards apply: Class II of Emission Standards for Odor Pollutants (GB14554-93) (for evaluation at the plant boundary) and PRC's Discharge Standard of Pollutants from Municipal WWTP (GB 18918-2002), which specify maximum allowable concentrations of NH_3 and H_2S at the plant boundary as 1.5 mg/m^3 and 0.06 mg/m^3 respectively. Emission rates of NH_3 and H_2S are estimated as 0.013kg/h and 0.0016 kg/h

respectively. Odor will be removed using activated carbon with a removal rate of 90% before emitting through a 15 m height funnel. The maximum ground concentrations (NH_3: 0.01402 mg/m^3; H_2S: 0.00191 mg/m^3) are predicted to occur 182 m downwind of the funnel. These are well within relevant standards.

238. **Noise.** As shown in **Table VI-12**, equipment used during operation of WWTP generates noise levels from 85-95 dB(A). To mitigate potential impacts, the WWTP will use low noise equipment, which will be well maintained. Together with attenuation from building walls, noise levels from equipment will be reduced to 60-75 dB(A), and levels at the WWTP boundary are predicted to range between 43.5-48.2 dB(A), which comply with Noise Standard at the Boundary of Industries and Enterprise (GB 13248-2008).

Table VI-12: Noise sources during Luobei WWTP operation

No.	Noise source	Noise (dB(A))level	After mitigation (dB(A))
N1	Regulation tank lift pump	80 ~ 85	60 ~ 70
N2	Sludge pump	80 ~ 85	60 ~ 70
N3	Sludge dewatering	80 ~ 85	60 ~ 70
N4	Sand filter pump, fan	85 ~ 90	65 ~ 75
N5	Ultra-filter water pump	80 ~ 85	60 ~ 70
N6	Reverse osmosis pump	80 ~ 85	60 ~ 70
N7	Reuse water pump	80 ~ 85	60 ~ 70
N8	Resin softening system pump	80 ~ 85	60 ~ 70
N9	High efficiency reverse osmosis pump	80 ~ 85	60 ~ 70
N10	Lift pump for STRO high pressure reverse osmosis system	80 ~ 85	60 ~ 70
N11	Pump for concentrated water evaporation system	90 ~ 95	70 ~ 75

239. **Solid waste.** The solid waste during operation of WWTP include domestic refuse, crystals from concentrated water evaporation, solid wastes from ultrafiltration devices and resin softening system. The estimated volume of solid waste are shown in **Table VI-13**.

Table VI-13: Solid waste produced during operation of Luobei WWTP

Solid Waste Category	Emissions (t/a)	Classification
Crystals from concentrated water evaporation system	2550 t/a	Hazardous waste (HW49)
Solids from ultrafiltration equipment, and reverse osmosis	26 t/a	General solid waste
Solids from resins system	12 t/a	Hazardous waste (HW49)
Domestic solid waste	10.5 t/a	General solid waste

240. The hazardous waste is required to be handled by licensed company. There are 33 companies with hazardous waste operating license in Heilongjiang Province. A list of registered companies is provided on the EPB Website.

241. **Groundwater Quality.** Due to the nature of their work, WWTPs may pose a risk to soil and groundwater quality through leakages, equipment failure, accidental spillage or other events. These risks are usually managed through implementation of standard plant design, management strategies and monitoring programmes.

242. Potential impacts to groundwater were assessed under normal and accidental condition (i.e., assuming 10 times leakage of normal condition) scenarios using MODFLOW model without seepage control measures. The potential impacts of COD and chloride ions (two key pollutants in the WWTP influent) were assessed. The prediction timeframes were 100 days, 1000 days and 20 years (service lifetime).

243. The modeling results indicate that without mitigation and under normal conditions, COD and chloride ion pollution would be limited to within the plant boundary under the 100 and 1000 day conditions, but after 20 years, pollutants would extend outside of the WWTP boundary and affect the Yadan River. Under accidental condition, the contaminant impact would extend outside of the WWTP plant boundary after 1000 day and 20 years conditions (**Figures VI-2 to VI-7**) without any mitigation, impacting the Yadan River.

Figure VI-2: Prediction of COD groundwater diffusion caused by sewage infiltration after 20 years under normal state for Luobei WWTP
(Note: the purple line represents the Yadan River)

Figure VI-3: Prediction of chloride ion groundwater diffusion caused by sewage infiltration

after 20 years under normal state for Luobei WWTP

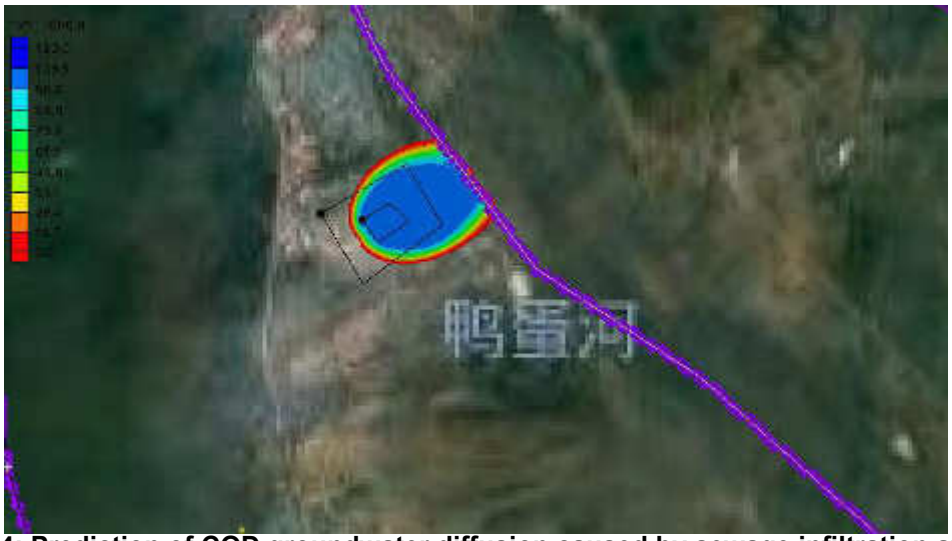


Figure VI-4: Prediction of COD groundwater diffusion caused by sewage infiltration after 1000d under accidental state for Luobei WWTP

Figure VI-5: Prediction of COD groundwater diffusion caused by sewage infiltration after 20 years under accidental state for Luobei WWTP

Figure VI-6: Prediction of chloride ion groundwater diffusion caused by sewage infiltration after 1000d under accidental state for Luobei WWTP

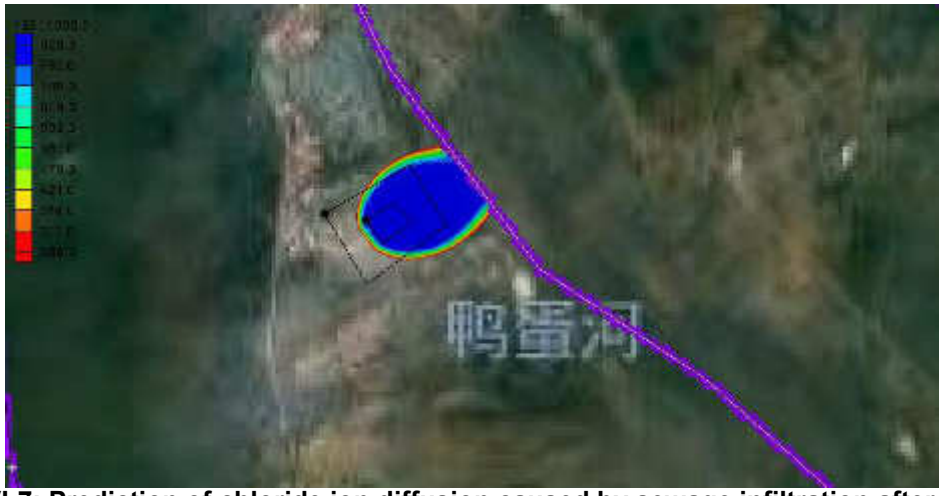


Figure VI-7: Prediction of chloride ion diffusion caused by sewage infiltration after 20 years under accidental state for Luobei WWTP

244. Measures will be implemented to minimise the risk of accidental discharge and leakage including: (i) plant seepage zoning districts and seepage control measures. Based on treatment characteristics and risk factors, the WWTP will be divided into general impermeable and key-impermeable zones. Seepage management and treatment for these zones will be conducted by adopting corresponding seepage prevention material and construction measures (i.e., use of impervious surfaces to prevent seepage in the event of equipment failure, spillage etc.); (ii) groundwater quality monitoring. The project will establish a long-term groundwater monitoring system and emergency plan, monitoring data will be collected through wells to document any pollution incidents and determine the extent and range of such incidents to plan emergency measures and remedial actions; and (iii) groundwater environment management. Regular maintenance procedures for wastewater treatment and discharge facilities across the whole plant will be established.

245. **Sludge**. Approximately 1023 t/a of dewatered sludge (75-80% water content) will be generated from the WWTP. The sludge will be managed and stored as hazardous waste during the commissioning stage. The final disposal measures will be determined according to the toxicity identification result:

- If the sludge is not classified as hazardous waste after toxicity identification, it can be transported to the domestic landfill plant for final disposal after the pre-treatment to meet the requirement of Standard for Pollution Control on the Landfill Site of Municipal Solid Waste (GB 16899-2008). Sludge management in the WWTP will comply with the Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18299-2001) and its modification in 2013.

- If the sludge is classified as hazardous waste after toxicity identification, qualified entities for hazardous waste treatment will be engaged for sludge disposal. The companies will be selected by standard local government procurement regulations. Sludge storage and transportation will meet the requirements of Standard for pollution control on hazardous waste storage (18597-2001).

246. **Risks of accidental discharge, overload and emergency preparedness**. To minimize peaks, a regulation tank will be installed to adjust influent flow and loading. There is also a non-negligible risk of accidental release of untreated wastewater at the WWTP, due to a possible malfunctioning of the electric, mechanical or control system, or the failure of the treatment process as a result of shock loads or chronic system overload. Measures to mitigate

this risk will comprise: (i) provision of an emergency holding tank of 35*4.5*45 m^3 (which can hold up to a days' worth of influent in the event of WWTP shutdown); (ii) provision of dual power supply; (iii) spare parts for key components; (iv) regular inspection and proper maintenance of the WWTP; (v) automated on-line, real-time monitoring of influent and effluent quality; and an in-house analytical lab will be established prior to operation of the WWTP. In the event of the WWTP shutting down for a period of 24 hours or more, the industrial park as a whole will be shut down to prevent production of influent wastewater until the issue is resolved.

247. **Health and safety.** WWTP O&M operators and staff are exposed to occupational risks of falls on wet floors or into treatment ponds, pits, clarifiers or vats, splashes of hazardous liquids, or cuts and contusions from equipment, etc. They are exposed to hazards related to work in confined spaces. The following measures will be implemented to safeguard the safety and health of WWTP operators: (i) compulsory use of safety shoes or boots with non-slip soles, protective equipment, and chemical resistant clothing and safety goggles to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapors; (ii) posting of safety instructions in each workshop regarding the storage, transport, handling or pouring of chemicals; (iii) check electrical equipment for safety before use; verify that all electric cables are properly insulated; take faulty or suspect electrical equipment to a qualified electricity technician for testing and repair; and (iv) adherence to safety instructions concerning entry into confined spaces. All workers will undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies. Finally, health and safety will be incorporated into the regular staff training programs.

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

f. Jixi City Wastewater Treatment and Discharge Infrastructure in the Industrial Park of Jiguan District (JX 2.2)

249. **Effluent discharge.** Discharge quality of Jiguan WWTP will meet the Class 1A standard of Discharge Standards of Pollutants for Municipal WWTP (GB18918-2002). The effluent will discharge to the Muling River, which joins the Kuangling River 500 m from the discharge point. Both of these waterbodies have Category IV water quality.

250. Wastewater to be treated at the WWTP will comprise industrial and domestic wastewater from the Jiguan industrial park. The majority of industrial wastewater is generated from bio-pharmaceutical and food production companies, with a smaller amount from machinery manufacturing enterprises. Each company serviced by the WWTP is required to construct an on-site facility to pre-treat wastewater to meet the emission standards (standards for discharge to municipal sewers (CJ343-2010), and Class III of integrated wastewater discharge standard (GB8978-1996)) before discharging to sewage pipelines that connect to the WWTP. A project assurance has been agreed with the EA to: (i) ensure that industries contain adequate on-site pre-treatment processes; and (ii) monitor and supervise the quality of wastewater discharged by industrial enterprises into the sewers to ensure compliance with

the relevant standards (CJ343-2010 and GB8978-1996) and other required wastewater discharge standards for specialized industry types.

251. The FSR and DEIA have predicted the WWTP influent quality based on the relevant standards (CJ343-2010 and GB8978-1996). Further verification of the design influent volume and quality parameters will be undertaken during the detailed design phase.

252. Water quality modeling was undertaken to predict the mixing zones of COD and NH_3-N upon discharge of treated wastewater under normal operation scenario and also a scenario of accidental untreated wastewater discharge in the dry season. Using a two dimensional steady-state model, the mixing zone was estimated at 1536.6 m downstream of the discharge point. A one dimensional steady-state mixed model (S-P) model was used for the fully mixed zone, which covered 1536.6 m to 16.1 km downstream of the discharge point. Upon discharge, the effluent will immediately go through initial dilution by the river water at the discharge point and mixed with pollutants already present in the river. **Table VI-14** to **VI-17** show the water quality modeling results.

Table VI-14: COD concentration decay (mg/L) for Jiguan WWTP (normal state)

River Length (m)	River Width (m)				
	0	10	20	30	50
500	11.3738	11.3303	11.2193	11.0883	10.95
1000	11.1813	11.1751	11.1481	11.1129	11.0729
1500	11.0957	11.1036	11.1023	11.0962	11.0876
1536.6	10.8023	-	-	-	-
1600	10.7226	-	-	-	-
2000	10.7027	-	-	-	-
5000	10.5551	-	-	-	-
10000	10.3136	-	-	-	-
16100 (Jidong Bridge)	10.0264	-	-	-	-
Class IV	30				

Table VI-15: COD concentration decay (mg/L) for Jiguan WWTP (accidental state)

River Length (m)	River Width (m)				
	0	10	20	30	50
500	16.7622	16.3282	15.218	13.9078	12.5244
1000	15.0622	15.0	14.7301	14.3779	13.9782
1500	14.4292	14.5084	14.4956	14.4347	14.3484
1536.6	10.8281	-	-	-	-
1600	10.7482	-	-	-	-
2000	10.7283	-	-	-	-
5000	10.5803	-	-	-	-

River Length (m)	River Width (m)				
	0	10	20	30	50
10000	10.3382	-	-	-	-
16100 (Jidong Bridge)	10.0503	-	-	-	-
Class IV	30				

Table VI-16: NH_3-N concentration decay (mg/L) for Jiguan WWTP (normal state)

River Length (m)	River Width (m)				
	0	10	20	30	50
500	1.303	1.2961	1.2783	1.2573	1.2352
1000	1.2734	1.2724	1.2681	1.2625	1.2561
1500	1.2609	1.2622	1.262	1.261	1.2596
1536.6	1.2104	-	-	-	-
1600	1.2014	-	-	-	-
2000	1.1992	-	-	-	-
5000	1.1827	-	-	-	-
10000	1.1556	-	-	-	-
16100 (Jidong Bridge)	1.1234	-	-	-	-
Class IV	1.5				

Table VI-17: NH_3-N concentration decay (mg/L) for Jiguan WWTP (accidental state)

River Length (m)	River Width (m)				
	0	10	20	30	50
500	1.746	1.707	1.6071	1.4892	1.3646
1000	1.5925	1.5869	1.5626	1.5309	1.4949
1536.6	1.2125	-	-	-	-
1600	1.2036	-	-	-	-
2000	1.2013	-	-	-	-
5000	1.1848	-	-	-	-
10000	1.1577	-	-	-	-
16100 (Jidong Bridge)	1.1254	-	-	-	-
Class IV	1.5				

253. The modelling results show that under normal discharge conditions, the predicted values of COD and ammonia can meet Class IV of GB 3838-2002 in both the mixing zone and

fully mixed zone. However, in the event of an accidental discharge, the predicted value of ammonia at mixing zone will exceed the Class IV standard. While there is no drinking water intake in the mixing zone, measures will be implemented to minimise the risk of accidental discharge. These measures will include: i) keeping spare parts for key equipment; ii) inspecting equipment performance in the daily operation; iii) providing and maintaining dual power supply; and iv) providing adequate technical training to workers. As part of project implementation, an emergency preparedness and response plan for the WWTP will be formulated and put in place before the plant becomes operational.

254. Monitoring at the WWTP will be undertaken prior to and during operation to ensure that Class 1A of Discharge Standards of Pollutants for Municipal WWTP (GB18918-2002) are met. Surface water quality monitoring in Muling River near to the discharge outlet of the WWTP will also be conducted, to ensure compliance with the Category IV Environmental Quality Standards for Surface Water (GB 3838-2002). These requirements are specified in the EMP.

255. **Groundwater.** Impacts to groundwater quality were predicted using a three dimensional pollutant transport model. Leakage from the biological treatment tank (A2O tank) is assessed under two scenarios: i) Normal condition. According to the Code for Water Structures Construction and Inspection (GB 50141-2008), the seepage of concrete tanks should not be greater than 2L/(m^2/d). This scenario was modelled assuming pollutant concentrations of 500 mg/L (COD) and 35 mg/L (NH3-N), with the prediction timeframe was set at 100 days, 1000 days and 5 years according to the Technical Guideline for Environmental Impact Assessment-Groundwater (HJ610-2016); and ii) Accidental condition: in a worst case scenario, it is assumed both tank structures and impermeable layer have cracks, and the seepage strength is assumed as 10 times of normal condition, i.e. 20 L/ (m2/d).The prediction timeframe is set as 100 days, 365 days and 1000 days.

256. The domestic EIA concludes that under normal conditions (where a small amount of leakage from the tanks is considered), any impacts to groundwater would be limited to the boundary of the plant (**Figure VI-8**). The concentration of COD and ammonia could satisfy with category III of groundwater quality standard at 29 m and 21 m respectively. The maximum impact distance after 5 years diffusion is 105 m and 88 m for COD and ammonia respectively.

257. Under the worse-case accidental state, the maximum impact distance is 176 m and 141 m for COD and ammonia respectively after 365 days migration (**Figure VI-9**). Although the impact increased COD would extend outside of the plant boundary, it would still be within the 100 m buffer zone established around the WWTP (**Figure VI-9**).

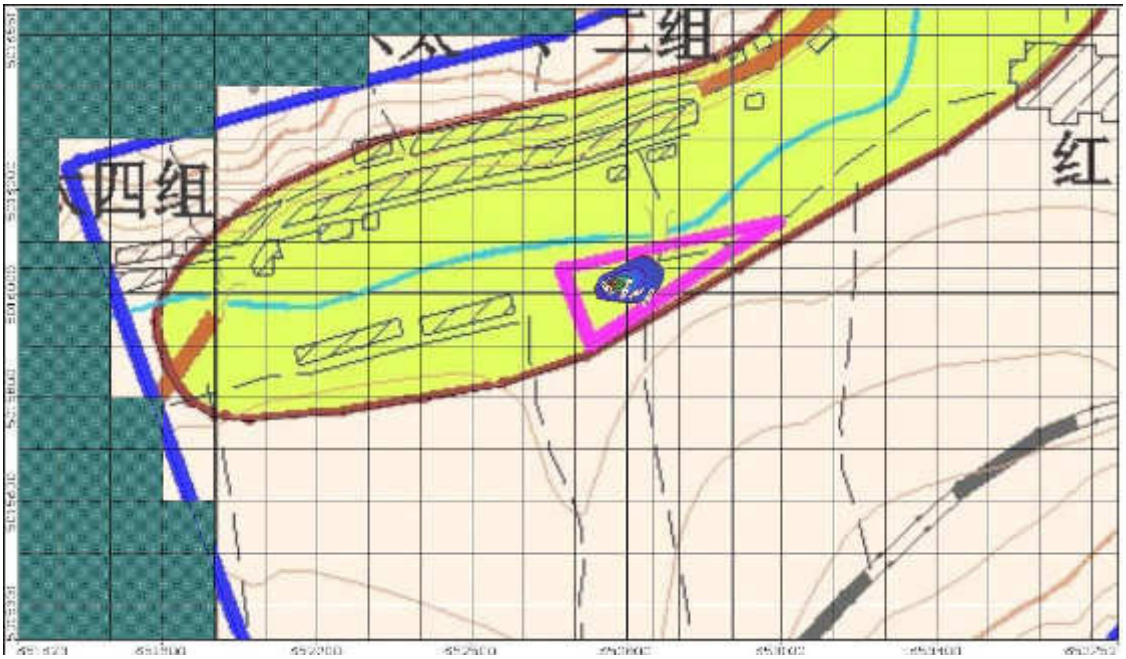


Figure VI-8: Prediction of COD groundwater diffusion caused by sewage infiltration after 5 years under normal conditions

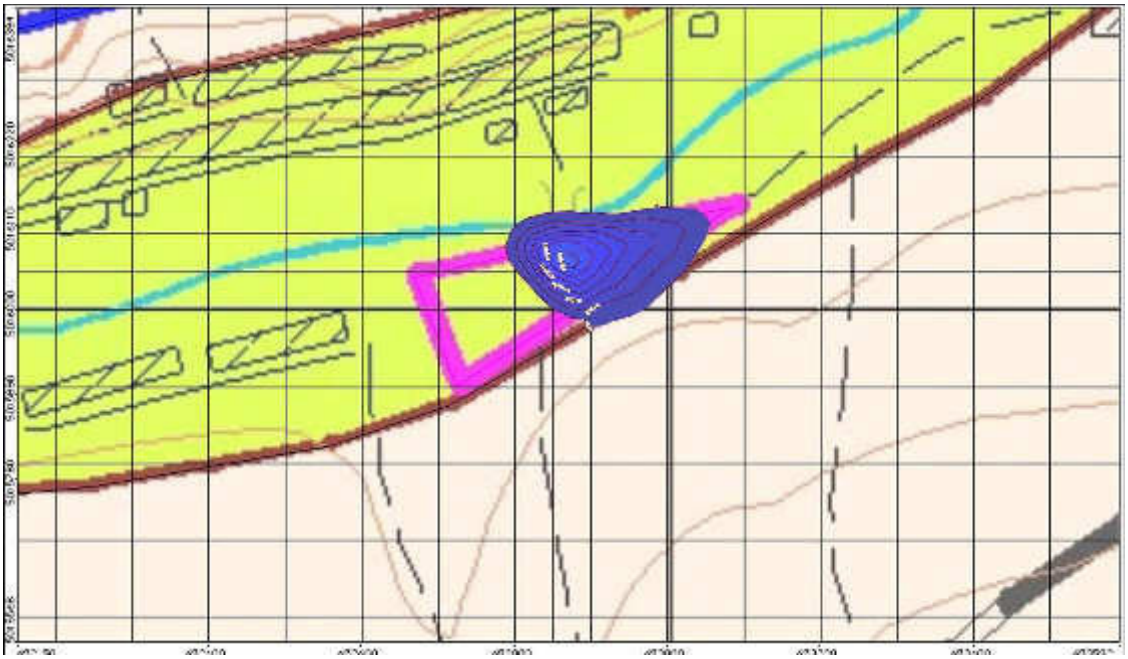


Figure VI-9: Prediction of COD groundwater diffusion caused by sewage infiltration after 365 days under accidental leakage conditions

258. To minimise potential groundwater quality impacts, areas with high risk of leakage (grid workshop, grit chamber, hydrolytic acidification tank, A2O tank, advanced treatment workshop, secondary sedimentation tank, sludge dewatering and storage workshop and underground sewage pipeline) are treated as key impermeable zone. The impervious properties shall be no greater than 1.0 × 10-7 cm / sec. HDPE film and anti-seepage concrete structure will be used. Other areas (i.e., offices area, internal roads) are considered general impermeable zone. The impermeability shall not be greater than 1.0 × 10-6 cm / sec. A clay layer with thickness of 150 mm will be used for infiltration prevention. Seepage control zones are shown in **Figure VI-10**.

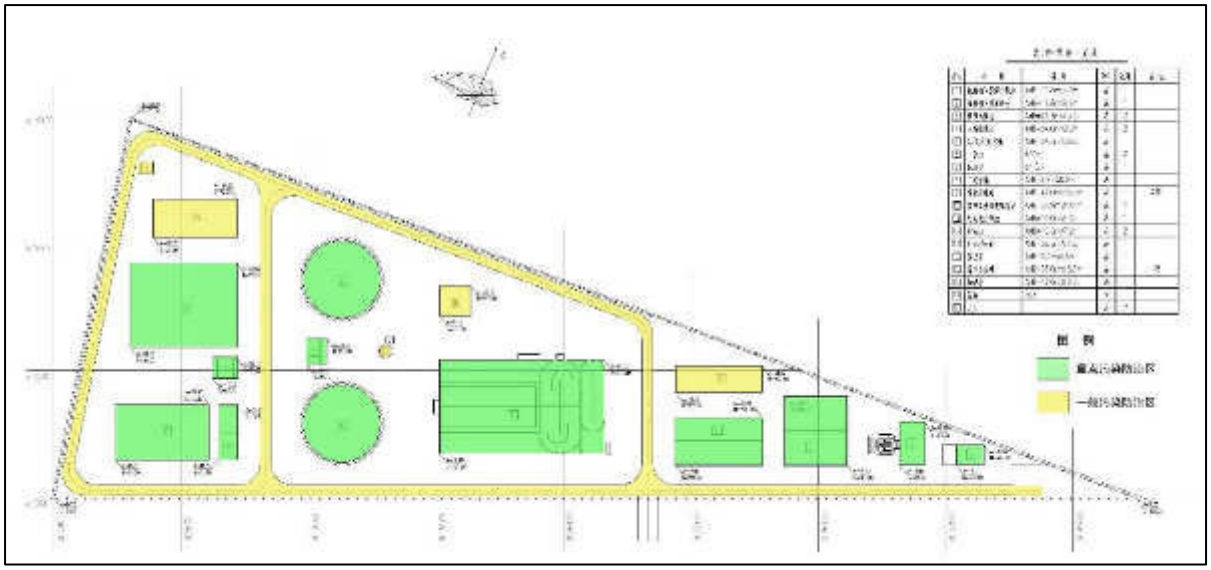


Figure VI-10: Seepage control zones of Jiguan WWTP
(Yellow: general impermeable zone; green: key impermeable zone)

259. **Odor.** Odor generated from wastewater treatment (including core screen, influent pump room, fine screen, biological treatment tank, and sludge dewatering pump house) will impact areas within and adjacent to the WWTP. Odor is a composite of pollutants of which ammonia (NH_3) and hydrogen sulfide (H_2S) are the key parameters. Two national standards apply: Class II of Emission Standards for Odor Pollutants (GB14554-93) (for evaluation at the plant boundary) and PRC's Discharge Standard of Pollutants from Municipal WWTP (GB 18918-2002).

260. According to the project design, sealed methods will be adopted for processing (including core screen, fine screen and sludge dewatering facilities). Structural sealed measures will be used for the sludge pump tank and sludge storage tank, so that odour generating pollutants can be removed via a suction fan and then treated with deodorization equipment, with removal efficiency of 90%. The treated odor will be discharged trough a 15 m high exhaust funnel. With these measures in place, boundary standards specified in GB 14554-93 for both NH_3 and H_2S can be met. Capping measures will also be used for both the regulation tank and hydrolytic acidification tank. With these measures, emissions of odorous chemicals such as NH_3 and H_2S from WWTP are regulated by PRC's Discharge Standard of Pollutants from Municipal WWTP (GB 18918-2002). The domestic EIA predicted the maximum ground concentrations of NH_3 and H_2S are 0.014629 mg/m^3 and 0.000799 mg/m^3 under normal operation condition and 0.0155031 mg/m^3 and 0.0008441 mg/m^3 under abnormal operation state respectively. Although these are well within relevant standards, a 100 m buffer zone is proposed (see **Figure VI-11**), which is a standard design feature for WWTP in the PRC. Five households located within the buffer zone will be resettled before operation.

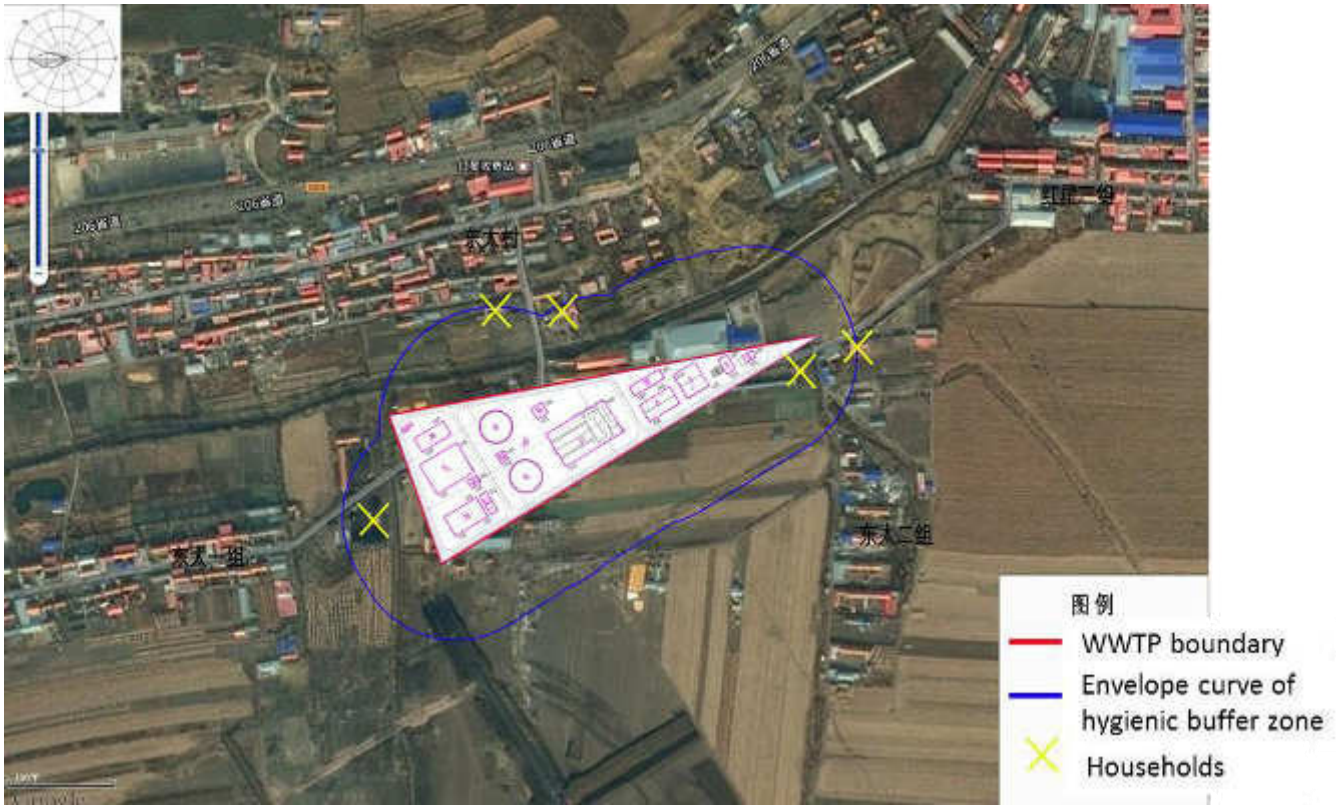


Figure VI-11: Buffer zone for Jiguan WWTP

261. **Noise.** Equipment used during operation of WWTP is predicted to generate noise levels from 75-130 dB(A) (**Table VI-18**). However, as all equipment will be installed and operated in water tanks and/or indoors, absorption, damping and installation of muffler, will reduce noise intensity to 27-55 dB(A).

Table VI-18: Noise sources during Jiguan WWTP operation

Structure	Device	Noise intensity (dB(A))	Quantity (set)	Working position	After mitigation (dB(A))
Coarse grid and lift pumping stations	Submersible sewage pump	90-110	2	Underwater	49
	Trash conveying crushing machine	75-85	1	Indoor	
Fine grid and grit	Blower	110-130	1	Indoor	51
	Trash conveying crushing machine	75-85	1	Indoor	
	Sand-water separator	75-85	1	Underwater	
	Sand machine	80-90	1	Underwater	
Regulation tank	Submersible mixer	80-90	4	Underwater	33
Hydrolytic acidification tank	Submersible mixer	80-90	4	Underwater	33

Structure	Device	Noise intensity (dB(A))	Quantity (set)	Working position	After mitigation (dB(A))
A^2O Reaction tank	Nitration of liquid Recirculation pump	90-110	4	Underwater	48
	Submersible mixer	80-90	1	Underwater	
Secondary sedimentation tank	Scraper	80-90	2	Underwater	27
Middle pool	Submersible sewage pump (lift pump)	90-110	2	Underwater	45
Advanced treatment of	Scraper	80-90	2	Underwater	30
Blower house	The three-lobe roots blower	110-130	3	Indoor	52
Sludge pump tank	Return sludge pumping	90-110	2	Under the sludge	46
	Remaining sludge pump	80-90	1	Under the sludge	
	Sewage pump	90-100	1	Under the sludge	
Sludge dewatering	Mud pump	90-100	3	Indoor	51
	Folding screw-sludge thickening machine	80-90	2	Indoor	
	Mud pump	75-85	2	Indoor	
	Plate and frame filter press	75-85	2	Indoor	
	Roots blower	85-95	1	Indoor	

262. Predicted noise levels at the WWTP boundary and adjacent areas are presented in the DEIA (**Table VI-19** and **Figures VI-12**). Noise standards (Noise Standards at the Boundary of Industries and Enterprises (GB 12348-2008) are not expected to be exceeded outside the WWTP boundary.

Table VI-19: Noise Levels Predicted During Operation of Jiguan WWTP

Location	Synthesis of sound level (forecast) Leq (dB(A))		GB 12348-2008
	Daytime	Nighttime	Daytime 60 Nighttime 50
South boundary	41.18	39.80	
West boundary	38.51	28.03	
North boundary	45.52	45.51	

(Daytime)

(Night time)

Figure VI-12: Noise Contours for Jiguan WWTP

263. **Solid Waste.** General refuse generated at the WWTP will be collected regularly for disposal at landfills. Spent disinfection Ultraviolet (UV) lamps from the WWTP contain mercury (Hg), and are therefore classified as hazardous waste. The UV lamp suppliers will take back spent lamps for recycling or proper disposal in hazardous waste treatment facilities by appropriately registered waste management company.

264. **Sludge.** Approximately 5560.6 t/a of dewatered sludge (75-80% water content) will be generated from the WWTP. The sludge will be managed and stored as hazardous waste during the commissioning stage. The final disposal measures will be determined according to the toxicity identification result:

- If the sludge is not classified as hazardous waste after toxicity identification, it can be transported to the local municipal landfill for final disposal after the pre-treatment to meet the requirement of Standard for Pollution Control on the Landfill Site of Municipal Solid Waste (GB 16899-2008). Sludge management in the WWTP will comply with the Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB 18299-2001) and its modification in 2013.

- If the sludge is classified as hazardous waste after toxicity identification, qualified entities for hazardous waste treatment will be engaged for sludge disposal. The companies will be selected by standard local government procurement regulations. Sludge storage and transportation will meet the requirement of Standard for pollution control on hazardous waste storage (18597-2001).

265. **Health and safety, emergency plan.** Measures to address these issues will be the same as for Luobei WWTP.

2. Impacts Related to River Improvement Works

266. River improvement works have the potential to impact downstream areas as

improved channel capacity can lead to increased flow rates and potential flooding. This impact is considered relatively minor for the following reasons:

- The channel improvement works would be relatively small in scale when considering the overall size of river systems involved. For example, improvement works to the Heli River will affect just 7.9 km, or 11.4%, of the total length of the river (69.3 km).
- The rivers channels to be improved by the project are much narrower than natural river sections upstream and downstream of the works areas due to adjacent urban development. Together with the accumulation of large amounts of sediments from industrial activities, these changes to the river channels have reduced flood capacity. The widening and deepening of rivers will therefore, to some extent, restore the natural hydrological conditions of the river channels.
- Areas downstream of the improvement works are typically rural in nature, and land adjacent to the rivers is not farmed to allow for natural increases in water levels due to snow melt and summer rainstorms. In this context, the small increase in levels associated with the upstream improvement works will not cause substantial impacts to farmland or properties.

3. Impacts Related to Remediated Land Operation

267. The land remediation works proposed under component 3.1 are expected to result in significant environmental improvements as compared to existing site conditions. Nevertheless, there are several potential impacts associated with the operation remediated land that need to be addressed:

- **Soil contamination.** As of April 2017, soil samples have only been conducted at one land remediation site (Lingbei mine, HG 3.1), which revealed elevated levels of Cd. Heavy metal concentrations at other land remediation sites could also potentially be high. This could pose potential health and safety issues at sites that are expected to be developed for residential/urban development (e.g., Lingbei mine, HG 3.1) or developed for agricultural use (e.g., Lingdong waste rock site, SY 3.1). Contaminants in these areas could enter the body through inhalation of contaminated dust, or through consumption of agricultural products that have directly or indirectly accumulated contaminants.
- **Groundwater/surface water contamination.** Leachate from the remediated land has the potential to accumulate contaminants as it percolates through fill material, leading to pollution of groundwater and surface waters adjacent to the site.
- **Air quality.** When waste-rock from coal-mining is used as a fill material, there is a risk it can combust, generating toxic sulfur-containing gases that will pollute the atmosphere around the mine as it escapes from fissures in the rocks. There are historic/current issues with underground fires at Lingbei Mine, (HG 3.1) and Henghan Mine (JX 3.1)
- **Subsidence.** Poorly compacted fill can lead to differential settlement, which can impact potential end uses, particularly at those sites where the ultimate landuse could involve built structures (Lingbei Mine, HG 3.1; Taoshan District village area, QH 3.1 and Lingdong waste rock site, SY 3.1).

268. All of these potential impacts can be adequately mitigated through proper design and construction of the remediation projects. Key design features that will provide mitigate are summarized below:

- All remediated sites would be lined with compacted clay and/or geomembrane. This would prevent leachate entering groundwater or surface waters. To further reduce permeability, fill would be layered with bands of clay.
- Fill compaction would be undertaken to reduce void ratios in the fill, which minimizes subsidence, and reduces the risk of underground fires. It is typically achieved through regulating the size of waste fragments used for fill, and applying fill to the site in layers,

with fill placement by scrapers or trucks and the use of roller based compacting plant.

- Fill would be capped with a 300 mm thick sealing layer formed from clay material compacted to greater than 80 % standard proctor density. The sealing layer will be covered with top soil, with a total thickness of 400 mm, to protect the sealing layer and offer sufficient water holding capacity to support the vegetation and reduce direct infiltration.

269. At this stage of the project, there is insufficient data to provide quantitative assessment of potential impacts during operation of remediated land, or to provide more specific design requirements to mitigate identified impacts. This will be dependent on environmental and geotechnical data collected during the detailed design stage (which itself forms part of the ADB project). Nevertheless, the overall design approach presented in this report was developed in consultation with an external international mine remediation expert engaged by ADB for this project. The design approach is consistent with international best practices, and the consideration of safeguard impacts during the design development were approved by the expert.

270. A project assurance has been developed and agreed with the EA that subsequent design of land remediation works should be submitted to ADB for review and approval prior to commencement of the works. The design information should include (but not be limited to): (i) details of planned environmental and geotechnical monitoring to be undertaken prior to the detailed design of remediation works; (ii) Detailed design of remediation works (taking into consideration the findings of baseline monitoring; (iii) Details of planned long-term environmental and subsidence monitoring; and (iv) Details environmental management plan including emergency plan. Design works should make reference to international best practice guidelines including the WBG EHS Guidelines for Mining and EHS Guidelines for Contaminated Land.

4. Impacts related to the Operation of the River Rehabilitation and Flood Protection Works

271. The river rehabilitation and flood protection works will result in multiple environmental benefits, including improved flood protection, ecological enhancement and added landscape value. The operation of the river components is not expected to generate major negative environmental impacts. The mitigation measures for environmental impact during operation include properly maintaining all river embankment vegetation, emergent aquatic plants and other vegetation, and inspecting all river embankment for stability issues. If signs of failure are discovered, a repair program will be implemented. The rivers will also require periodic maintenance to remove garbage or excessive plant growth. These operations would be conducted by the relevant municipal engineering management departments in Hegang and Jixi.

5. Impacts related to District Heating System Operation

272. District heating systems are a sustainable, energy efficient solution that have insignificant negative environmental impacts during the operation. The only potential impact of note will be in the event of pipe leaks, where hot water circulating in the district heating network may cause damage to roots of plants and road surfaces and, in the winter season, it may produce ice on the road surfaces and steam that obstructs visibility. Chemicals used in the district heating water do not cause any harm to people or the environment due to the small concentrations used. Furthermore, the risk of leaks will be reduced compared to the current situation, as the project will improve the condition of existing heating systems. Risks will be further minimized with proper maintenance and management of the new systems.

6. Impacts Related to WTP Operation

273. **Air quality.** The main air quality impact during operation is odor from the WTP, with potential odor sources including sludge dewatering pump houses and sludge storage tanks. Standard measures to manage these facilities (e.g., provide adequate ventilation in the sludge dewatering and storage areas of WTPs, daily dispose of sludge) will be sufficient to control any odour issue. Odor dispersion estimations indicate that the concentrations of odor emitted during operation of the WTPs would meet PRC GB 14554-93 Emission Standards for Odor Pollutants, Class 2 standards (Odor concentration <20) for new construction/reconstruction/ expansion facilities.

274. **Noise.** Noise will be generated by mechanical operations in the WTPs such as water pumps and blowers, with levels predicted to range from 80-105 dB(A) To mitigate potential impacts, the WTP will use low noise equipment, which will be well maintained. Together with attenuation from building walls, noise levels at the WTP boundary would meet Grade II noise requirements of 60 dB(A) during day time and 50 dB(A) at night under PRC's Noise Standards at the Boundary of Industries and Enterprises (GB 12348-2008).

275. **Water quality.** Water quality impacts during operation will be mainly from wastewater generated by workers at the WTPs, estimated to be 1401.6m^3/a and 6832.8m^3/a at Jixi WTP and the Qitaihe WTPs respectively. Estimated pollutant levels will be 300 mg/L COD, 200 mg/L BOD_5,149 mg/L SS, and 25 mg/L NH_3-N. Both of the Qitaihe WTPs are connected to the district sewage system, therefore disposal of domestic wastewater is not an issue. As of April 2017, the Jixi WTP is still not connected to the sewerage system. Wastewater from the Jixi WTP will therefore be treated with a septic tank system to meet Class III standard of Integrated Wastewater Discharge Standard (GB8978-1996). After discharge to a specified collection well in the plant, the treated wastewater will be transferred to local domestic WWTP by tank truck.

276. **Solid waste.** Solid waste generated during operation will comprise domestic solid waste from the workers and the sludge from water treatment facilities. The amount of domestic waste generated is estimated at 4.02 t/a and 8.54 t/a at the Jixi WTP and Qitaihe WTPs respectively. The dewatered sludge generated at the Jixi WTP and the dried sludge from the Qitaihe WTPs would be approximately 160 t/a and 10.58 t/a respectively. All solid waste will be transported to and disposed of at Municipal Solid Waste (MSW) Sanitary Landfill Plant (Jixi) and Qitaihe City MSW Sanitary Landfill (Qitaihe).

277. **SCADA operation and NRW reduction**. A SCADA system was proposed in the project for Qitaihe WTPs. The SCADA system consists of a master terminal unit that communicates with and controls a number of remote terminal units at key control points including water intake points at Taoshan Reservoir, water supply pumping and metering. The main functions of the SCADA is to adjust water supply network pressure based on the water consumption for both energy saving and non-revenue water reduction. The project also include procurement of water leakage detectors and repiring tools for daily leak detection. A pilot district metering area (DMA) will conduct in Qitaihe.

278. **Health and safety.** WTP O&M operators and staff are exposed to similar occupational risks as those working in WTTP. Measures implemented to manage health and safety at WWTP are also applicable for WTP.

279. **Emergency plan**. As part of project implementation, an emergency preparedness and response plan at each WTP will be formulated and put in place before the WTP becomes operational. The emergency preparedness and response plans will address, among other things, training, resources, responsibilities, communication, procedures, and other aspects required to respond effectively to emergencies associated with the risk of accidental discharges. Appropriate information about emergency preparedness and response activities, resources, and responsibilities will be disclosed to affected communities.

7. Impacts related to Roads, Tunnel and Flyover Operation

280. Main environmental issues during operation of the proposed roads, tunnel and flyover in the project cities are related to direct vehicle emissions, traffic noise, pollution from storm-water runoff, traffic safety and the risk of hazardous spills. These impacts are discussed below.

281. **Water pollution.** Stormwater that flows over the ground can entrain debris, rubbish, petroleum, chemicals, sediments and othter pollutants. The following measures will be implemented to minimize water pollution from road surface drainage: (i) regular collection and appropriate disposal of litter and debris from sidewalks, driveways, and parking lots; and (ii) cleaning the roadside drainage systems before the wet season to minimize surface water pollution by stormwater runoff flushing debris and silt.

282. **Accidental spills.** Roads constructed to service industrial parks will potentially be used to transport hazardous goods which can pose a risk to the environment and public health. The applicable PRC standards and regulations related to hazardous goods transportation on roads include the Standard for Hazardous Substances and Major Hazard Installations Discrimination (GBl8218-2000), Classification of Health Hazard Levels from Occupational Exposure to Toxic Substances (GB50844-85), and Rules of Transportation of Dangerous Goods by Automobile (JT3130-88). The standards and regulations provide a framework for hazardous goods transport, including specifications for vehicles and equipment, packaging and logos, consignment and documentation, consignment acceptance and hand-over, transport, loading and unloading, storage and fire control, labor protection and medical emergency treatment, as well as supervision and management. The national standards will be strictly complied with during operation of the roads.

283. **Road Safety.** The concerns over the community safety of the proposed roads have been thoroughly examined during the PPTA. An intelligent transportation system (ITS) will be introduced to reduce traffic accidents. Design of road elements will ensure provide good access, mobility, appeal and safety to a hierarchy of road users, with pedestrians given the highest priority and motor vehicles lower priority in the main urban areas and especially in residential, educational, and commercial areas. In industrial areas or on major arterial roads, vehicle throughput may be prioritized, though pedestrian safety and bike network connectivity should not be sacrificed even where major roadways are concerned. A road and traffic safety specialist (16 man-months) will be procured under the projec's capacity building component (package CS1). Traffic audit and straffic safety awareness campaigns will be conducted.

284. **Air quality.** Road improvements will result in increased traffic and related emissions that can impact air quality, primarily due to the release of major pollutants (NO_2, CO, and $PM_{2.5}$) from vehicle exhausts. Emission concentrations of the indicator pollutants NO_2 and CO were calculated with the AERMOD2.2 software developed by American Meteorological Society/United States Environmental Protection Agency Regulatory Model Improvement Committee. The main prediction parameters include traffic volume predictions from the FSRs, road parameters, terrain, and local climate data. The results of modeling were compared with PRC Standards (GB 3095-2012). Class 2 PRC Standards for NO_2 are the same as WBG AQG. For CO, there is no WBG AQG standard.

285. The vehicle emission control measures for the proposed roads under the Component 2 and 4 are considered in the context of provincial and national policies and measures for vehicle emission control. Heilongjiang province government issued the Implementation Program on Pollution Control for Vehicle Exhaust in 2012. In 2016, PRC promulgated the "Limits and Measurement Methods for Emission of Pollutants from Light-duty Vehicles (Phase VI (GB 18352.6-2016). The local EPBs and Traffic Management Bureau are in charge of implementing all the policies and measures for vehicle emission control formulated by the

state and provincial authorities, and take the corresponding inspections and measures to control the exhaust pollutants emission of vehicles running on the proposed roads.

286. **Noise.** Noise levels were predicted using Breeze Noise software in accordance with modelling recommendations from the Technical Guideline for EIA - Acoustic Environment (HJ 2.4-2009). The horizontal noise generation of vehicles at speed is referring to Assessment Criterion on Environmental Impact in Road Construction Project (JTG B03-2006). The noise impact assessment criteria are:

(i) For areas outside of 35 m from the edge of road right-of-way, Class 2 standard is applicable (60 dB at daytime and 50 dB at nighttime). Reference was also made to the equivalent WBG EHS standard (55 dB at daytime and 45 dB at nighttime).
(ii) For areas within 35 m from the edge of road right-of-way, the Class 4a of Acoustic Environmental Quality Standard (70 dB at daytime and 55 dB at nighttime) is applicable. There is no equivalent WBG EHS Standard;
(iii) For areas within 35 m from the edge of railway right-of-way, the Class 4b of Acoustic Environmental Quality Standard (70 dB at daytime and 60 dB at nighttime) is applicable. There is no equivalent WBG EHS Standard;

287. Air quality and noise level modelling results for roads associated with industrial park development (i.e., those included under component 2.1) were all found to meet relevant standards (Ambient Air Quality Standard (GB 3095-2012), and Environmental Quality Standard for Noise (GB 3096-2008)) without the need for specific mitigation measures. Modeling results for larger urban roads included in the project (i.e., those included under component 4.3) are discussed in more detail below.

a. Hegang

288. **HG 4.3 Bus lanes: air quality.** NO_2 and CO concentrations at the existing representative sensitive receptor of Hegang No. 6 Middle School along Meijian Road was simulated and predicted according to the traffic volume. **Table VI-20** shows the simulation results for NO_2 and CO concentrations, which would comply with the Class 2 of Ambient Air Quality Standard (GB3095-2012).

Table VI-20: Predicted NO2 and CO concentrations at Existing Sensitive Receptors (mg/m^3)

Sensitive Receptor	Item	Year	Predicted Value	Class II Standard
Hegang No.6 Middle School	NO_2	2020	0.0468	0.2
		2026	0.0276	0.2
		2034	0.0564	0.2
	CO	2020	0.0612	10.0
		2026	0.132	10.0
		2034	0.264	10.0

289. **HG 4.3 Bus lanes: noise.** The predicted noise attenuation of Meijian Road at different distances from the road central line is show as below in **Table VI-21**.

Table VI-21: Predicted Traffic Noise Levels of Meijian Road (dB)

Year	Time	Predicted Traffic Noise Levels at different distances from the road central line								
		20m	30m	50m	60m	80m	110m	150m	180m	200m
2020	Day	51.65	49.1	47.9	47.35	46.41	45.28	44.11	43.4	42.99
	Night	48.56	46.53	45.33	44.78	43.84	42.71	41.54	40.83	40.42
2026	Day	53.75	51.2	50	49.45	48.51	47.38	46.21	45.5	45.09
	Night	50.98	48.63	47.43	46.88	45.94	44.81	43.64	42.93	42.52
2034	Day	55.37	53.82	52.62	52.07	51.13	50	48.83	48.12	47.71

Year	Time	Predicted Traffic Noise Levels at different distances from the road central line								
		20m	30m	50m	60m	80m	110m	150m	180m	200m
	Night	52.85	49.3	48.1	47.55	46.61	45.48	44.31	43.6	43.19

290. Predicted results show that acoustic environment quality in year 2020, 2026, and 2034 in the Category 2 and 4a noise environment functional areas along Meijian road can meet the standard of Environmental Quality Standard for Noise (GB3096-2008).

b. Jixi

291. **JX 4.3 Jiaotong Street: air quality. Table VI-22** presents the predicted maximum pollutant concentrations of six representative sensitive receptors adjacent to the Jiaotong street boundary. The results indicate that the maximum CO and NO_2 ground-level concentration values will comply with the Class 2 standards (GB 3095-2012) during future operation.

Table VI-22: Maximum pollutant concentration projections for Jiatong Street (dB)

Yr	Pollutant mg/m³	One-story house		Hengshan district government community		Hengshan District Government		Hengshan District Public Prosecutor's Office		Hengshan Community		Qijie Community	
		1-hr	24-hr	1-hr	24-hr	1-hr	24-hr	1-hr	24-hr	1-hr	24-hr	1-hr	24-hr
2022	NO_2	0.062	0.055	0.062	0.055	0.062	0.055	0.062	0.055	0.062	0.055	0.062	0.055
	CO	1.5	1.4	1.5	1.4	1.5	1.4	1.5	1.4	1.5	1.4	1.5	1.4
2027	NO_2	0.14681	0.05948	0.1071	0.0615	0.08816	0.06131	0.08663	0.06124	0.07665	0.05644	0.09729	0.06198
	CO	2.88915	1.47336	2.14734	1.49333	1.87546	1.4905	1.85355	1.48959	1.71026	1.42069	2.00649	1.50025
2037	NO_2	0.15023	0.05994	0.12302	0.0638	0.09739	0.06353	0.09533	0.06345	0.08182	0.05695	0.10974	0.06445
	CO	3.857	1.49125	2.59835	1.51608	2.13704	1.51257	2.09988	1.51144	1.85675	1.42574	2.35937	1.52469

292. **JX 4.3 Jiaotong Street: noise. Table VI-23** presents the predicted noise levels at residential buildings along the alignment of Jiatong Street. The predictions indicate that the noise level will satisfy with the Class 2 standards in short, medium and long term.

Table VI-23: Predicted noise levels at sensitive receptors close to Jiaotong Street (dB)

Sensitive receptor	Applicable standard	Distance to the central line	Predicted value (dB)	Short term (2022)		Medium term (2027)		Long term (2037)	
				Day	Night	Day	Night	Day	Night
One-story house	Class 4a	25 m	Baseline	47.60	43.30	47.60	43.30	47.60	43.30
			Contribution	40.84	33.59	41.67	35.62	42.57	36.07
			Predicted	48.43	43.74	48.59	43.98	48.79	44.05
			Exceedance	——	——	——	——	——	——
			Incremental	0.83	0.44	0.99	0.68	1.19	0.75
Hengshan district government community	Class 4a	20 m	Baseline	49.50	44.40	49.50	44.40	49.50	44.40
			Contribution	48.68	41.43	49.51	43.46	50.41	43.91
			Predicted	52.12	46.17	52.51	46.97	52.99	47.17
			Exceedance	——	——	——	——	——	——
			Incremental	2.62	1.77	3.01	2.57	3.49	2.77
Hengshan district	Class 4a	18 m	Baseline	49.50	44.40	49.50	44.40	49.50	44.40
			Contribution	47.75	40.50	48.58	42.53	19.48	42.98

Sensitive receptor	Applicable standard	Distance to the central line	Predicted value (dB)	Short term (2022)		Medium term (2027)		Long term (2037)	
				Day	Night	Day	Night	Day	Night
government			Predicted	51.72	45.89	52.07	46.58	52.50	46.76
			Exceedance	——	——	——	——	——	——
			Incremental	2.22	1.49	2.57	2.18	3.00	2.36
Hengshan District Public Prosecutor's Office	Class 4a	18 m	Baseline	49.50	44.40	49.50	44.40	49.50	44.40
			Contribution	47.23	39.98	48.06	42.01	48.96	42.46
			Predicted	51.52	45.74	51.85	46.38	52.25	46.55
			Exceedance	——	——	——	——	——	——
			Incremental	2.02	1.34	2.35	1.98	2.75	1.15
Hengan Community	Class 2	128 m	Baseline	58.20	49.30	58.20	49.30	58.20	49.30
			Contribution	33.49	26.24	34.32	28.27	35.22	28.72
			Predicted	58.21	49.32	58.22	49.33	58.22	49.34
			Exceedance	——	——	——	——	——	——
			Incremental	0.01	0.02	0.02	0.03	0.02	0.04