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**World Bank Loan Funded Yan'an Water Supply Project
In Shaanxi, China**

ENVIRONMENTAL ASSESSMENT

Executive Summary

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Entrusted by:
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ABBREVIATIONS

API	American Petroleum Institute
DI	Design Institute
DSP	Dam Safety Panel
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPB	Environmental Protection Bureau
EPP	Emergency Preparedness Plan
FS	Feasibility Study
MEP	Ministry of Environmental Protection
OMS	Operation, Maintenance and Surveillance
OP/BP	Operational Policy/Bank Procedure
PA	Project Area
PD	Preliminary Design
PMO	Project Management Office
PRC	The People's Republic of China
SHIDRI	Shaanxi Hydropower Investigation, Design & Research Institute
WB	World Bank
YMG	Yan'an Municipal Government
YRCC	Yellow River Conservancy Commission
YWAB	Yan'an Water Affair Bureau
YWIC	Yan'an Water Investment Company
YWSP	Yan'an Water Supply Project

CURRENCIES & OTHER UNITS

Mu	Area Unit (1 mu=0.0667 hectare)
RMB	Chinese Yuan (Renminbi)
USD	United States Dollar

Exchange rate 1 US\$=6.30 RMB

CHEMICAL ABBREVIATIONS

BOD ₅	Biochemical Oxygen Demand (5 days)
COD	Chemical Oxygen Demand
NH ₃ -N	Ammonia Nitrogen
TSP	Total Suspended Particulates

1. Project Background

This document summarizes the environmental impact assessment of the World Bank financed Yan'an Water Supply Project (YWSP), highlighting the main issues and conclusions of the environmental impact assessment (EIA) and environment management plan (EMP) for YWSP. According to both the Chinese Environmental Assessment laws and the World Bank's Operational Policy 4.01 Environmental Assessment, the proposed project is classified as Category A for environmental assessment purposes, given the diversion and transfer of water from the Yellow river, and the large footprint of the project. Therefore, a full environmental assessment report was required. The project is estimated to cost about 1.27 billion RMB (both BF and NBF portion), of which the World Bank is to finance US\$ 60 million; the rest will be financed by the Borrower's counterpart funds.

In accordance with Chinese internal review and approval procedures, an EIA report together with an EMP was prepared for YWSP by the Shaanxi Hydropower Investigation, Design & Research Institute (SHIDRI). The Chinese EIA report for YWSP has been reviewed and approved by the Shaanxi Provincial Environmental Protection Department (SEPD) in 2009. This Executive Summary is based on a modified EIA and EMP which was prepared by SHIDRI in accordance with the World Bank environment policy, as well as feasibility studies carried out for the project.

The EA reports and EMP were submitted to the World Bank for review and they fully conform to the Bank policy guidelines regarding environmental and social issues. All reports mentioned above will be made available in China and in the Public Information Center (Infoshop) of the World Bank.

2. Project Development Objectives

The development objective of the proposed project is to enhance the water security in Yan'an City by increasing the water supply.

The economy and population of the Yan'an city have grown rapidly during the past decade. Water has become the number one bottleneck for the continued socio-economic development of the municipality. The existing water sources are no longer able to provide reliable water in sufficient quantity to the urban and rural residents even for drinking purposes. Also, some key industrial enterprises such as Yanchang Oil Company are confronted with the need of reduce and possibly shutting down production because of water shortage if immediate actions are not taken to bring additional water to the area. The water shortage in Yan'an will get only worse according to conducted water resources assessment studies.

The proposed project is intended to help address this challenge and enhance the water supply security in the Baota District, where urban area of Yan'an City is located, to benefit 154,000 households in this area who will receive water from the existing and the proposed water supply. Yan'an will use the Yellow River as the water source since the smaller rivers in the area have either

insufficient flow or inadequate water quality to supply the core city and the urban areas in the surrounding counties.

3. Environmental Assessment Process and Legal Framework

A full Environmental Assessment (EA) was carried out in accordance with Chinese EIA Law and relevant regulations and World Bank environmental safeguard policies. The project triggered the following World Bank Policies: Environmental Assessment (OP/BP 4.01), Natural Habitats (OP/BP4.04), Involuntary Resettlement (OP/BP 4.12); and Safety of Dams (OP/BP 4.37). Compliance with these policies, and the World Bank’s disclosure of information policy, is summarized in Table 1. The project is also in full compliance with environmental policies and regulations in China, as summarized in Table 2.

Table 1 Compliance with World Bank Safeguard Policies

Safeguard Policies	Actions
Environmental Assessment (OP/BP 4.01)	Category A project. Full EIA and EMP have been prepared.
Natural Habitats (OP/BP 4.04)	To protect aquatic habitats, a protective net (1×1cm) will be installed at the intake to prevent the loss of fish. In addition, raw water diversion from the Yellow River will be stopped and opt to use the regulating reservoirs if the flow at Wanjiagu section of the Yellow River is lower than 100 m ³ /s (ecological base flow).
Involuntary Resettlement (OP/BP 4.12)	Resettlement Action Plan (RAP) has been prepared.
Safety of Dams (OP/BP 4.37)	A panel of dam safety experts ((DSP) was established by Yan’an PMO with terms and conditions satisfactory to the Bank, A dam safety review report was prepared by the DSP. An updated report on the results of dam safety review for Wangyao and Hongzhuang dams, and on the feasibility study review (including dam safety plans) for Kangjiagou and Baishuwua dams, incorporating Bank’s comments, was submitted on Nov 24, 2011, and the proposed recommendations were reviewed and accepted by the Bank’s team during the appraisal.

Table 2 Compliance with Chinese Laws and Regulations

Chinese Laws and Regulations	Project Compliance
Environmental Protection Law	The EIA is prepared according to relevant laws/regulations and technical guidelines; Mitigation measures are developed in the EMP and incorporated into project design, to be implemented and supervised during construction. A final acceptance inspection will be carried out before commissioning.
Environmental Impact Assessment Law	A full EIA report together with an EMP has been prepared for YWSP by the Shaanxi Hydropower Investigation, Design & Research Institute (SHIDRI). The Chinese EIA report for YWSP has been reviewed and approved by the Shaanxi Provincial Environmental Protection Department (SEPD) in 2009.
Notice on Strengthening EIA Management for Construction Projects Funded by Loans from International Financial Institutions	EIA and EMP are prepared in compliance with World Bank OP4.01.
Solid Waste Pollution Prevention and Control Law	Solid waste generated from construction campus and construction sites must be collected and disposed in the designated spoil disposal sites as planned in the EMP. The sludge from water treatment plant

	(WTP) during operation phase will be treated before disposal.
Water Pollution Prevention and Control Law	Mitigation measures are built into the EMP based on the <i>Water Resources Assessment Report</i> developed for this project.
Water and Soil Conservation Law	Based on a special study, water and soil conservation plan and mitigation measures were developed and incorporated into the EMP. The plan will be specified in bid documents for contractors to allow for implementation.
Cultural Property Law	Consultations with local cultural property authorities in the project counties and cities were held. Chance finding procedures will be followed.
Interim Method for Public Participation in EIA	Public consultation was conducted following the tentative method during the preparation of the EIA.

4. Project Description

The proposed project is designed to abstract 12.75 million cubic meters (MCM) water annually from the Yellow River at Wangjiaqu in Yanchuan County and transfer then to Yan'an city. However, its projected extraction volume is 27.47 MCM by 2030. The total length of the conveyance works from Wangjiaqu intake in Yanchuan County to the inlet of the Dongchuan water treatment plant (WTP) in Yan'an is 83 km, including six online booster pump stations. To address special circumstances such as excessive sand content (greater than 60 kg/m³) in the Yellow River water under certain river flow conditions and/or very low flow rate (less than 100 m³/s) in which drawing water from the Yellow River is no longer appropriate, it is proposed to construct a reservoir in Baishugua for storage and regulating flows. Also, a reservoir will be built in Kanjiagou for maintenance backup. Meanwhile, at the end of transfer line, one full water treatment plants will be constructed in Dongchuan. A brief description of the components is as Table 3.

As illustrated in Figure 1, the proposed project is financed by both the World Bank and Yan'an Municipal Government (YMG), however, this EA covers the entire system. Figure 2 illustrates the location of YWSP.

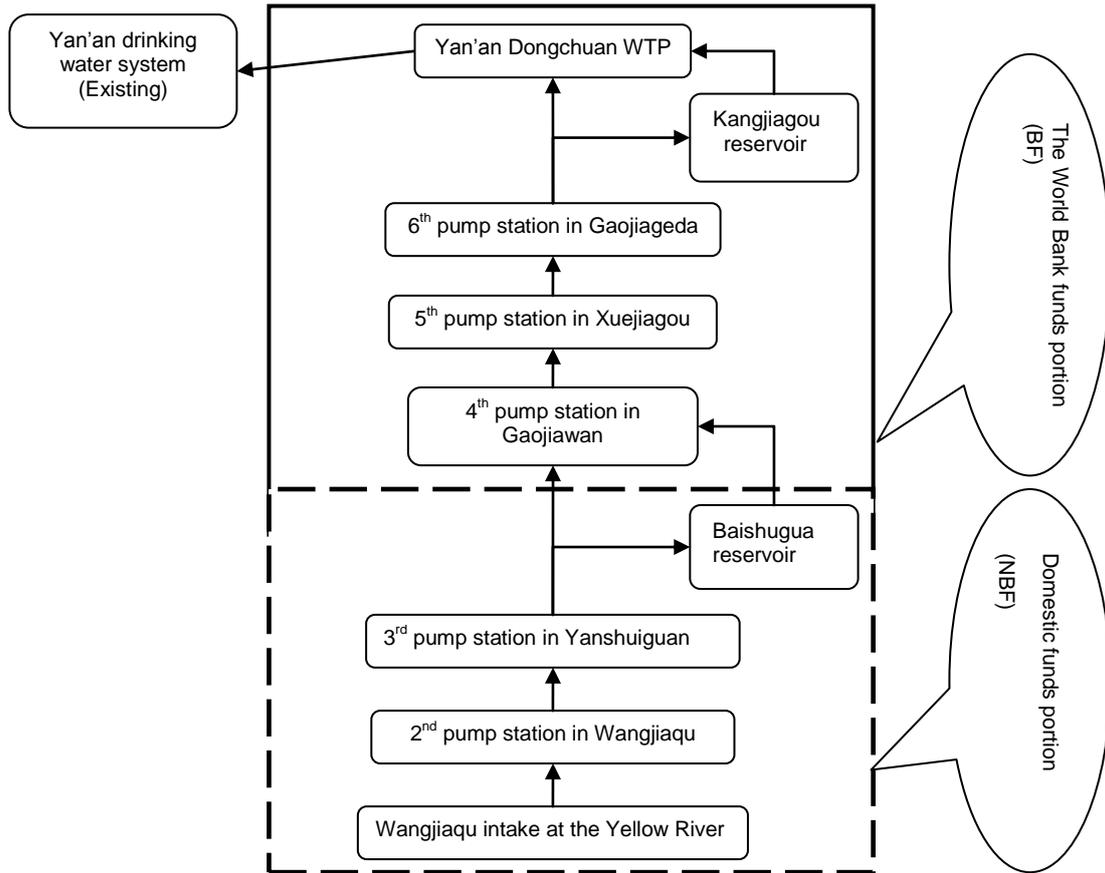


Figure 1 The sketch map of the proposed YWSP

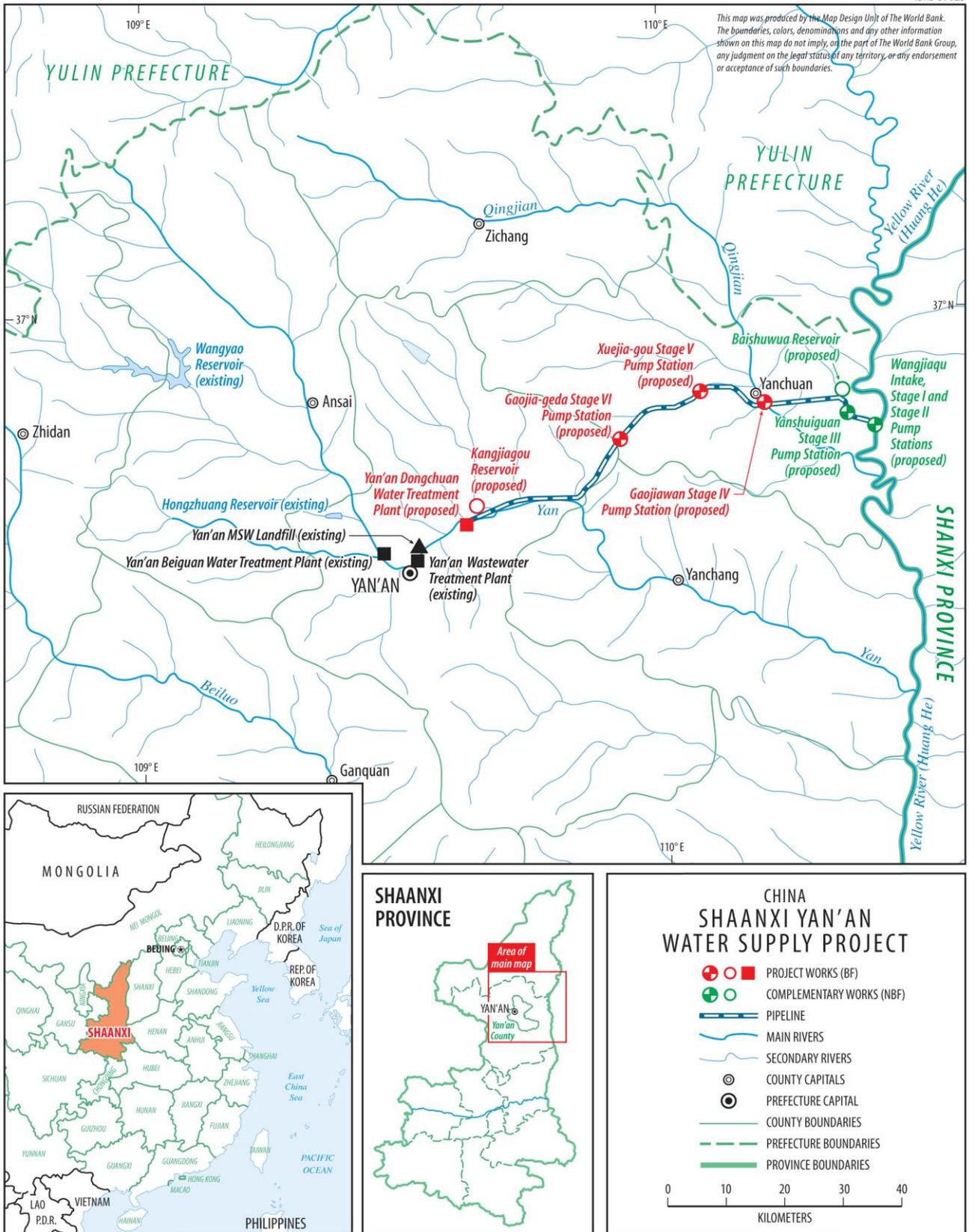


Figure 2 Geographic location and layout of the proposed project

Table 3 Project Components

Item	YWSP Project Components		
	Project works to be financed by the World Bank under YWSP	Complementary works to be financed by Government investments under YWSP	
Principal part	<ul style="list-style-type: none"> (a) water conveyance works from Gaojiawan pump station in Yanchuan County to Dongchuan WTP, 63.78 km, including tunnel of 2.953 km (b) Three online pumping stations located at Gaojiawan, Xuejiagou and Gaojiageda; (c) a water treatment plant at Dongchuan (d) a regulating reservoir in Kangjiagou 	<ul style="list-style-type: none"> (a) intake facilities from the Yellow River at Wangjiaqu; (b) water conveyance works from the intake at Wangjiaqu to Gaojiawan pump station, 19.20 km, including Yangjiashan tunnel (11.342km) (c) three online booster pump stations; (d) a regulating reservoir in Baishugua 	
Capacity building and project management	<ul style="list-style-type: none"> (a) Consultancy services to assist with detailed designs, construction supervision, environmental assessment and EMP supervision, and resettlement action planning and RAP implementation supervision.; (b) training and study tour for project management staff (c) Project management strengthening including monitoring and evaluation, procurement; (d) Office equipment and vehicles 		
Auxiliary Works	Diversion works	Out of 56 inverted siphons for river crossings, only two inverted siphons on Yanhe River needs water diversion, for which a stone and earth cofferdam will be used.	Out of 4 inverted siphons for river crossings, only one inverted siphon on Zhaojiahe River needs water diversion, for which a stone and earth cofferdam will be used.
	Flood prevention	220 m flood wall and 500 m flood wall will be constructed in Xuejiagou 5th pump station and in Dongchuan WTP, respectively.	80 m flood wall will be constructed in Wangjiaqu.
	Number of construction areas	5 construction areas consisting of 18 construction sites.	3 construction areas consisted of 8 construction sites.
	Road and construction access	Construct permanent roads 9 km (5m in width); upgrade roads 17.38 km; construct temporary construction access 18.5 km (5m in width) and share the existing roads 70.6 km	Construct permanent roads 6.2 km (5m width); upgrade roads 3 km; construct temporary construction access 2.74 km (5m in width) and share the existing road 25.2 km
	Spoil disposal site	10 spoil disposal sites with a total area of 7.63 hm ² to handle 208,200 m ³ of construction waste.	6 spoil disposal sites with a total area of 3.67 hm ² to handle 107,800 m ³ of construction waste.
	Borrow pit	No borrow pit will be arranged for this portion of the project. The spoil earth from water transfer ditch will be reused. Outsourcing of concrete, sands and	No borrow pit will be arranged for this portion of the project. The spoil earth from water transfer ditch will be reused. Outsourcing of concrete,

Item	YWSP Project Components		
		stone blocks will be considered.	sands and stone blocks will be considered.
	Workers camps	Onsite PMO and logistics service will be set in the nearby villages through renting. At peak time, worker's camps of the contractors will be set on sites to accommodate 1,100 construction workers for the pipe line and about 200 workers for Kangjiagou reservoir construction.	Onsite PMO and logistics service will be set in the nearby villages through renting. At peak time, worker's camps of the contractors will accommodate 450 workers for the pipe line construction and about 250 workers for Baishugua reservoir construction.
Land acquisition and resettlement	Land acquisition	A total of 104.48 ha of land will be used, including 9.56 ha of land to be permanently acquired and 94.92 ha of land to be temporarily borrowed.	A total of 37.29 ha of land will be used, including 18.09 ha of land to be permanently acquired and 19.20 ha of land to be temporarily borrowed.
	Resettlement	A total of 355 persons will be affected by land acquisition and none affected by house demolition.	A total of 455 persons will be affected by land acquisition, and 70 persons out of 455 will be affected by house demolishing.
	Public facilities to be affected	Impacting 29 oil wells, 1 km of asphalt paved road, 3 km of unpaved road, 6.5 km of communication cables and 15.5 km of power cables.	Impacting 1 km of communication cables and 2.6 km of power cables.
Environmental protection works	Refer to EMP		

5. Environmental Baseline

5.1 Physical Environment

Topography and Climate

The proposed project is located in the center of northern Shaanxi loess plateau, where topography is featured in hilly area, including numerous valleys, ravines and gullies. The elevation of northwest terrain is higher than that in southwest with an attitude between 800 and 1800 meter. The project area belongs to the temperate semi-arid continental monsoon climate and enjoys four distinct seasons. The monthly mean temperature in January is -6.4 °C, and monthly mean temperature in July is 22.9 °C. Average annual precipitation is 493 mm with an uneven spatial and temporal distribution. Precipitation gradually declines from the south to the north and two-thirds of it is concentrated during the months from June to September. Average annual evaporation is 983 mm. Southwest winds prevailed throughout the year.

River System and Water Resources

Yan'an municipality is in a region which is extremely short of water. The per capita water resources availability is only 463 m³ compared to the national average of 2,200 m³, and the international threshold for extreme water scarce regions of 1,000 m³. The following factors make things worse: (i) a rather uneven temporal distribution of Yan'an's 493 mm annual precipitation, with over 70% concentrated in the months of June-September; (ii) sedimentation resulting from soil erosion of the

Loess Plateau which reduces the limited storage capacity of existing water source reservoirs; and (iii) heavy water pollution and water quality deterioration in river systems as a consequence of rapid economic growth, particularly in the oil and coal-mining industries.

The project area is located in the drainage basin of the middle reaches of the Yellow River. The surface water system consists of three rivers, namely the Yellow River, Yan River and Qingjian River. The segment of the Yellow River in Yan'an municipality is 183 km with an annual mean runoff 28.87 billion m³ at Yanshuiguan section. Yan River and Qingjian River are the first class tributaries of the Yellow River with an annual mean runoff 282 million m³ and 163 million m³, respectively.

At present, water supply in the Yan'an Municipality is based on two water sources, i.e., municipal waterworks system and private groundwater wells. The municipal water waterworks abstracts about 50,000 m³ per day from the Wangyao and Hongzhuang reservoirs on the Yan River to supply the existing Yan'an Beiguan Water Treatment Plant to produce drinking water to supply to the end-users.

5.2 Environmental Quality

Surface Water

Routine monitoring data indicated that water quality in sections of mentioned rivers within the project area ranges from Class III to Class V defined in the Chinese National Environmental Quality Standard for Surface Water (GB3838—2002)¹. However, water quality in the Yellow River meets Class II ~ III of the same standard. Fortunately, the monitoring data shows a trend that water quality at the sections of the above rivers is improving with the enforcement of the national and local emission standards.

Ground Water

Based on a survey in 2005 by China Institute of Water Resources and Hydropower Research (IWHR), 11 of 26 ground water sources in Yan'an were in compliance with Class III of the Chinese National Environmental Quality Standard for Ground Water (GB/T14848-93) and water quality from the other 15 wells satisfied with Class IV of the same standard or worse. According to this standard (GB/T14848-93), only water with Class III quality can be used for centralized drinking water supply, and industrial and agricultural uses. This implies that a big portion of groundwater in this region has been polluted and not suitable for using as drinking water.

5.3 Ecological Environment

Terrestrial Ecology

¹ Refer to Chapter 4 of the EIA report for details of surface water quality in the project area.

According to GB3838-2002: Class I – suitable for source water and national nature reserve; Class II-suitable for grade 1 protection zone of surface water that used for centralized drinking water supply; Class III- suitable for grade 2 protection zone of surface water that used for centralized drinking water supply; Class IV- suitable for general industrial use and entertaining water that has no-direct contact with people; and Class V-agricultural use and landscaping.

There are no natural reserves in the project area. The land that will be requisitioned or temporarily occupied by the project is mainly farm land or uncultivated land. Vegetation is dominated by farming crops, grasses and bushes. Some secondary forest on the south bank of Yan River was replanted in 1970s. Therefore, the project area has low biodiversity value.

Aquatic Ecology

A dedicated survey was conducted by Shaanxi Fisheries Research Institute in 2009. The results indicated that the abundance of aquatic flora and fauna in the water bodies of Yan River, Qingjian River is relatively low. Fish are scarce in the two rivers. The historical record shows that there were about 20 fish species in the middle reaches of the Yellow River, including 5 endemic species. Unfortunately, the fish species have been decreasing in Wangjiaqu section (intake) in recent years due to the construction of the upstream Tianqiao Hydro (dam) and the downstream Sanmenxia Dam in the 70's and 60's, respectively. The survey also concluded that none of the fish species is in the first or second class of the national or provincial protection list.

Soil Erosion

The project area presents most severe soil erosion area in the province and one of the major sediment contributors to the Yellow River. A total of 4,256 km² of land, accounting for 75% of the territory of Baota District and Yanchuan County, is suffering from soil erosion with an average erosion modulus of 9,000 t/km² a, which is in the second worst category defined in the Standards for Classification and Gradation of Soil Erosion (SL 190-2007)². The main causes of the high soil erosion rates in the region are the poor soil conditions and fragile geology of the loess plateau, plus extensive agricultural and industrial development. Fortunately, the trend of soil erosion has slowed down and the ecosystem is gradually improving especially during the last decade due to a series of effective measures taken by the government, including the grain-for-green policy and implementation of the World Bank loan project for Loess Plateau Watershed Rehabilitation Project³ which focuses on water and soil conservation while increasing agricultural production and income. According to the State Forestry Administration of PRC⁴, in the major rivers of Yan'an, annual sediment content has decreased 8% and runoff has increased 10 million m³, erosion modulus in Wuqi and Ansai counties has decreased to 5,400 t/km² a in 2009 from 15,300 t/km² a in 1999.

5.4 Socio-Economic Situation

The project city of Yan'an is a medium-size city in northern Shaanxi Province, rich in oil and coal resources and of national strategic importance as an energy production base. Yan'an is a historical, rapidly growing prefecture-level city in a very poor area located on the Loess Plateau, administering

² The standard was issued by the Ministry of Water Resources of the People's Republic of China on Jan 4, 2008. The standard defined soil erosion as six categories based on the dimension of erosion modulus.

³ On May 20, 2004, Loess Plateau Watershed Rehabilitation Project received *the World Bank group president's awards for excellence 2003* which chose from 3105 projects

⁴ <http://tghl.forestry.gov.cn>. The official website of the State Forestry Administration, July 14, 2010.

thirteen counties in addition to the core city.⁵ The World Bank financed portion of the YWSP lies in Baota District and Yanchuan County. The World Bank-financed Poverty V Project identified several of the counties in Yan'an as poverty counties. The average net income in most rural areas of Yan'an Municipality was about Y5,173/capita/year (US\$796) in 2010. This is about US\$2.2 per capita per day. There is a need to increase the income of the population in the area, and facilitate a shift from agriculture to the service and industrial sectors.

5.5 Sensitive Sites

There are no sensitive natural habitats and other environmentally sensitive sites within the project area and all the significant historic and cultural relics are far from the project sites. Main environmental concern will be the fish species in the Yellow River. Necessary protective and mitigation measures will be implemented in the intake facility engineering

6. Analysis of Alternatives

The project has been subject to intense analysis of alternative options including the no project scenarios, and various options for the water supply sources, water transfer line alignments, reservoir sites, technologies in the Dongchuan WTP, as well as the arrangement of borrow pits, and the transportation plan for construction. The optimal alternatives were selected based on the avoidance of or possibility to mitigate adverse social and environment impacts, as well as other economic, technical, and financial considerations for the least cost solutions.

6.1 Alternative Analyses of Water Supply Sources

Five water supply sources were considered, including supply water from Yan River, Qingjian River, Beiluo River, the Yellow River and groundwater. These sources were compared according to a wide range of factors such as water quantity, quality, construction conditions, resettlement, environmental impacts, sustainability, and total investment. Abstracting water from the Yellow River at Wangjiaqu in Yanchuan County is the best choice due to its sufficient quantity, relatively better quality, construction conditions and lower environmental impact in terms of less resettlement and shorter construction period.

6.2 Alternative Analyses of Dam Sites and Structures

This project will finance construction of two new dams. One is located downstream, in Baishugua, for regulating and another located upstream, in Kangjiagou, for emergency and maintenance backup. In principle, the initial sites of the two dams met the project design concept. In order to optimize the design and construction, two alternative sites and dam structure were examined and analyzed. The

⁵ The current population of Yan'an municipality is estimated to about 2.15 million, of which about 0.4 million reside in Yan'an City.

final sites of the two dams were selected according to a number of considerations including topography, engineering geology, construction conditions, quantities of earth and stone works, land occupation, inundation damages, resettlement, environmental impacts, and total investments. Given the locally available construction material, the structure of the dams was narrowed down to masonry gravity dam and earth-fill dam. Since the later structure is widely used in Yan'an and the loess plateau area, it would be used for construction of both dams.

6.3 Alternative Analyses of Water Treatment Process

The site of the Dongchuan WTP has been decided during the feasibility study considering its closeness to the water pipeline, topographical, geological conditions, and environmental settings. During the EIA, the focus of alternative analysis was given to the ground layout, in terms of land requisition, and water treatment process in the Dongchuan WTP. As a result, a staging land requisition plan was developed. The immediate objective is to reach a capacity of 40,000 m³/d with a land requisition of 25 mu (or 1.67 hectares) and the future objective is to reach a capacity of 80,000 m³/d with total land occupation of 50 mu (or 3.34 hectares). To minimize the impact of wastewater and sediments/sludge from the water treatment process (i.e. backwash water, and dewatered sludge), the wastewater will be recycled and reused internally and the sludge will be dewatered and disposed in the municipal landfill site.

6.4 Access Roads Optimization

The existing state highway G210, provincial highway S201 and many local roads will provide great convenience to the project. However, optimization of infield construction roads was one of the EIA objectives. The following principles were applied in the alternative analysis. 1) maximize the use of existing roads; 2) integrate temporary construction roads with the permanent pipeline maintenance roads; 3) minimize new road and temporary roads; 4) minimize land occupation and side slope excavation; and 5) design roads with considerations to accommodate the construction traffic. As a result, the new roads to be constructed have been reduced from 55.3 km in feasibility study stage to 36.44 km in preliminary design stage.

6.5 Optimization of Spoil Disposal Sites

It is estimated that about a total of 316,000 m³ of spoil needs to be disposed. One third of the spoil will be generated from the Yangjiashan tunnel construction, financed by YMG. The Yangjiashan tunnel will alone produce 107,800 m³ of waste. Spoil disposal sites have been optimized in many ways such as the total number and distribution, site capacity, location and transportation distance as well as environmental impact to the surrounding ecosystem.

7. Environmental Impacts and Mitigation Measures

7.1 Impacts during Construction and Mitigation Measures

Project construction will have a temporary impact on the surrounding environment. Typical short-term construction impacts include those on the river water regime, ecological environment, soil erosion, water quality, air quality, noise, and solid waste. If properly planned, construction impacts on the natural environment can be minimized to an acceptable level.

Water Environment

Hydrological regime The construction of the project will involve several inverted siphons when crossing Yan and Wenanyichuan Rivers. It is suggested to schedule the constructing of cofferdam during November-March (dry season) to minimize disturbances to the river.

Water quality The limited impact on the water environment during construction can be mitigated by several measures, including installing sedimentation tanks in each of the construction material process sites, concrete mixing sites, applying water recycling and reusing, installing small oil-separation tanks at vehicles and equipment maintenance stations, and providing dry latrines at construction camps.

Special attention was paid to the cleanup of the area of the new Kangjiagou reservoir. An agreement between the Qinghuabian Oil Field and YWIC has been reached for capping 29 oil wells which are located on the site of the proposed Kanjiagou reservoir. The 29 oil wells will be capped by the owner of oil wells, Qinghuabian Oil Field, in two stages and the abandonment of the wells will follow the guidance of *Well Abandonment and Inactive Well Practice (SY/T 6646-2006)*⁶, and that an independent consultant will be requested to verify the safety of the oil well capping (well abandonment for permanent/irreversible capping) to ensure no risk of contamination of the water stored in the reservoir. Prior to storage of water, the reservoir will be throughout cleaned up according to the requirements specified in the *Design Specifications for Cleaning of Reservoir Zone of Hydroelectric Project (DL/T 5381-2007)*⁷. YWIC will entrust Yan'an Environmental Protect Bureau and Water Resources Bureau to inspect and certify that the area is safe for raw water storage.

Ecological Environment

Potential impacts on terrestrial ecology during construction would be mainly on agricultural ecosystems, including crops vegetation, fruit trees, secondary forests, and grass lands. The impact also include disturbance of some small terrestrial animals and birds. Such impact will be temporary and can be mitigated or minimized by the implementation of well planned and budgeted soil

⁶ National Development and Reform Commission of the PRC, July 10, 2006, which was developed based on API Bulletin E3; 1993 Environmental Guidance Document: well abandonment and inactive well practices for U.S. Exploration and Production Operations

⁷ National Development and Reform Commission of the PRC, July 20, 2007

conservation measures at all construction sites. The recovery of farming crops and local indigenous vegetations are expected after construction.

Potential construction impacts on aquatic ecology in Yan River and Qingjian River are also not expected to be significant as no aquatic plants or animal species with a high economic value or ecological protection status were identified. The impact of the construction on fish of the intake section of the Yellow River is neglectable because most of the construction activity would be on shore and construction activities in the river will be very limited and would not last long. The mitigation measures include minimizing construction activities in the river course and scheduling the construction during the dry season. The construction activity will have no impact on river flow as there is no much water abstraction from the Yellow River at this section during construction period.

Social Environment

Social impact during construction will include the impact on local traffic, infrastructure, and public health. Although the EIA concluded that the construction impact to the downstream Yellow River Meanders National Geopark will be negligible, some impact to the local infrastructure during construction phase will be inevitable, including impact on roads and wire poles, communication cables, utility lines and potential damage of construction machinery to the natural gas transmission pipelines. The construction impact on local traffic will be mitigated by (1) build new alternative roads prior to the construction to compensate the damage and loss of local roads; and (2) strengthen traffic management of the affected areas, including scheduling construction traffic to avoid busy roads and rush hours, placing safety warning signs and detour maps, and preparing traffic emergency preparedness plans. Regarding the potential impact to the natural gas transmission pipeline, the construction activity will strictly follow the required specifications provided by the West-East Gas Pipeline Company to secure the safe operation of the gas pipeline. To ensure construction workers' and local people's health during construction, the EIA adopts applicable measures from the EHS and included in the EMP, which includes protection of drinking water sources, life and fire safety (L&FS), and personal protective equipment (PPE),

Impact of Construction Waste

A total of 316,000 m³ of construction spoils and 570 tons of domestic waste will be generated during the construction phase. A total of 16 disposal sites have been arranged and optimized for disposal of construction spoils. Soil conservation measures will be applied to control soil erosion at these sites. With respect to domestic waste, garbage bins will be provided to the construction sites and camps for collecting and sorting. Food waste will be used for livestock or composting. Organic solids waste and other inorganic waste from camps will be collected and disposed in the local municipal landfill sites.

7.2 Impacts during Operation and Mitigation Measures

Water Environment

The impact of proposed project on the water environment includes two aspects, hydrological regime and water quality. Change of hydrological regime usually cause by flow pattern and/or runoff fluctuation. The proposed intake facility is an onshore stationary pump station with no cofferdam or

any obstacle in the river. Therefore, the project will not change the original watercourse of the Yellow River. With respect to runoff change, the Water Resources Study Report⁸ concluded that the volume of the water, 56.83 million m³/a to be extracted by the project in 2030 accounts for 0.21% of the annual average runoff (27.53 billion m³/a), or 0.43% of the dry year runoff (13.19 billion m³/a at 95% confidence) at Yanshuiguan section of the Yellow River. Therefore, the project has little impact on the hydrological regime of this section of the Yellow River. It is also anticipated that a total of 23.06 million m³ return water or treated wastewater will be discharged to Yan River by the objective year 2030. Comparing to the total runoff (282 million m³/a) of this segment of Yan River, the return water is about 8.2 % of the runoff of Yan River. The impact of returning water to the hydrological regime of the surface water is limited because the amount is relatively small. In opposite, the local surface water system may benefit from the return water, especially in dry seasons.

Return waters are a combination of treated domestic sewage and industrial wastewater. The discharge loads from WWTP and industrials is crucial to the quality of receiving water body. Two strategic measures will address this threat. One is enhancement of the Energy Saving and Emission Reducing policy across all industrials to make sure the industrial discharges meet the requirements of the national standard as enforced by local EPB. Another is increase wastewater treatment capacity. According to the approved YMG's sewerage master plan, the city's wastewater treatment capacity will be increased to 150,000 m³/d by 2015 from 50,000 m³/d at present. Therefore, by the completion of YWSP, the city will have sufficient capacity to make sure the newly increased wastewater can be treated to meet the Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918—2002)⁹ before discharge to the surface water system.

Ecological Environment

As mentioned above, the quantity of water to be extracted from the Yellow River during operation phase is relatively small comparing to the total runoff in the river. Therefore, this is not expected to bring a significant impact on the fish in the river. In addition, a protective fence with 1×1 cm mesh will be installed around the intake to prevent the loss of fish in the river. Despite this, an ecological base flow of 100 m³/s has been defined by Yellow River Conservancy Commission of the Ministry of Water Resources to maintain the river's health and ecological functions. It is agreed that extraction of water from the Yellow River must be stopped and switch to using the reservoir water whenever the flow at this section of the Yellow River is less than 100m³/s.

According to the Yan'an Government's plan, once the YWSP is in operation all the groundwater wells covered by the municipal service system must be capped and water demands from the Yan River for industrials use will be reduced. As a result, the groundwater regime and agriculture ecology will be improved gradually

⁸ Yellow River Engineering Consulting Co. Ltd., 2011, *Water Resources Study Report of YWSP*

⁹ Issued jointly by State Environmental Protection Administration of China (SEPA) and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) on December 24, 2002, effective on July 1, 2003

7.3 Safety of Dams

The project will finance the construction of a regulating and emergency reservoir/dam at Kangjiagou (42m high earthfill dam, reservoir capacity: 1.55MCM). Another reservoir/dam with a similar function at Baishugua near the water intake (59m high earthfill dam; reservoir capacity: 5.56MCM) is also to be built as part of the complementary works (to be financed with government funds) ahead of the Bank project. In addition, two existing reservoirs/dams, Wangyao (55m high earthfill dam, reservoir capacity: 203MCM) and Hongzhuang (50.2m high earthfill dam, reservoir capacity: 9.79MCM) supply water to the existing service areas of Yan'an city (Baota District). All the above-mentioned dams are owned by YWIC.

A dam safety panel (DSP) was established by Yan'an PMO with terms and conditions satisfactory to the Bank. A dam safety review report was prepared by the DSP for the two existing dams, Wangyao and Hongzhuang, and the two new dams, Kangjiagou and Baishuwua, both of which were reviewed by the Bank team during pre-appraisal mission. An updated report on the results of dam safety review for Wangyao and Hongzhuang dams, and on the feasibility study review (including dam safety plans) for Kangjiagou and Baishuwua dams, incorporating Bank's comments, was submitted on November 24, 2011.

The YWIC will prepare Operation, Maintenance and Surveillance Plans (OMS Plans/Manuals) and Emergency Preparedness Plans (EPPs), which will be furnished to the Bank for review a year ahead of the dam commissioning time. During project implementation, qualified contracts will be awarded for the dam construction, and competent consultants will be engaged to supervise dam construction.

7.4 Cumulative Impacts

The cumulative impact assessment intends to address the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of the sources of funding (WB or YMG). There are three projects directly linked to the YWSP, including the existing Wangyao Reservoir and Water Supply System, Yan'an Wastewater Treatment Plant, and the proposed wastewater treatment projects will be constructed by YMG at the later stage of YWSP. The existing water supply and wastewater treatment plan will continue to work when the YWSP is in operation. To deal with the increased wastewater treatment load induced by this project, the YMG has planned to construct two new WWTPs with a capacity of 50,000 t/d each. An overview of the linked project is presented in Table 5.

Table 5 Relationship of Linked Projects in Yan'an

	Wangyao Reservoir and Water Supply System	Yan'an Wastewater Treatment Plant	Proposed Wastewater Treatment Project	YWSP
Nature	Existing urban drinking water supply	Existing urban wastewater treatment	Additional urban wastewater treatment	Additional Urban drinking water supply
Brief Description	Most water supplied by the combination of Wangyao, and Hongzhuang Reservoirs, and small amount of water is from Beiguan Water Plant	Secondary WWTP with a design capacity of 50,000 m ³ per day, located in Baota District	Two new WWTPs will be built in Yaodian and Lique with a capacity of 50,000 m ³ /d for each by 2020.	Abstract water from the Yellow River and transfer to Yan'an through 82.98 km pipeline and tunnels
Operational Capacity	50,000 m ³ /d(reservoirs) 50,000 m ³ /d (Beiguan Water Plant)	50,000 m ³ /d	100,000 m ³ /d	12.75 Mm ³ /a by 2020 27.77 Mm ³ /a by 2030
Service area and population	25.95 km ² 340,000 people	25.95 km ² 340,000 people	42 km ² 500,000 people (in total by 2020)	42 km ² 500,000 people (in total by 2020)
Construction Duration	Wangyao reservoir started providing water in 1997 and Hongzhuang Reservoir was built in 2005 as a supplementary water source	The only WWTP was built in 1998. During the first several years, it runs with a capacity less than 28,000 m ³ /d. Now, it is running with full capacity.,	In the projects preparation stage	To be completed in 2016

The water intake of this project is located in the Development and Utilization Zone of the Yellow River according to the *Surface Water Function Zoning in Shaanxi Province*. This project is the only project in the region to abstract water directly from the Yellow River and its cumulative impact on the downstream flow has been reviewed and approved by the Yellow River Conservancy Commission. However, it is estimated that an additional 23.06 million tons of domestic sewage and small amount of industrial wastewater will be added to the existing 10 million tons of wastewater annually due to the increased water supply by this project. The existing wastewater treatment plant is running well, although the capacity is only 50,000 tons per day (≈16.5 million tons per year) at present. The city government has forecasted this issue and planned to build two more new WWTPs in Yan'an with an additional capacity of 100,000 tons per day. Feasibility studies of the new WWTP projects are in progress. The Bank requested YMG to construct and completed the two WWTPs with YWSP simultaneously so that the wastewater will be treated to meet the national standards prior to discharge to the receiving water body, and a date covenants is proposed in project legal document for YMG to undertake to complete construction of the proposed wastewater treatment plants with the total capacity of 100,000 m³/day by the time that construction of the project is finished to enable the treatment of additional wastewater due to additional water supply.

8. Environmental Management Plan

The EIA report recommends the implementation of an Environmental Management Plan (EMP). The EMP proposes a number of measures to mitigate environmental impacts during the construction and operation of the proposed project and establishes an organizational structure, a set of procedures and a budget to implement activities under the EMP. The EMP has also identified a set of environmental monitoring activities, water & soil conservation monitoring activities, and capacity building programs to ensure achievement of the project's environmental objectives.

The EMP addresses all issues identified in the EIA, and includes a detailed description of all activities, the institutional responsibilities for implementation, and defines a budget and source of financing for each one of the activities included in the EMP. The estimated budget for implementation of EMP is 9.12 million RMB (1.45 million US dollars) and the budget for soil and water erosion control is 21.80 million RMB (3.46 million US dollars). Most mitigation measures have already been included in project design and included in project costs. Main components of the EMP include:

- Environmental management system.
- Environmental management capacity building and training
- Management of construction impacts
- Environmental monitoring, and water & soil conservation monitoring
- Resettlement Action Plan
- Budget for environmental management
- EMP reporting and information management

Clear environment management responsibilities have been defined for both construction and operation of the YWSP. Environmental management must be available throughout the construction and operational periods whereby there will emerge many factors that will have impacts on the environment. Therefore, the project will establish professional administrative institutions and equipped with necessary environmental protection personnel, being responsible for carrying out and supervising the work of environmental protection of the project.

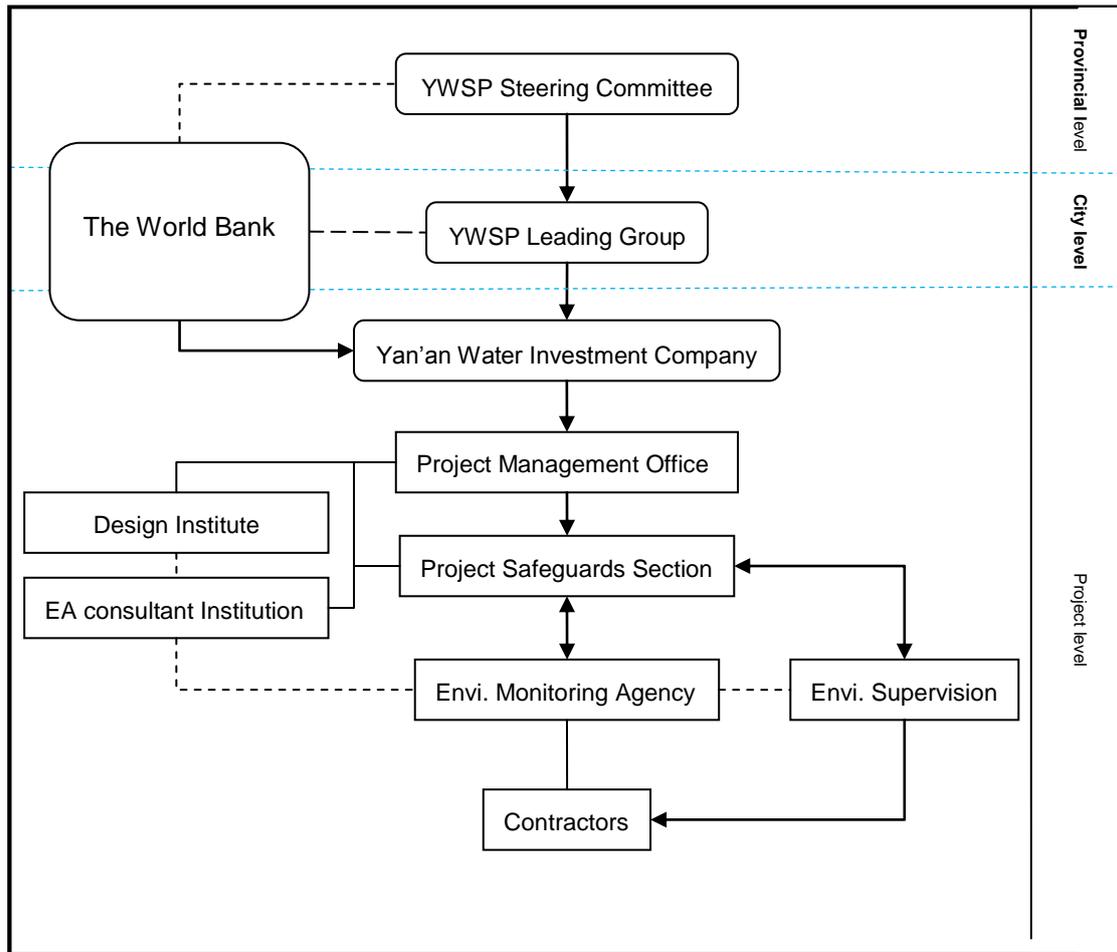


Figure 3 Environmental management system of YWSP

To ensure the implementation of the EMP, a qualified professional environmental supervision agency will be hired and working onsite to monitor the implementation of mitigation measures, and reporting to PMO, local EPBs and the World Bank. Comprehensive environmental monitoring programs have been designed for both construction and operation phases of the project. Monitoring includes water quality, air quality, noise, public health, ecology, as well as erosion of the PA. Monitoring will be conducted by qualified professional agencies. After trial operation, environmental monitoring and erosion monitoring will be carried out by provincial and Yan'an municipal environmental protection bureaus, and water conservancy bureaus, respectively.

Since capacity building for the preparation and implementation of the EA/EMP and RAP is a project component, which includes (a) consultancy services for survey, engineering design and construction supervision; and (b) consultancy services for project management (including M&E), and supervision of the implementation of environmental assessments, resettlement action plans, and dam safety. In addition, all personnel of the Project Office Safeguards Section and construction workers will receive environmental protection training before commencement of construction. Key environmental administrative and monitoring personnel will also receive the technical training. The main issues addressed in the EMP are presented in the following Table 6.

Table 6 Main Mitigation Measures and Responsibility in EMP

Impact	Mitigation	Responsibility
General construction impacts	A detailed set of environmental specifications including a soil and water conservation plan will be included in all bidding documents and contracts; Environmental training and technical consultation will be provided to the contractors; Environmental Supervision Consultant will be hired.	Contractor, enforced by Environmental Supervision Consultant and PMO/YWAB
Construction work financed by the Government	The part of the 19.2 km government financed work, including 11.36 km long Yanjiashan Tunnel, will be follow the same standards/requirements specified in the EMP. A special clause will be included into the contracts as contract variations, that is, the contractors must comply with all the environmental safeguard requirements of the EIA/EMP.	Contractor, enforced by Environmental Supervision Consultant and PMO/YWAB
Reservoir Construction and capping oil wells	Construction of the two reservoirs will strictly follow the specification/requirements developed by the Dam Safety Expert Panel according to the bank policy of Safety of Dams (OP/BP 4.37). In additional, the construction activities will obey the general environmental specifications including a soil and water conservation plan. In particular, capping the 29 oil wells in Kangjiagou site must follow the guidance of Well Abandonment and Inactive Well Practice (SY/T 6646-2006) that an independent consultant will be requested to verify the safety of the oil well capping, and the site cleanup will be inspected and accepted by Yan'an EPB and WRB.	Contractor, owners of the oil wells, enforced by Environmental Supervision Consultant and PMO/YWAB with support of YMG
Water resources and fish species	To minimized the impact on water resources and fish species in the Yellow River, a ecological base flow, 100 m ³ /s, has been established for the Wangjiaqu section of the Yellow River, the project will stop diverting raw water from Wanjiaqu water intake of the Yellow River at any time when the flow is less than 100 m ³ /s. As an engineering measure, a protective grid of 1 × 1cm mesh will be installed around the intake to keep fish away from the pump intake.	YWSP, Yellow River Conservancy Commission
Relocation of Population	Resettlement Action Plan	PMO of YWSP

9. Resettlement Action Plan

To achieve its objectives, the project envisages abstracting Yellow River water and building the associated works (pipes, tunnels, water treatment plant, and reservoirs) to transfer water to Yan'an city. While bringing benefits to local populations, these project activities would also cause some land acquisition and involuntary resettlement of local community. The project social assessment (SA) was first carried out in Dec 2008, and a supplementary survey was carried out in Jun 2011. The survey covers 45 villages in 7 townships that may be affected by the project. Based on fully informed and extensive consultation among these communities, the SA proved a broad support of local communities to the project.

Moreover, in view of construction of the project, resettlement investigation was also carried out by professional teams in cooperation with local authorities at county and township levels. A total of 810 people, in 176 households living in 9 villages, will be affected by land acquisition. In addition, 70 people in 12 households will be affected by house demolition. RAP was prepared with census survey and impact inventory, on the basis of intensive consultation with the affected people.

Since the Bank supported project is an integral part of the YWSP as a whole, the RAP also contains the resettlement contents of the overall YWSP. Appropriate and practicable measures were planned for compensation and rehabilitation of the affected peoples' livelihoods, as agreed and satisfied by them. Policies and entitlements included in the RAP are based on national, provincial and municipal regulations, as well as requirements in the World Bank's OP 4.12. The following key considerations were applied in project planning and design and in RAP preparation:

- Minimizing the extent of land acquisition and resettlement by optimizing project design, and minimizing the impact to the local communities if land occupation and resettlement is inevitable.
- Surveying socio-economic baseline conditions, and identifying all displaced persons (DP) in households, enterprises and others at the project preparation stage.
- Determining compensation for land, structures, and other fixed assets at replacement cost, and guarantee their incomes and living standards can be improved or at least restored.
- Providing assistance to help the displaced people diversifying incomes avenues and improving their livelihoods.
- Consulting with displaced persons on arrangements for compensation and assistance.
- Establishing mechanism to address complaints and grievances for the displaced persons including discussions, negotiations, arbitration, and legal proceedings.
- Arranging supervision and monitoring to ensure the RAP compliance and to address other issues that may arise during RAP implementation.

10. Public Consultation and Information Disclosure

A variety of ways of public participation, including questionnaires, public announcement, public meetings in the township government, village committee and affected villagers' homes, as well as meetings with key stakeholders, have been implemented during preparation of the EIA and Resettlement Action Plan. Each mitigation measure was determined by suggestions from both experts and the public. Most of the concerns have been incorporated either in project design, project management or in the environmental management plan or resettlement plan.

Two-stage public consultations have been conducted with those affected by the proposed project and included persons from different groups, gender, socioeconomic and educational backgrounds, and occupations. The primary objective of the first round was to survey the public's opinion about the project, while that for the second was to communicate the EA findings, discuss intended mitigation measures, and confirm public acceptance and satisfaction. In addition, there have been several

rounds of consultations with government agencies, local governments, and other stakeholders to discuss site location, scope, and potential environmental and socioeconomic impacts of the proposed project. On the top of that, intensive consultations have been conducted with Yanchang Oil Company, the West-East Gas Pipeline Company and Land and Resources Bureau of Yanchuan County for the potential impact on oilfield in the site for proposed Kangjiagou reservoir, natural gas pipeline and the Yellow River Meanders National Geopark, respectively. All the stakeholders have well informed about the project impact and expressed their understanding and support; together some constructive solutions have been worked out.

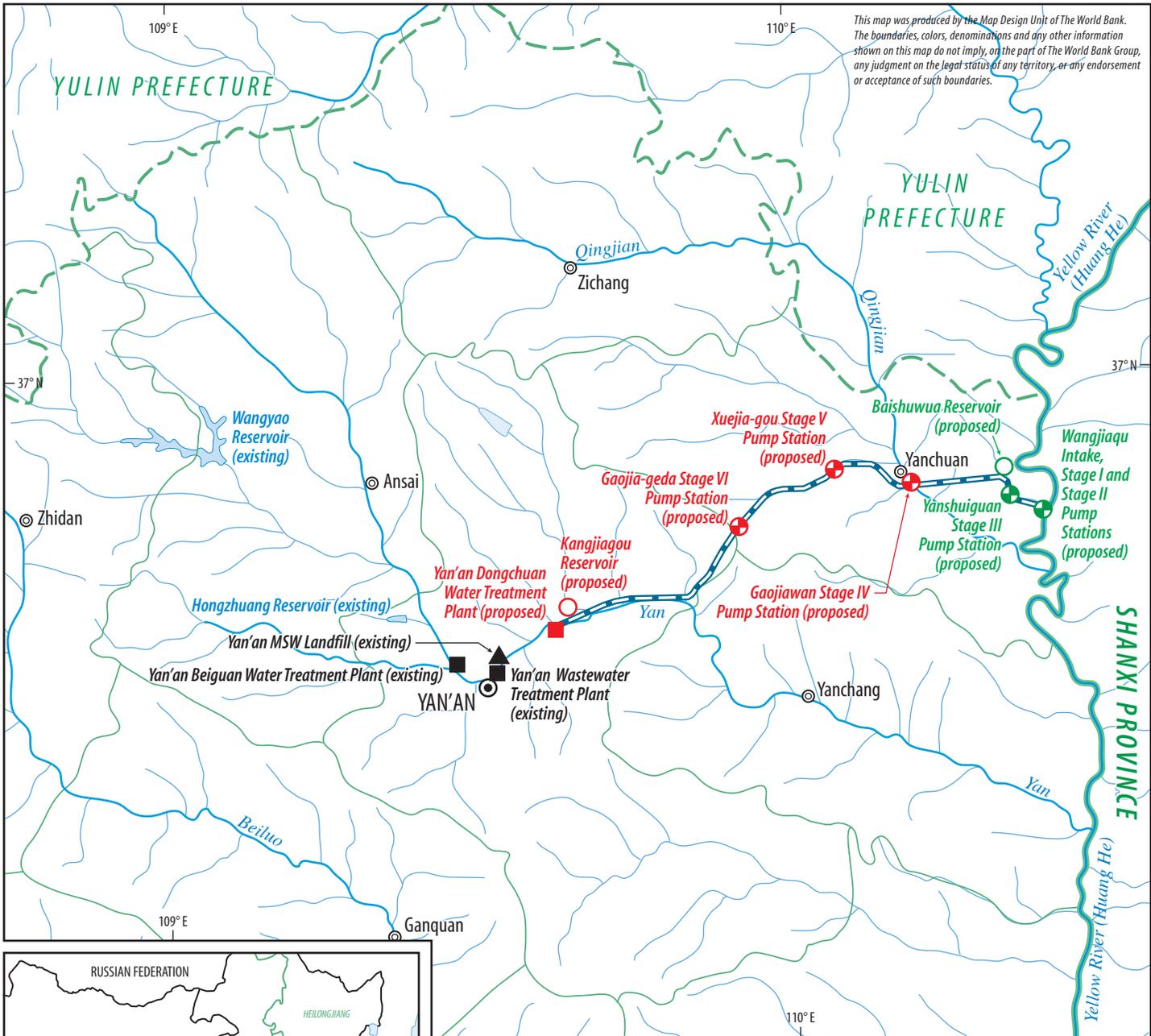
Information about the project has been disclosed through major local newspapers, such as Yan'an Daily on Nov 8, 2011. A telephone hotline has been established for the public to access relevant documents and offer comments. The EA/ EMP/EA Summary, and RAP will be available at the PMO and Project owner. The reports will also be disclosed at the website of the Bank's Beijing office and at the Infoshop in Washington, DC.

11. Conclusions

The project city of Yan'an is the political, economic and cultural center of northern Shaanxi, rich in oil and coal resources and of national strategic importance as an energy production base. However, Yan'an has suffered from water shortage for many decades, because of limited water resources on the Loess Plateau, outdated infrastructure, and increasing water demand caused by rapidly population growth and industrial development. The World Bank financed YWSP is essential to safe water supply for Yan'an. The project implementation will substantially relieve the tension between severe water demand and water supply. It is the most critical and effective measure to resolve the water crisis in the region, improve people's standard of living, and ensure sustainable development in Yan'an.

After the completion of YWSP, many groundwater supplies will be gradually closed and the trend of over-exploitation in groundwater will be reduced. Thus, it will be beneficial to groundwater resources recovery and protection. Meanwhile, the increased water supply will produce a volume of return water of about 23.06 million m³ annually, which will be treated to be compliant with the national discharged standards and returned to the surface water system. The treated return water is useful for maintaining an ecological base flow in the Yan River, which has been seriously polluted by the domestic and industrial discharges. Therefore, the project will also improve the local aquatic environment and ecosystem.

The adverse impacts on the eco-environment and soil erosion during the construction phase are considered minimum, and will further be reduced and mitigated to an acceptable level by taking environmental friendly measures. The Environmental Assessment concludes that the YWSP will not affect the environment and the project construction will be environmentally feasible.



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