World Bank Financed
Xian Comprehensive Urban Transport Project

Environmental Impact Assessment

Executive Summary

July 2007
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LIST OF ABBREVIATIONS

BOD  Biological Oxygen Demands
BRT  Bus Rapid Transit
CCTV Closed Circuit Television
CO  Carbon Monoxide
COD  Chemical Oxygen Demands
dB  Decibel (a measure for vibration)
dB(A) Decibel (Acoustic)
DO  Dissolved Oxygen
EA  Environmental Assessment
EIA  Environmental Impact Assessment
EMP  Environmental Management Plan
HC  Hydrocarbon
I/M  Inspection and maintenance
GPS  Global Positioning System
MIS  Computerized Management Information System
NH$_3$-N Ammonia Nitrogen
NO$_2$ Nitrogen Dioxide
OP  (World Bank) Operational Policies
pH  Acidity unit
NMHC  None Methane Hydrocarbon
PM$_{10}$ Particulate Matter smaller than 10 microns
PMO  Project Management Office
PRC  The People’s Republic of China
SEPA: State Environmental Protection Administration
SOEs  State Owned Enterprises
SS  Suspended Solids
TOR: Terms of Reference
1. Introduction

As part of the city’s effort to improve urban transportation system, the Xi’an Municipal Government (XMG) has applied for a loan from the World Bank for the Xian Comprehensive Urban Transport Improvement Project (the Project). It is one of the key projects of the 11th five year plan in Xian. Following extensive discussions between the World Bank and the senior government agencies in the Xi’an and central governments, the proposed loan of US$150 million will provide funding for road network, public transport, traffic management, air quality management, cultural relics protection and transportation policy and planning capacity building.

This document is the Executive Summary of Environmental Assessment (EA) for the World Bank financed Xian Comprehensive Urban Transport Project, in Shaanxi Province, P.R.China (PRC). The document provides a general summary of the findings from the Project Environmental Impact Assessment (EIA) the Environmental Management Plan (EMP) and the Resettlement Action Plans (RAP) for each of the components. This Executive Summary is intended for environmental administrators, decision-makers, project-affected groups, non-government organizations (NGOs), the general public and other stakeholders, as well as to the Executive Directors of the World Bank Board.

1.1 Project Background

Xian, a world renowned ancient capital and State Level Historical City, is located in the middle of Hanzhong Plain in mid west PRC. The city has a total area of 9983 km$^2$ coving nine urban districts and four suburb/rural counties. Starting from 11 century B.C. Xizhou Dynasty, the city has over 3000 years of development history and is a show case Chinese civilization history. The long human activities and development history have left the city a large amount of cultural and historical cultural properties and remarkable archaeological finds throughout the city and the surrounding areas.

In its modern history, the city has grown into a regional center of finance, science and technology, education, tourist and commerce in northwest China as well as one of country’s pillar industry bases for aviation, electrical, industry control, and transportation equipment. In the 15 year period from 1990 to 2005, Xian had maintained a constant double digit economic growth, exceeding the national average. The urban area has gradually developed into a city center with administration/government, tourist, commerce and residences encircled completely by a Ming Dynasty wall (the old city) and outskirt of industrial, science and technology and education, tourist, residential set ups and the ancient Han Dynasty city site.

Xian has also been a transportation hub over the years of its development. As the first major city towards the northwest China, Xian is a gate way of the country’s coastal and middle areas to the west. The city is a regional hub for railway, highway and air transportation, with substantial transportation infrastructure. Within the city, the road network has mostly inherited from the Tang Dynasty with roads following a well oriented grid especially within the urban center. Second and third ring roads have been constructed in the recent years, outside the city wall, as the backbone of the road transportation supporting urban expansion beyond the city center.
However, the basic urban transportation infrastructure development has lagged behind the rapid economic growth, urbanization and population increase particularly in the past two decades. The slow transportation infrastructure development is further compounded by the unique city feature: the Ming Dynasty city wall which separates the urban center from the fast growing economic development zones, new residential and commercial areas, higher education zones, tourist spots, industries and other urban developments outside the wall and places restrictions in the road development options in the city. As a result, Xian is suffering severe traffic congestion, low motor vehicle traveling speeds, difficulties in parking, lack of sufficient and convenient public transport. The congested traffic and longer transportation time than it could have been have impedes the city’s social and economic development, reduces the city’s competitiveness, increases air pollution and affects the quality of life for its citizens. Transportation issues have become one of the most concerned among Xian residents. There are apparent and urgent needs for upgrade urban transportation system development through better planning and development strategy, advanced urban transportation management, and effective and sufficient transportation infrastructure to alleviate traffic congestion, enhance transportation efficiency, improve the investment environment and tourist conditions, and provide safe, convenient, comfortable and affordable transportation to Xian citizens.

1.2 Policy and Regulatory Framework

Relevant regulatory, policy and administrative requirements for environmental assessment of development projects in China, both at state and provincial levels, were followed during the preparation environmental assessment, as were the Bank’s ten safeguard policies. Major laws and regulations applied in the EA are as follows:

- Laws of Environmental Protection of the PRC of December 26, 1989;
- Law of Air Pollution Control of the PRC of September 1, 2000;
- Law of Water Pollution Control of the PRC of May 15, 1996;
- Law of Environmental Noise Pollution Control of the PRC of March 1, 1997;
- Management Regulations on Environmental Protection for Construction Projects of November 18, 1998;
- Circulation on Strengthening EIA for Construction Projects Receiving International Financing of 1993;
- Technical Specifications for Environmental Impact Assessment; and
- Various applicable regulatory standards for air, water, and noise.

Of the ten World Bank safeguard policies, Environmental Assessment (OP/BP/GP4.01), Involuntary Resettlement (OD4.30), and Cultural Property (OP4.11) are triggered by the project. Six Component EIA reports are prepared, based on which a Consolidated EIA and EMP were developed for Bank’s approval.

A number of other documents, including feasibility study reports for various project components, as well as expert opinions and review comments for the draft EA reports, Xian Master Development Plans (1995-2010) and Tourist Development Master Plan (2000-2010), as well as provincial and Xian’s Environmental Master Plan have also been the basis for the EA.

The Consolidated EIA and Component EIA Reports are expected to be approved by Shaanxi Environmental Protection Bureau in July 2007.
2. Project Description

The objective of the project is to improve accessibility and mobility in Xi’an while protecting its cultural heritage and reducing the environmental impact of the urban transport system. Within this overall objective, the city leaders have identified the specific priorities of the Project as:

(i) Protection of the Ming walled city;
(ii) Strengthening public transport performance, and implementing Bus Rapid Transit (BRT);
(iii) Improving local air quality – with a target to meet national standards by 2008;
(iv) Developing a transport planning capability in Xi’an municipality.

An integrated package of investments in six components is proposed which meets this vision and the specific priorities. The measures are pioneering and innovative as they seek to promote sustainable (or “green”) transport, particularly within the walled Ming walled city, and establish the foundations for Travel Demand Management (TDM), including possible congestion pricing in the future. The six components designed to protect the Ming walled city are:

**The Road Network Component (RN)** [$229.5 million] will finance (i) junction improvements to improve the functionality of the First and Second Ring Roads; (ii) improvements to pedestrian and NMV facilities; and (iii) upgrading of 14.4 km of roads to improve accessibility in Huxian County.

**The Public Transport Component (PT)** [$ 71.4 million] will finance: (i) Integrated public transport priority/traffic management packages in 13 of Xi’an’s most heavily used bus corridors; total length 139.43 km; (ii) Construction of two public transport passenger interchange terminals; (iii) One bus depot.

**The Traffic Management and Road Safety Component (TM)** [$ 34.8 million] aims to enhance operation of the existing road network, and establish the foundations for future Transport Demand Management (TDM) within the Ming walled city. It will finance: (i) An Area Traffic Control (ATC) system, with associated junction channelization, CCTV and other ITS applications; (ii) Road safety – equipment and software to investigate and analyze accidents, and implementation of remedial measures; (iii) Enforcement and Road User Education; (iv) Parking measures and equipment, and road marking equipment. All these investments complement investments in the ongoing ADB funded project.

**The Air Quality Management Component (AQM)** [$16.8 million] will support the comprehensive plans of the Xi’an Environmental Protection Bureau (XEPB) to improve air quality and to reduce vehicular emissions. It will finance: (i) A building to house the newly established Xi’an Ambient Air Supervising and Monitoring Center; (ii) Equipment for motor vehicle emission inspection compatible with inspection methods newly issued by SEPA; (iii) Civil works and equipment for improvement of air quality monitoring network (iv) Equipment for improvement of information management and data analysis; and (v) Technical assistance for the development of Motor Vehicle Emission Control Plan.
The Cultural Heritage Component (CH) [$51.2 million] The component will be financed: (i) Han Chang’an Site – Recreation of the old Han Dynasty road network in the area of Weiyang Palace (7 km²) in the Chang’an City Archaeological site. (ii) Bicycle Network inside the Ming walled city. Construction of 41.52 km of bicycle routes around the main tourist sites which are also intended as a catalyst for more fundamental changes in the approach to bicycle use and traffic management in the Ming City.

The Institutional Development Component (ID) [$3.5 million] This component is designed to respond to the request from Xi’an for Bank assistance to develop a capacity in the city for transport planning and policy making. The component will finance:

ID 1  Xi’an Urban Transport (UT) Policy & Comprehensive Planning,
ID 2  Support for Implementation of Project Investments
ID 3  Domestic and International Training and Workshops
Bus interchange
3. Environmental Baseline

Considering the scope of this EA, and the forecast impacts on the investments, only the most relevant baseline data are presented here.

3.1 Physical setting

The city of Xian is located in the middle of the Guanzhong Plain, about 400 m above the sea. The project area is the warm temperate zone where a monsoon climate prevails. The annual precipitation averages 580.2 mm, with 45% to 60% in the month from July through September. The temperature over a year averages 13.3°C. The prevailing wind is northeast in the winter and southwest in the summer with annual average of 1.7 m/s. The frost free period over a year is 210 days. There are a number of rivers within Xian, which are mostly part of the Wei River System within the Yellow River Basin. While, the proposed project will not have direct linkage with these rivers.

3.2 Social Economic Conditions

The city has a total population of 7.42 million in a developed area of 222.84 km². The city has well developed mechanical/aviation, textile and chemical industries. The industrial output is over 60% of the GDP which was about RMB127.014 billion in 2005, a growth of RMB58.114 billion over 2000. There are 250749 motor vehicles in use.

3.3 Ambient Air Quality Baseline

Baseline monitoring data of ambient air quality in Xi'an indicated that the primary air pollutant in Xi'an is fine particulate matters (PM), while other parameters are generally in compliance with relevant standards. In recent years pollution levels of PM$_{10}$ in the city have been constantly exceeding the National Class 2 Ambient Air Quality Standard, mainly due to loess plateau background and increasingly vehicle emission. There is also ad-hoc exceeding results of nitrogen dioxides (NO$_2$) at roadsides at peak hours. A PM$_{10}$ source appointment study indicates that vehicular emissions represent 25% (including 12% of secondary PM$_{10}$) of local emission sources in July 1998. With rapid increase of vehicle fleet in Xi'an, it is foreseeable that vehicle contribution to air pollution in Xi'an will continue to increase.

3.4 Environmental Protection Targets

Based on the site investigation during the baseline study in the project areas, environmentally sensitive receptors to the above listed concerns have been identified for each of the project components. These sensitive receptors include residential buildings, schools, nursery houses, hospitals, cultural properties and villages along the project roads and adjacent to interchanges. These are the primary targets for environmental impact assessment and mitigation planning.

The inventory of sensitive receptors are shown the following Table 3-1 to Table 3-6.
### Table 3-1 Sensitive Receptors for Xian Road Upgrading Component

<table>
<thead>
<tr>
<th>Works</th>
<th>No.</th>
<th>Receptor</th>
<th>Distance (m)</th>
<th>Environmental Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Management Upgrading on the South gate and South Ring Road</td>
<td>1</td>
<td>Chengdu Yinxiang Residential Building</td>
<td>20</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Xian No. 93 Middle School</td>
<td>20</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Residential Building for Petroleum Appratus Plant</td>
<td>15</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>No. 116 Residential Building on South Ring Road</td>
<td>15</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Xian No. 2 Nursery</td>
<td>25</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Northwest University</td>
<td>40</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td>Dongmen Interchange</td>
<td>7</td>
<td>Residential Building on Paofang Street</td>
<td>20</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>No. 7 Residential Building on East Ring Road</td>
<td>20</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td>East Second Ring Road-North Second Ring Road Interchange</td>
<td>9</td>
<td>Xinjiamiaoxi Village</td>
<td>25</td>
<td>Traffic noise, air-born dust</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Xinjiamiaoxin Village</td>
<td>25</td>
<td>Traffic noise, air-born dust</td>
</tr>
</tbody>
</table>

### Table 3-2 Sensitive Receptors for Urban Road Project in Huxian

<table>
<thead>
<tr>
<th>Road</th>
<th>No.</th>
<th>Sensitive Receptor</th>
<th>Distance</th>
<th>Environmental Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meipi Road</td>
<td>1</td>
<td>QIngyangwu Vlage, Wuzhu Town</td>
<td>5 m</td>
<td>Resettlement</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Lianfeng Village, Ganting Town</td>
<td>5 m</td>
<td>Resettlement</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Laohe</td>
<td>20m</td>
<td>Surface water</td>
</tr>
<tr>
<td>Dongcheng Road</td>
<td>4</td>
<td>Baoyufang Village, Ganting Town</td>
<td>10m</td>
<td>Resettlement</td>
</tr>
<tr>
<td>Xincheng Road</td>
<td>5</td>
<td>Songjiazhuang Village, Ganting Town</td>
<td>5 m</td>
<td>Resettlement</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Chenping Village, Ganting Town</td>
<td>5 m</td>
<td>Resettlement</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Xitun Village, Ganting Town</td>
<td>150 m</td>
<td>Traffic noise and air-borne dust</td>
</tr>
<tr>
<td>Lvgon Road</td>
<td>8</td>
<td>Residential buildings, Ganting Town</td>
<td>100 m</td>
<td>Traffic noise and air-borne dust</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Residential Building of Laoyu Town Government</td>
<td>20 m</td>
<td>Traffic noise and air-borne dust</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Laohe</td>
<td>20m</td>
<td>Surface water</td>
</tr>
<tr>
<td>Lvgon Bridge over Xiyu Railway</td>
<td>11</td>
<td>Lvgongzhai Village, ganting Town</td>
<td>20m</td>
<td>Traffic noise and air-borne dust</td>
</tr>
</tbody>
</table>

### Table 3-3 Sensitive Receptors for Bus Lane

<table>
<thead>
<tr>
<th>Name of Works</th>
<th>Scope</th>
<th>No.</th>
<th>Receptor</th>
<th>Distance</th>
<th>Environmental Concern</th>
</tr>
</thead>
</table>
### Table 3-4 Sensitive Receptors for Bus Terminal*

<table>
<thead>
<tr>
<th>Project activity</th>
<th>No.</th>
<th>Receptor</th>
<th>Distance</th>
<th>Environmental concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Bus Terminal</td>
<td>1</td>
<td>Xinsi Village</td>
<td>80</td>
<td>Ambient air and noise</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Xiwang Village</td>
<td>60</td>
<td>Ambient air and noise</td>
</tr>
</tbody>
</table>

* The site selection process is not finalized yet. This location is an option currently available. For the maintenance depot, there is no environmental sensitive receptor around the current available site option.

### Table 3-5 Sensitive Receptors for Bicycle Lanes

<table>
<thead>
<tr>
<th>No.</th>
<th>Receptor</th>
<th>Distance</th>
<th>Environmental Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Xi’an City Wall</td>
<td>30m outside bicycle ring road</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>2</td>
<td>Bell Tower</td>
<td>300m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>3</td>
<td>Drum Tower</td>
<td>30m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>4</td>
<td>Grand Mosque</td>
<td>50m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>5</td>
<td>West Mosque</td>
<td>50m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>6</td>
<td>Xiwiutai</td>
<td>50m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>7</td>
<td>Guangren Temple</td>
<td>50m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>8</td>
<td>Yanghucheng Memorial Museum</td>
<td>70m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>9</td>
<td>Old site of No. 8 Army Office</td>
<td>50m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>10</td>
<td>Old site of Xi’an Incident</td>
<td>100m</td>
<td>Cultural heritage protection</td>
</tr>
<tr>
<td>11</td>
<td>Wolong Temple</td>
<td>100m</td>
<td>Cultural heritage protection</td>
</tr>
</tbody>
</table>
### Table 3-6 Sensitive Receptors for Road Rehabilitation within Weiyang Palace Site

<table>
<thead>
<tr>
<th>No.</th>
<th>Receptors</th>
<th>Distance</th>
<th>Environmental Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lujiakou Village</td>
<td>3# Road N, 210 m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4# Road E, 120m</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Majiazhai Village</td>
<td>150m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>3</td>
<td>Dongzhang Village</td>
<td>300m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>4</td>
<td>Xijiazhai Village</td>
<td>50m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>5</td>
<td>Dalu Village</td>
<td>70m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>6</td>
<td>Xiaoliuzhai Village</td>
<td>80m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>7</td>
<td>Tianluge Village</td>
<td>90m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>8</td>
<td>Zhoujiahewan Village</td>
<td>300m</td>
<td>Ambient air, noise</td>
</tr>
<tr>
<td>9</td>
<td>Front Palace of Weiyang, north part</td>
<td>100m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>10</td>
<td>No.10 relic site</td>
<td>50m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>11</td>
<td>No.11 relic site</td>
<td>30m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>12</td>
<td>Jiaofangdian relic</td>
<td>50m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>13</td>
<td>Front Palace of Weiyang, east part</td>
<td>50m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>14</td>
<td>No.14 relic site</td>
<td>60m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>15</td>
<td>Front Palace of Weiyang, south part</td>
<td>100m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>16</td>
<td>Changcheng gate relic</td>
<td>60m</td>
<td>Underground cultural relics</td>
</tr>
<tr>
<td>17</td>
<td>Xi’an gate</td>
<td>60m</td>
<td>Underground cultural relics</td>
</tr>
</tbody>
</table>

### 3.5 Cultural Heritage and Tourism

As the capital of 14 ancient dynasties for over 3000 years, Xian has rich cultural heritage and cultural and historical relics across the city. Among the known cultural relics, 34 are classified as the state level, 72 provincial level and 176 city/county level, as well as 2944 other relics and archaeological finds throughout the city. Over the last 700 years since the Ming Dynasty, the city has been developed mostly within an area completed encircled by a 12 m high, 18 (at the foot) to 15 m (on the top) thick city wall (the Ming Dynasty wall). The wall was first built in 1370 to 1378 AD as a defensive and military structure with total lengths of 2590 m on the east, 2631.2 m on the west, 3441.6 m on the south and 3241 m on the north. As the only complete city wall for major city in China, the Ming Dynasty wall has become the landmark of Xian and a major tourist attraction of the city.

The major cultural heritage sites related to the project include Ming Wall and Weiyang Palace relics site in Han City.

- The Ming Wall is a rectangular enclosing wall surrounding central part of Xi’an city, with a perimeter of 11.9km. Since built in 14th century, it had been renovated three times and the last time was in 1983. The planned round-city bicycle route will renovate the existing road along the inside of the wall to bicycle tourism route. 14 tourism spots and cultural heritage sites will be connected by round-city and inside-city bicycle routes, while these sites will not be physically impacted by the project activities. The underground road will be constructed under the existing street outside the south wall, which is about 100 m away from the wall with a moat rive in between.
- Weiyang Palace relic site is within the Han City protection area, about 8 km northwest of Xi’an city. Han City protection area is about 36km². Han City was the capital of Han Dynasty (ca. 200 B.C.), and Weiyang Palace is one of the major palaces. Abandoned in 6th century, the existing relics are mainly compacted soil foundation, ruins of earth wall, and underground roads and water canals. Due to restrict of development, the area is limited to farmland. There are 55 villages in the area with a total population of 53,178. The proposed 5 roads are around the compacted soil foundation ruins of Weiyang Palace, resembling the underground ancient road networks while without touching the ancient roads.

3.6 Noise

The analysis of noise monitoring results indicates that the social activities are the main source of noise in Xian in 2005 in terms of quantity which contributes 74.5% to the total. The secondary source is traffic which contributes 20.0% of the total, followed by industrial source and other sources which contributed 1.5% and 4.0%. In terms of noise source intensity, traffic sources contribute the most to the total with the average 59.7 dB(A), followed by industrial source with noise averaging 56.2 dB(A). Statistics from 155 traffic noise monitoring points indicate overall compliance with Urban Ambient Noise Standards.

In Huxian county, the noise level in day time in the project area ranges from 44.3 dB(A) to 53.0 dB(A) and at night from 38.0 dB(A) to 44.7 dB(A), meeting the Class II noise standards (GB3096-93). It is thus concluded that the project area has a good acoustic quality.
4. Environmental Impacts and Mitigation

4.1 Land Acquisition and Resettlement

This project requires acquisition of land of 1,683.14 mu permanently (with 456.3 mu state-owned and 1,226.84 mu collectively owned), demolition of residential houses with a total area being 49,274 m², demolition of non-residential houses with a total area being 40,857.1 m², and demolition of public utilities and ground attachments. Totally 2,477 people will be affected by the project via demolition of house and land occupation. A RAP is developed, and main mitigation measures are summarized below.

Mitigation measures:

• **Economic rehabilitation.** Village rehabilitation approach was developed in consultation with affected farmer groups. The project will follow a rehabilitation strategy combining land-for-land measures and cash payment option. Redistribution of the remaining village land is the primary measure. Land to be redistributed will be from village reserved land, returned contract land and land to be developed. Land compensation fund is retained by the villages for collective use following villagers’ decisions. This measure is planned for the Han Palace Road Component, Huxian Road Network Component and the Environmental Monitoring Station, following consultations with the villagers.

• **Relocation of households.** The affected people can all be resettled within existing villages. They will be allocated new plots for their new house construction. These sites will be selected in consultation with the relocating households. County and township government will be responsible for their design and construction. All relocating households will be provided access to basic infrastructure serves either through sharing existing infrastructure or new infrastructure to be provided by the project. All houses will be paid at replacement cost without depreciation, and without deduction of salvageable materials. The resettler households will be responsible for their new house construction in rural areas. In urban areas, households losing residence provided the option of self-resettlement with cash payment or replacement houses at their own preference.

• **Rehabilitation of infrastructure and business.** Infrastructure affected is mainly power, telecommunications and transportation facilities. For these facilities, compensation based on the reconstruction cost will be paid to the government departments who are responsible for these facilities. The government departments will be in charge of the reconstruction. Most business affected are small family business or village workshops. They will be compensated in cash and assisted in reestablishing their business if they wish.

• **Consultation and participation.** The resettlement planning followed a participatory process. Affected villagers and various government agencies participated in the social economic survey, impact census, inventory and formulation of the compensatory and livelihood rehabilitation plan. Project information, relevant government policies and regulations were broadly disseminated through village meetings in the project areas. A project information handbook will be developed and distributed to every affected farmer household. Project RAPs have also been disclosed.

• **Resettlement organization.** Xi’an DRC will assume the overall responsibility for the implementation of the resettlement program. The actual implementing agencies
include Xi’an Infrastructure Investment Company and various component offices. These offices will work with the district and country government offices, on a contract basis, to implement the resettlement programs. These offices will employ competent and experienced staff. Their respective responsibilities and functions are detailed in the RAPs. Training will be provided to the project staff.

- **Grievance redress.** A mechanism has been established for grievance redress. Grievances can be filed both orally and in writing. Starting at village and neighborhood committee level, the grievances can be elevated to county/district, city level if they are not happy with the resolution at the lower level. The affected people could also file their cases in court if they are not happy with the resolution by the project authority. All grievances and their resolutions will be recorded. This mechanism has been disclosed to the local population and will be further disseminated through the Resettlement Information Booklet.

- **Monitoring and Evaluation.** Both internal and external monitoring is planned for resettlement implementation. The resettlement offices will be responsible for the internal monitoring. An external institute will be appointed to undertake the independent monitoring of the resettlement program. The monitoring scope, targets, indicators, procedures, methodology and reporting requirements are described in the RAPs.

- **Resettlement Cost.** The total resettlement cost is RMB 196.70 million, equivalent to US$25.21 million (1 USD=7.8 RMB). This budget includes the compensation fund for land, houses and attached structures, infrastructure and trees, various relocation allowances, business loss during transition, special allowance for vulnerable groups, management and monitoring costs, contingencies. All resettlement costs will be financed by domestic funding.

- **Resettlement policy framework.** This is developed for Public Transport Component where exact site for bus terminal, bus depot and BRT parking site are not finalized yet. It will provide guidance for future resettlement planning.

### 4.2 Construction

#### 4.2.1 Impact on Socio-environment and Mitigation

The construction of urban roads will have impact on traffic, particular in the rush hours everyday when the traffic will be particularly heavy. The residents will be affected through traffic disturbance, increased difficulties to access to the stores, workplace, services, schools and residences near the project roads, possible bus route changes, and construction safety risks.

The underground utilities such as water supply, sewers, television cables, gas, etc. will be relocated under the project roads. Although the utilities relocation will be carefully planned and will not be cut off, risks exist that municipal services may be interrupted will relocation of the utilities does not carried as planned.

The road construction activities inside the city will be restricted within ROW, with enclosure fence/barrier protection. Passages will be maintained for pedestrian and bicycle users. Access to roadside stores/shops will not be blocked, therefore, the impact on these businesses will be minimal.
Mitigation measures:

☑️ In the planning stage of the construction the basic investigation will be carefully undertaken for the road, power supply and communication, so as to successfully cooperate with local relative agencies in ensuring municipal services while relocating the underground utilities.

☑️ To minimize the impact on the traffic blocking, a traffic flow diversion plan will be developed for the affected roads prior to the construction. Non local vehicles will be detoured to other roads where necessary. Information on the construction schedule will be disclosed to the public via TV, radio or other mass media prior to construction so that the affected residents can plan their outings as may be needed.

☑️ As the demand for water and power supply will significantly increase during the construction stage, the construction team will develop a connection plan with local relative agencies and implement the plan prior to construction. Where the capacity of water or power supply is inadequate to meet the demand, the capacity expansion will be completed prior to construction, so as to avoid the accidents of power or water supply cut-off.

☑️ Where the construction site is close to schools, residential settlements, institutions and commercial outlets, temporary assess will be provided for people such as crossings over excavated ditches etc. Safety shields will be provided in areas where there are overhead construction activities in the access routes and sidewalks.

☑️ All construction sites will be fenced with good control for public access to ensure construction site safety. Safety warning signs will also be erected in eye catching places to alert the public of the safety risks.

☑️ The lighting for construction will be placed at a proper elevation so as not to affect the residents in night.

4.2.2 Impact on Agricultural Production by Land Occupation

The impact on agricultural production will stem from permanent occupation of farmland which is a long-term loss of productivity and temporary occupation of farmland which is considered to be short-termed. Such land occupation impact is relatively scattered and marginal as agriculture income is only insignificant share of the affected households.

Mitigation measures:

• Resettlement Action Plan has been developed following Bank’s policy requirement to provide full compensation for affected households;

• In the detailed design stage, further fine tuning of alignment will be carried out to minimize the occupation of farmland;

• Contractors will be required to minimize temporary land occupation for construction activities.

4.2.3 Impact on Urban Ecological Landscape and Mitigation

Impact on surface vegetation

There will be loss of surface vegetation due to permanent land conversion, which are mainly farmland crops, fruit trees and roadside green belt. The total removal of green belt will be 40,684m², and 49,858 trees (including fruit trees) relocation.
There will also be temporary impact of construction dust on roadside flora and crops. However, such impact is temporary which only occurs during the construction phase and will quickly disappear after the construction is completed.

**Mitigation measures:**
- Land acquisition will be minimized and construction activities will be strictly restricted within ROW;
- Greening upon project completion is well planned to restore loss of green belt. While upon completion of the project, newly planted green belt will be 230,878 square meters, which is more than amount of pre-project situation. All the trees, according to regulation in Xi’an, must be relocated by Greening Committee, while project proponents must secure approval from Greening Committee and Forestry Authority and provide fund for such relocation.
- New road side trees will also be planted by project proponents after completion of project;
- Water spraying will be implemented to minimize dust impact on roadside crops.

**Impact on Urban Landscape in Construction Phase**

Construction activities will have adverse impact on urban landscape due to demolition of roadside houses, temporary stockpile of spoils or materials onsite, parking of construction equipment and vehicles, dust and wastewater from construction site, and separation facilities such as fencing during the construction of interchanges and sidewalks. However, such impacts will be significant and can be properly managed.

**Mitigation measures:**
- The median green belt and the roadside vegetation cover will be moved to other places and protected during the construction period after which they will be replanted to the origination places;
- The site demolished will be fenced with barriers or walls to avoid exposure of the site to public;
- The earth and spoils will be carefully balanced and the temporary stockpiles of spoils and materials will be covered so as to avoid erosion by rainfall;
- The land to be occupied will be minimized and the construction schedule will be carefully developed. Immediately after the construction is completed, the site will be cleaned;
- The vegetative covers along the road to be reconstructed will be protected.

**4.2.4 Noise Impact and Mitigation**

The major noise source during the construction phase is construction equipment and the transportation vehicles. According to the “Noise Limit for the Construction Site Boundary” (GB12523-90), the noise limit for day time is 70~75dB(A), and 55dB(A) for night time. It is concluded that construction noise level at 50 m from the source in day time can meet the noise limit, and in night time at 100 m can meet the limit.

**Mitigation measures:**
- The construction schedule will be carefully developed for the section near schools which are on the section K118+100-K118+200 and k95+900-K96+100. Noise
activities will be arranged during school vacations and/or after classes. If such an arrangement is not feasible, the contractors will be requested to consult with the schools in question first to provide advanced warning and to develop other possible mitigation.

• The construction materials will be transported on the existing road to the construction sites. The transportation schedule will be carefully designed to minimize the adverse impact on residents and students, as well as the traffic on the existing road. The transportation vehicles will be requested to slow down and banned from horn when passing townships and near schools.

• The construction activity in residential area will be scheduled in daytime only, and the noisy equipment will be prohibited from night operation. During the construction in daytime, the construction site will be fenced. 

• The construction equipment will be well maintained to keep it best operating conditions and lowest noise levels possible.

• Construction team will be equipped with potable detecting device to monitor the noise level at the sensitive receptors.

• Night time construction is generally banned at night for the project. However, in case it is technically necessary, the following mitigation measures will be taken for night time construction:
  - Public, particularly residents, in areas immediately adjacent to the construction sites will be consulted prior to the start of night time construction, to alert them the noisy activities at the night time, to explain the reasoning for night construction to obtain public understanding, and to solicit specific public concerns and suggestions for mitigation;
  - Public billboards will be erected at the construction sites, listing construction activities, contact persons and telephone numbers for receiving public concerns., complaints, and suggestions on a constant basis;
  - The most noisy activities such as piling will not conducted at night where possible;
  - Temporary noise barriers may be erected at the most sensitive areas; Some of the stationary noise machinery such as generators will be located away from sensitive receptors and in enclosed structure for noise control;
  - Dedicated and trained staff from contractors and construction supervision will be on site for traffic management and public safety during night time construction;
  - Proper signage, fencing and lighting will be used to divert the traffic, alert the motor vehicle and pedestrian traffic of the safety hazards, particularly during the night construction;
  - Night time supervision by the environmental monitoring teams will be enhanced including on-site noise measurement and prompt incidents response.

4.2.5 Ambient Air Quality Impact and Mitigation

As a common issue of infrastructure construction, there will be air pollution during construction phase related to construction site, unpaved road, material stockpile site, and access road. The air-borne dust from the site, waste gas from the asphalt pavement operation, and the end gas from the operational equipment will also be concerns.

Mitigation measures:
Access roads will be paved with gravel to reduce generation of air-borne dust.

Construction team will be requested by contracts to provide water spray vehicles to water the unpaved ground, storage piles and other areas where airborne dust may originate. The water spray operation will be carried out in dry and windy day, at least twice a day (morning and afternoon). The frequency of water spray near sensitive receptors, such as villages and school, will be increased as may be needed.

The truck transporting powder materials, such as cement, sand and lime, will be covered.

The roads and construction sites will be fenced;

After construction is completed, the sites will be cleaned.

4.2.6 Impact on Water Environment and Mitigation

While, the project activities do not have direct linkage with rivers, the impact of surface water will be minimal.

Mitigation measures:

- The domestic wastewater from construction camp will be collected into septic tanks. Wastewater and solid waste will be carefully managed so as not to enter rivers, causing water pollution;
- The mud from construction site will be filtered to remove fine solids prior to discharge into collection facility and not allowed to be discharged into water bodies nearby.
- After construction is completed, residues in asphalt mixing stations will be collected and transported to designated site.

4.2.7 Impact of Solid Waste and Mitigation

During the construction of roads, a considerable amount of spoils and construction wastes are to be generated requiring proper disposal. With proper disposal of these spoil materials, the impact can be adequately mitigated.

Mitigation measures:

- The spoils will be collected and hauled to the designed site permitted by environmental agencies (Dengfengge landfill in Xi’an and Quyou landfill in Huxian);
- Top soil in Huxian will be sent to Cangyou Town for poor land improvement program which is to improve quality of 1,330 ha farmland;
- The hauling of wastes will be scheduled to avoid rush hour and a hauling route will be selected to avoid sensitive receptors. The wastes will be covered during haulage.
- On the temporary stockpiles of solid wastes, the spoils will be compacted to a stable angle and well fenced.
- The construction site will be enclosed.

4.2.8 Impact of Vibration and Mitigation

The typical source for vibration in road construction includes piling, foundation and compaction as well as movement of heavy-duty trucks. It is concluded that the limit for vibration stipulated in the Standard for Environmental Vibration in Urban Area can be met at the distance 10 m from the operating equipment. In this project, the sensitive
receptors such as schools, residential buildings areas are at least 15 to 40 m from the construction site boundary, therefore the vibration impact is limited.

Major concern in this project is the potential vibration impact on cultural heritage sites. Referring to the list of heritage within impact assessment scope (Table 3-5, 3-6), these cultural heritage sites are at least 30m away from project activities and beyond the adverse impact scope of vibration. In addition, heavy vibration equipment will not be used in Weiyang Palace site and Ming Wall project, careful measures are planned and construction activities will be guided by professional specialist from Xi’an cultural heritage authorities.

Mitigation measures:
- Heavy vibration will be banned, construction activities using vibration equipment is not allowed for night construction;
- Excavation in Weiyang Palace site will all be done manually;
- Professional specialists from Han City Cultural Heritage Protection Agency will closely guide each step of construction activities.

4.2.9 Impact on Cultural Property and Mitigation

The project activities of bicycle lanes within the walled area are all limited to the existing roads and there are no construction activities on any cultural properties directly. The road construction in Weiyang site will also not have direct damage of identified relics listed in Table 4-1. The construction is guided by archeological specialist to ensure underground ancient road will not be touched and impacted.

In conclusion, no direct damage or other serious impacts are anticipated to the properties and all temporary to the construction phase, and impacts on these cultural properties are expected to be minimal. On the contrary, all the project components are intended for protection of these properties once completed.

Mitigation measures:
- Water spray as needed to suppress the dust;
- Equipment with lower noise will be used and noise barriers will be installed on sites;
- Excavation near the Weiyang Palace Site will be done manually to avoid the vibration impacts;
- Construction activities will be guided by archeological specialist;
- The construction will be suspended during the raining season from July through September to minimize the intrusion of rainfall to the underground cultural relics;
- Chance-find procedures are well stipulated in China regulation and will be strictly followed in the project, this include:
  - When a chance find or potential chance find is uncovered at the construction site, all construction activities at the site will be immediately put hold.
  - Workers and site management are responsible to take necessary measures to protect the chance finds from damages by construction related or other activities such as sliding, flooding, damages by machinery, access by others, stolen, etc.
  - Contractors will notice the PMO, project owner and cultural relics authority immediately.
Site investigation by professional archaeologists may be conducted to determine the nature, value, conditions, areas of the find, etc. On this basis, the professional team will recommend on next steps as to preserve the site or not.

Construction may only resume following the reports of the professional investigation and approval of the cultural relics authority.

If the site is of high value and site preservation is recommended by the professionals and requested by the cultural relics authority, the project owner will need to make necessary design changes to accommodate the request and preserve the site.

All contractors and construction supervision companies will be trained by the professional before the construction starts to understand the procedures and the basics on how to recognize a potential archaeological chance find.

4.3 Operation

4.3.1 Benefits and Positive Impacts

The project is designed with strong focus on improving accessibility and mobility in Xi’an while protecting its cultural heritage and reducing the environmental impact of urban transport system. It will have substantial positive environmental benefits through physical investment of improving traffic efficiency, increasing pedestrian and bicycle facility and promoting public transport in Xi’an city (Ming City), strengthening motor vehicle emission inspection control and protecting cultural heritage, as well as technical assistance program of institutional capacity strengthening of city government agencies with particular emphasis on traffic management, environmental protection and cultural heritage preservation.

4.3.2 Air Quality

The air modeling results indicate that although the concentration of NOx from motor vehicle emissions will increase as the traffic flow increase after the road project is operational, the NOx concentration on most of the road sections will not exceed the standard under full designed traffic flow condition. On the city wide perspective, however, as the road project will improve the transport condition leading to increased average motor vehicle speed, and most air pollutant in the emissions will decrease with the increasing motor vehicle speeds. So although the vehicular emissions will increase along the project roads, the total emission load on a city wide basis and for the same amount of traffic volumes and distances traveled will decrease over the city.

Xi’an Municipal Government will implement the following measures to control and improve air quality in Xi’an:

- Effective implementation of vehicular emission inspection system (random inspection on road and annual inspection in inspection centers);
- Polluting vehicles will be restricted on major roads, and will be gradually removed phased out;
- Promotion of cleaner fuel, such as CNG and LPG;
- Strict management of in-city construction site to reduce dust, hence reduce secondary dust from road;
- Improved landscaping and roadside plantation;
Adequate emission treatment facility designed for fixed sources such as boilers used in air quality lab and bus depots.

### 4.3.3 Noise Impact

A noise model was used in EA to predict the noise impact. The results shows that as the road condition is improved, the traffic noise intensity is generally less after the project is completed than in the without project scenario. Noise prediction for specific sensitive receptors was conducted, and concluded that some sensitive receptors will be subject to noise impact over the standards. Based on modeling results, mitigation measures are developed.

**Mitigation measures:**
- Protect sensitive receptors with Noise insulation windows (Table 4-2).
- Limited motor vehicles speed by traffic control signs particularly at night near sensitive receptors.
- Maintain the road surface in good condition to avoid increased noise from rough surfaces.
- Planning of urban development with noisy road sides allocated for land uses with less noise sensitive buildings

### Table 4-2 Noise mitigation to Sensitive Receptors

<table>
<thead>
<tr>
<th>Component</th>
<th>Road</th>
<th>Sensitive Receptors</th>
<th>Dist. To road center (m)</th>
<th>Mitigation</th>
<th>No. of windows facing St.</th>
<th>Noise reduction dB(A)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xi’an Urban Road Network</td>
<td>South gate and ring road component</td>
<td>Chengdu Impression Residence</td>
<td>20</td>
<td>Noise insulation windows</td>
<td>160</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Petro Instrument Co. Residence</td>
<td>15</td>
<td>Noise insulation windows</td>
<td>64</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. 116 Residence</td>
<td>15</td>
<td>Noise insulation windows</td>
<td>20</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.2 Kindergartens</td>
<td>25</td>
<td>Noise insulation windows</td>
<td>20</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northwest University</td>
<td>40</td>
<td></td>
<td>0</td>
<td></td>
<td>Classrooms not face street</td>
</tr>
<tr>
<td></td>
<td>East gate interchange</td>
<td>Paofang St. Residence</td>
<td>20</td>
<td>Noise insulation windows</td>
<td>28</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Huangcheng E. St.</td>
<td>20</td>
<td>Noise insulation windows</td>
<td>28</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>East 2nd ring road and north ring road interchange</td>
<td>Xingjiamiao W. village</td>
<td>25</td>
<td>Relocation</td>
<td>2</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Xingjiamiao Xin Village</td>
<td>25</td>
<td>Relocation</td>
<td>2</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Huxian Road</td>
<td>Xincheng Road</td>
<td>5</td>
<td>Noise insulation windows</td>
<td>50</td>
<td>-30</td>
<td></td>
</tr>
</tbody>
</table>
4.3.4 Water Environment

The primary concerns during operation are wastewater from the one bus depot, one terminal and one BRT parking site in the project. As mitigation, the domestic wastewater will first be discharged to onsite septic tanks. The supernatant from the septic tanks will be discharged to the municipal sewer, while the sediment and sludge will be removed and disposed of in local landfill or other dedicated facilities. All effluent from bus washing will be collected. The wastewater will be treated on site first through an oil/water separator to remove oil and a sedimentation tank to remove the solids. Effluent from the oil/water separator and sedimentation tanks will then be discharged to municipal sewer and treated at a central wastewater treatment plant.

4.3.5 Traffic Vibration

Comparative analysis of vibration impact under normal traffic indicated the vibration impact of urban road is expected to be negligible. For the cultural heritage sites within Ming Wall (listed in table 3-5), no impact is foreseen from bicycle route. For heritage sites in Weiyang Palace, only pedestrian/bicycle and tourism vehicle (battery vehicle) are allowed within the site, and all the heritages are at least 30m from the road, no vibration impact on those relics is expected.

4.3.6 Cultural Property

The air quality prediction results indicate that although the NOx load will increase after the project becomes operational, the concentration of NOx will meet the standard at 2000 m from the road, while the concentration of other pollutants will meet the standard at 40 m from the road. Thus it is expected that the impact on cultural properties from vehicular emission is at an acceptable level.

One of the indirect or induced impacts to the cultural properties would be the increased tourists, particularly in such site as the Weiyang Palace remains. The improved road and other conditions following the project implementation would attract more tourists as well as commercial developments such as shops and restaurants to the site, creating higher environmental and protection burdens.

As mitigation, proper planning is the most critical. The Weiyang Palace site administrative authority has been advised to develop an environmental management plan to accommodate the anticipated increased tourists after the project. The plan will include: property planning and zoning of tourist supporting facilities such as restaurants and souvenir shops, sufficient and convenient service and pollution control facilities such as public toilets and garbage bins in public places, control of motor vehicles in the area allowing only the staff operated electric carts at the site and environmental monitoring programs.

4.3.7 Fuel Storage

The one bus depot will have storage facilities for substantial amounts of fuel on site. As the exact location of this bus depot is yet to be finalized, EIA only provided a set of criteria for site selection and general safety requirement for design and operation. Once
the site is finalized, the Public Transport Component EIA will be further updated according to a framework developed in EMP.
5. Analysis of Alternatives

5.1 Without Project Scenario

Xi’an faces the dual challenges common to all urban areas in China – increasing urbanization and rapid motorization. However, the rapid urbanization that accompanied Xi’an’s growth has also brought Xi’an great pressures on its infrastructure provision. Transport demand, in particular, has been grown much faster then the economic growth, resulting in traffic congestion and increasing motor vehicle emission. In 2003, the urban population was 5.2 million, and urban residents made 1.95 trips/day. Between 1990 and 2001, when real economic growth averaged 10.4% per annum, road traffic grew at 15.7% per annum. During the same period, vehicle ownership in Xi’an grew from 10.1 vehicles per 1,000 people to 23.1. Currently, the motor vehicle fleet in Xi’an is 440,000, and this is expected to increase to 970,000 in 2010 and 1,800,000 in 2020. As a result, Xi’an’s transport system sees great pressures in providing an enabling environment for sustaining development, maintaining urban accessibility and mobility, preserving its cultural and historical characteristics or minimizing environmental impacts of transport systems.

Road Network. Due to historical setup of the city, the road network in Xi’an features an urban core area surrounded by two ring roads. It suffers from traffic congestion on the primary road network due to a lack of an effective network of secondary roads, which forces traffic on the main roads for even short distance trips. There are specific issues regarding the functionality of the ring roads which tend not to operate as rings, rather they currently operate as north/south and east/west arterials. Because the urban core area is surrounded by city wall from Ming Dynasty, traffic in/out city is limited by XX wall gates. While the 1st ring road outside the city wall still has grade intersections in East Gate and Yuxiang Gate, its ability to accommodate traffic from various directions is compromised. The 2nd Ring Road also has some at grade intersections on its east section, reducing its capacity for diversion of longer distance cross town traffic. Without improvement of these intersections, traffic congestion will become more and more serious in these intersections along with rapid motorization, and eventually become bottleneck of sound road network development in Xi’an.

Public Transport. Public transport has been developing rapidly in Xi’an, however, it still can not meet ever increasing demand due to management and infrastructure shortages. Currently, bus operating speeds are declining and below 10km/h in the core area, as no priority measures have been provided. There is a shortage of parking and depot space, due in part to land allocation problems. Use of ICT for routine administrative or operational tasks (including ITS/AVL for on street bus dispatch and monitoring) is limited. It is commonly recognized that promotion of public transport is an effective intervention to improve urban traffic effectiveness and management. If current issues of public transport in Xi’an are not well addressed, the effectiveness and service level of public transport will be further declining, which will inevitably lead to substantial increase of private vehicles causing more traffic congestion and air pollution issues.

Traffic Management. Traffic management is undeveloped in Xi’an city where the focus is on police operations rather than a comprehensive package of integrated on-street traffic
management measures. There is a weak technical and institutional foundation for
developing ITS. Pedestrians and bicycles are not well provided for; space for these
vulnerable road users has been squeezed to make more room for MVs. In addition, there
is a perceived lack of parking spaces and this has not been addressed systematically. While
provision of road infrastructure is a foundation of efficient urban traffic, good traffic
management is the core. Continuation of current traffic management practice will be
obviously not sustainable for Xi’an. It is clearly recognized by the city of the need for more
comprehensive approach to traffic management to broaden practices from police
operations to include traffic management planning, design and implementation of on-
street physical measures, use of traffic management and ITS tools to help establish the
foundations for future TDM, better provision for pedestrians and cyclists, parking
management and a comprehensive parking strategy, and better road safety.

Cultural Heritage Protection – Weiyang Palace component in Han City. Weiyang
Palace relics reflect the historical development of Han Dynasty, one of the most powerful
e Empires in Chinese history. It is the main target of archaeological research, a historic
relic of great economic, political, cultural and environmental values, as well as an
important tourism site, which has direct and indirect historical and scientific education
function. The Han Chang’an City, where Weiyang Palace is located has been surrounded
by rapid urban development. To protect the relics, the economic development of local
residents (about 9342 people within the area) has been limited in terms of infrastructure
and production for long time, therefore, the income level of these people is much lower
than that of people outside the protection area. The notable economic gap between the
areas inside and outside the relics has strongly discouraged local residents’ enthusiasm in
protecting cultural relics. With the rapid urbanization, the whole Han Chang’an city and
especially the relics of Weiyang Palace are confronting rigorous challenge.

Currently, problems exist in the protection and exhibition of Weiyang Palace Relics. The
lacking of exhibition measures has caused a bad exhibition result, which can not realize
the social education function and promote the development of sight-seeing business.
According to archeological documents, all the relics of Weiyang Palace Relics are
situated around the roads of Han Dynasty. The implementation of protection project on
the basis of original roads system will protect and exhibit the relics in Weiyang Palace
Relics and their distribution, and greatly enhance the protection, exhibition of Weiyang
Palace Relics and sight-seeing business. However, existing roads on Weiyang Palace site
are built inconsistently with the form and orientation of the original Han Dynasty roads,
which has caused damages to the original road system and structure. The economic
development (including not well-controlled construction activities), along with the
vehicle emission, vibration, and noise pollution caused by the increasing traffic volume,
has greatly threatened both the ecological environment and the Han Dynasty relics that
has passed through thousands of years history. The Weiyang Palace site is a world-class
relics and has strong potential to become a new sight-seeing spot in Xi’an. While,
without proper protection and exhibition, such an important archeological, education and
tourism value will not be materialized, and the Han City area will be very likely
encroached gradually by rapid economic development.

Cultural Heritage Protection – Bicycle route component. Currently the core area of
Xi’an is surrounded by the wall constructed in Ming Dynasty (Ming Wall). There are a
large number of cultural relics and historical heritage inside the city. Motor vehicles are
the main transportation for tourists into the city every year, contributing to the already severe traffic congestion and air pollution situation, particular in tourism season. Without development of alternative solutions, such situation will continue and surely deteriorate with increase of tourists in the future. The proposed bicycle route (mostly using small streets) connecting the main tourism spots inside the city will provide a great opportunity to promote environmental-friendly tourism, alleviate traffic pressure, protect and restore the historical style and features of ancient capital.

**Air Quality Management.** Results of ambient air quality monitoring in Xi’an show that the primary air pollutant in Xi’an is fine particulate matters (PM). In recent years pollution levels of PM$_{10}$ in the city have been constantly exceeding the National Class 2 Ambient Air Quality Standard. While the annual averages of nitrogen dioxides (NO$_2$) have not exceeded the standard, ad-hoc measurements at roadsides reported the violation of the standard at peak hours. A PM$_{10}$ source appointment study indicates that vehicular emissions represent 25% (including 12% of secondary PM$_{10}$) of local emission sources in July 1998, followed by coal combustion (24%) and fugitive dust (22%). Based on current increase of motor vehicles in Xi’an, it is foreseen that vehicle emission pollution will increase rapidly (confirmed by model estimation of Xi’an EPB) unless adequate measures are taken.

Overall, the proposed Xi’an Urban Transport Project will address these existing issues, and its implementation will improve accessibility and mobility in Xi’an while protecting its cultural heritage and reducing the environmental impact of urban transport system. It will have substantial positive environmental benefits through physical investment of improving traffic efficiency, increasing pedestrian and bicycle facility and promoting public transport in Xi’an city (Ming City), strengthening motor vehicle emission inspection control and protecting cultural heritage, as well as technical assistance program of institutional capacity strengthening of city government agencies with particular emphasis on traffic management, environmental protection and cultural heritage preservation.

**5.2 Alternatives Considered during Project Planning**

The basic policy for urbanization in Xi’an city is to protect the heritage of the existing urban area, and to provide new areas for economic development. The sub-regional plan designates a number of satellite towns (including Huxian and Xianyang) as the main centers for development, with some development in smaller towns dotted about the sub-region. The centerpiece of the master plan is the protection of the Ming dynasty walled city, which contains some of Xi’an’s important cultural resources. Under the “Imperial City Recovery Plan”, all government offices are being moved form the Ming walled city to the northern quadrant of the city, while traditional commerce, and tourism, are retained as the main activities.

The project has been designed within this framework, and with sustainability in mind. The emphasis has been on scaling ‘down’ rather than scaling ‘up’ – choosing investments that are appropriate in scale to the vision of the city leaders for Xi’an’s future. This emphasis forced consideration of some major investment alternatives. The objective was to identify and select the alternatives with the least adverse impact on the natural environment and local communities,
Level of investment in roads. The original project proposal placed almost 80% of the total investment into the road network, with limited investment in public transport, a not unusual situation. Analysis of overall investment in the ADB project and 10 & 11 FYP showed that the road investment was already far greater than PT investment, and that PT was failing to meet existing travel demands. Without greater investment in PT the mobility and accessibility of the majority of the population without access to a car could not be improved. According the original proposal was rejected in favour of an option which places only 56% of the investment in roads, and 35% in the other modes – public transport, cyclists and pedestrians.

Focus of road investment programs. The original proposals were not based on any systematic analysis of existing problems, or achievement of specific objectives, and tended to focus on a desire to upgrade all primary roads to urban expressways. Analysis showed that the most pressing problems related to relieving traffic pressures in the walled city, to strengthening the emerging road hierarchy, and improving conditions for cyclists and pedestrians. This provided the focus to select road investments. Various packages of road schemes were considered before choosing the package of schemes to support the Ming Walled City that is included in the Project.

Focus of pedestrian improvements. The alternatives considered for pedestrian improvements were: (i) to focus investment on a limited number of relatively expensive pedestrian overbridges/underpasses at key points of traffic/pedestrian conflicts (where the investment tends to benefit motorists) or: (ii) to invest in improving pedestrian facilities and providing more user friendly at grade crossings over a wider area. The later alternative was chosen as it provides benefits to pedestrians rather than motorists – and in larger numbers.

Focus of improvements for NMV. One way to enhance NMV mode share is through networks of segregated and exclusive NMV and MV roads. However, experience has shown that only the exclusive MV roads got implemented. Accordingly, this project aims to maintain and enhance NMV mode share by

(a) ensuring that that NMVs are provided with appropriate facilities on as many roads as possible and that there is a spread of routes with NMV facilities across the network.

(b) introducing the concept of an functional road hierarchy, where the lower order roads in the network have a predominantly NMV and pedestrian function

(c) creation of an NMV predominant route in the Ming Walled City with a high quality urban design and traffic calming to make cycling both a safe and pleasant experience

Not including the BRT pilot line. The BRT is a high risk but high reward investment. While several BRT had been implemented in China, none has so far received the critical acclaim of the pace setting BRT in Latin America. So the question arose of whether or not the project should help Xi’an create a pilot line that would become the model for other cities. The reasons to support the pilot line should be self evident.

Inter –Linking of PT, TM, ITS and AQM. An Italian Grant Funded demonstration project in the centre of Beijing is examining ways to inter-link these four aspects of urban
transport. The basic concept is that when AQM detects emissions exceed prescribed limits, heavy polluting cars are prevented through TM from entering the central area, and using ITS extra buses are supplied to carry the people in the stopped cars. An MoU has been signed for a similar demonstration project in Xi’an on several access points to the walled city. There was discussion on whether the results of this demonstration in Xi’an could be scaled up to the whole walled city as part of this project. It was agreed that as the practical issues may not be solved within the project life time, there would be no attempt to link these four items in the project.

5.3 Alternatives Analysis during Project Design

In all project components, various alternative designs, alignments and sites have been identified where applicable during the project feasibility study and environmental assessment stage. While the project engineers and planners have evaluated the alternatives from the engineering and transportation considerations, the EA team at the same time evaluates and compares the alternatives from mainly the environmental and socio-economic considerations. The EA team has worked closely with the engineers and planners, and communicated the results of environmental analysis of the alternatives to the engineers and planners which where appropriate have been incorporated into the decision making process. The objective of the analysis of alternatives during the EA is to identify and select the least adverse impact alternatives during the project design and planning so that the project adverse impacts to the natural environment and local communities can be avoided or minimized.

The alternatives evaluated for various components are summarized as follows:

5.3.1 Xian urban road network upgrading

- The alternative of an underground tunnel underneath the south ring road from the west to east ends versus underground passes only under the sections of the near Hanguang gate, South gate and Heping gate. The first alternative has been adopted for the project due to the better cultural conservation, less emission and noise impact and better solution for the traffic congestion in the area.
- Direct West Ring Road pass through the intersection under the ground with four lanes double ways versus the conversion of round about at the ground level to traffic light control intersection. The first alternative has been selected due to its low construction phase impacts.
- Direct East Ring Road pass through the intersection through an underground culvert, versus the pass only for north to south traffic. Although alternative 1 has higher impacts on utilities and wall side river, it can best solve the traffic congestion and can best meet the project transportation target and is thus adopted for the project.
- A four deck interchange with alternative configurations. The one with less occupation and low construction phase impact has been selected.
- Partial interchanges at east/south second ring road. The one with low land occupation and low construction and operation phase impacts has been selected.
- Partial interchange at Taibai/Zhangba roads versus full four deck interchange. Although the full interchange has higher impacts overall, it best resolves traffic congestion and meets the transportation objective at the location so it is selected for the project while mitigation measures are taken to address the higher impacts.
5.3.2 Huxian road

☑ Two alternative road plans. The one with better achieving transportation objective while occupies less than and has less impact has been selected for the project.
☑ Considerations of flyover and underpass for grade separate passes. As Huxian has heavy rains in the summer months causing flooding, increase burden to the local drainage system, and interrupt traffic at underpasses, the plan with flyover where possible has been adopted for the project.

5.3.3 Public transport

☑ Two design options for BRT: one is to build dedicated central BRT lane with island stations and with the door open to the left and the other option is to use the central dedicated BRT lane but with the door open to the right. In all five streets/roads, door open to the left option would better utilize the existing road conditions, safe passenger access and has thus been selected as the design.
☑ At the time this EA was prepared, this project component was still in the process of site selection for bus depots and maintenance. No specific site conditions were available for analysis of alternatives yet but a set of environmental and community impact considerations have been established and will be applied during the site selection process.

5.3.4 Bicycle route in Ming City

☑ Three alternative routes were considered, which provide connection of different tourism spots, traditional street, famous restaurants, with consideration of local demand for shopping, working and education. The selected route has the smoothest alignment, shortest distance, and reasonable coverage of Xi’an city. It is also compatible with urban planning by including trunk/secondary roads to promote bicycle trip.

5.3.5 Air quality control component

☑ Two alternative sites for air quality inspection center at Lintong and Changan. The Lintong site is a better from the environmental perspective but has no expansion potential. The Changan site is finally selected with necessary mitigation to address the environmental concerns.

5.3.6 Weiyang Palace site road rehabilitation

☑ Two alternatives for the scope of road to be protected are developed for comparison. The alternative with better cultural property protection, cultural relics conservation, tourist and tourism development and access to the site, although higher in construction cost, is selected for the project.
☑ Three road surface pavements are compared and evaluated. The alternative with better resemblance of the ancient architect and road style, while suitable for electrical vehicle operation and the problems of dust and drainage has been selected for the project.
6. Environmental Management Plan

6.1 Environmental Management Organizations

**Overall Project Implementation Arrangement.** A Project Steering Committee (PSC), established by Xi’an Municipal Government (XMG), is responsible for providing overall leadership and guidance as needed on project preparation and implementation. Under the leadership of PSC, the Xi’an World Bank Project Management Office (PMO) was established to undertake project preparation. During project implementation, the PMO will retain responsibility for coordinating policy and institutional issues related to the project, and the institutional development and capacity building activities that are not directly related to any specific project components. Upon completion of project preparation (i.e. the signing of the World Bank Loan Agreement), Xi’an Infrastructure Investment Company (IIC) will be contracted by the Municipality to project manage the implementation of the Project. The Xi’an PMO will provide oversight of IIC’s implementation of the Project. IIC ensures that the individual component implementing agencies take day to day responsibility for implementation activities, and manages overall project implementation including budgets, certifying payment requests to contractors, procurement quality, and construction supervision. Upon completion of implementation, projects will normally be handed over to the relevant operating, management or maintenance agencies.

Environmental management responsibilities of key organizations involved are:

**Xian Urban Transport Project Management Office (PMO):** Xian PMO will provide oversight of overall implementation of EMP; together with IIC ensure EMP provisions are incorporated into bidding documents and contracts; supervise implementation of environmental mitigation measures during construction; organize environmental training for IIC, Component Owners, Contractors and Supervision Engineer; consolidate EMP implementation report and communicate with the World Bank. The PMO will have dedicated environmental staff who will be responsible for overall environmental management issues, liaison with regulatory agencies.

**Xi’an Infrastructure Investment Company (IIC):** IIC will be responsible for overall implementation of environmental mitigation measures; development of environmental protection work plan; incorporating EMP provisions into bidding documents and contracts (together with PMO and Component Owners); contracting supervision engineer with clear requirement of environmental supervision; providing guidance to Component Owners, contractors and supervision engineers on environmental mitigation measures implementation during construction; supervising EMP implementation. IIC will have dedicated environmental staff responsible for environmental issues mentioned above.

**Component Owners:** The component owners are responsible for day to day environmental management of their own component construction, incorporating environmental specifications into bidding document and contracts, carrying out environmental management activities during construction stage and operation stage, supervising contractors on implementation of environmental mitigation measures;
reviewing and responding with new mitigation as may be necessary; reporting EMP implementation status to IIC and Xi’an PMO. Each Component Owner will assign one full time environmental staff for environmental management and supervision. The Component Owners involved including the following:

<table>
<thead>
<tr>
<th>No.</th>
<th>Project Component</th>
<th>Component Implementing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Road Network – Xi’an</td>
<td>Municipal Public Works and Management Commission (MPWMC)</td>
</tr>
<tr>
<td>2</td>
<td>Huxian County</td>
<td>County Construction Bureau</td>
</tr>
<tr>
<td>3</td>
<td>Public Transport</td>
<td>Xi’an Municipal Communication Bureau (XMCB), and Xi’an Public Transport Company (XPTC)</td>
</tr>
<tr>
<td>4</td>
<td>Traffic Management</td>
<td>Xi’an Public Security Bureau Traffic Police Detachment (XPSB)</td>
</tr>
<tr>
<td>5</td>
<td>Air Quality Management</td>
<td>Xi’an Environment Protection Bureau (XEPB)</td>
</tr>
<tr>
<td>6</td>
<td>Cultural Heritage – Ming City Bicycle Network</td>
<td>Xi’an City Scenery Wall Committee (XCSWC)</td>
</tr>
<tr>
<td>7</td>
<td>Cultural Heritage – Han Chang’an Site</td>
<td>Xi’an Municipal Cultural Heritage Bureau (XMCHB)</td>
</tr>
<tr>
<td>8</td>
<td>Capacity Building</td>
<td>Xi’an Planning Bureau and relevant line agencies</td>
</tr>
</tbody>
</table>

**Contractors:** Contractors are responsible for implementing concrete environmental mitigation measures as specified in contracts; developing environmental protection working plan for its contract; reporting to IIC/PMO new environmental issues or chance-find of any cultural relics encountered during construction; carrying out continued public consultations for construction. Each Contractor will be required to appoint one to two full time environmental staff responsible for environmental management under its contract.

**Supervision Engineers:** Supervision Engineers will supervise both engineering quality as well as environmental performance of contractors; identify deficiency of contractor’s environmental performance and provide corrective instructions; reporting EMP implementation status to IIC/PMO. Each Supervision Engineer company will be required to appoint one environmental supervision engineer.

**Xi’an Environmental Monitoring Station:** XEMS will conduct environmental monitoring according to Monitoring Plan of EMP for both construction and operation stages; provide monitoring reports to IIC/PMO; recommend corrective actions based on analysis of monitoring data.

### 6.2 Environmental Management

**Construction Stage:** In order to effectively control and minimize environmental pollution resulting from construction activities, the construction site must be assured of an environmental management system including qualified full time personnel to ensure the mitigation measures are appropriately implemented. More specifically, the system construction stage will:

- Include environmental protection requirements, mitigation plans and monitoring plan into the bid documents and eventually in the contract;
- Require contractors to have full time environmental staff at the site;
- Require the construction supervision team to have at least one full time environmental supervision engineer.
• Explain to the affected residents potential impacts through public notice and information release; and
• Continue public consultation through hotline telephone, and bill boards at the construction site.

**Operation stage:** Environmental management during operation is a long term effort, which requires well structured environmental management system, on which to further build supervision, monitoring and management procedures. The environmental monitoring will be an effective tool to determine the environmental performance but preventive measures will also be needed such as proper maintenance. During the operation, the project operator (Communication Bureaus of each project cities) will work closely with provincial and municipal EPBs on city environmental programs such as motor vehicle emission control strategy, vehicle inspection and forced retirement plan etc.

### 6.3 Personnel Training

Given the importance of mitigation measures implementation during construction phase, a training plan is developed for Contractors, Supervision Engineers, Project Owners and PMO/IIC staff. Though the environmental staff assigned may have fairly good knowledge and capacity, continuous and repeated training is always expected to be valuable.

Other capacity building program include training of environmental staff from bus depot, terminal and parking site; training program in AQM component related to vehicle emission monitoring network operation, use of monitoring equipment and data processing, data analysis and policy development etc. An Intelligent Traffic Management system project under Italian Government grant is also an important capacity building initiative for Xi’an along with this project.

**Table 6-2 Environmental Training and Capacity Building Program**

<table>
<thead>
<tr>
<th>Staff</th>
<th>Content</th>
<th>Type</th>
<th>Quantity</th>
<th>Duration (day)</th>
<th>Cost (10^3 RMB)</th>
<th>Organized by</th>
<th>Fund source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contractor</strong></td>
<td>Environment regulations and policies; contents of EMP, particular various mitigation measures; environmental reporting; cultural heritage protection and chance-find procedures; emergency response</td>
<td>Domestic</td>
<td>2 people from each contracted section</td>
<td>4</td>
<td>8</td>
<td>PMO</td>
<td>Project fund</td>
</tr>
<tr>
<td><strong>Environmental Supervision company, project owners, PMO</strong></td>
<td>Environment regulations and policies; contents of EIA and EMP, particular various mitigation measures; environmental reporting;</td>
<td>Domestic</td>
<td>1-2 people from each contracted section</td>
<td>5</td>
<td>8</td>
<td>PMO</td>
<td>Project fund</td>
</tr>
</tbody>
</table>
environmental monitoring requirement; cultural heritage protection; emergency response

<table>
<thead>
<tr>
<th>Senior environmental managers, and environmental engineers from PMO, IIC and Component PMOs</th>
<th>International best environmental practice for traffic management and noise control</th>
<th>Overseas</th>
<th>4</th>
<th>15</th>
<th>20</th>
<th>PMO</th>
<th>Project fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Operation**

<table>
<thead>
<tr>
<th>Environmental staff from bus terminal, depot and parking site</th>
<th>Environmental regulation and standards; operation of wastewater treatment facility; waste management</th>
<th>Domestic</th>
<th>6</th>
<th>3</th>
<th>3</th>
<th>Public Transport Company</th>
<th>Operation cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training program under AQM component for XEPB, XEMS</td>
<td>Vehicle emission monitoring network operation, use of monitoring equipment and data processing, data analysis and policy development</td>
<td>Domestic and overseas</td>
<td>To be decided in AQM</td>
<td>To be decided in AQM</td>
<td>To be decided in AQM</td>
<td>XEPB/XEMS</td>
<td>AQM component fund</td>
</tr>
<tr>
<td>Intelligent Traffic System program</td>
<td>Intelligent traffic control to reduce emission pollution</td>
<td>Study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500,000 EURO</td>
</tr>
</tbody>
</table>

### 6.4 Environmental Monitoring

A two tier monitoring program has been developed for this project:

(i) **Routine monitoring** to be carried out by contractors and construction supervision companies. Environmental staff will be trained prior to the start of construction for the routine monitoring which will include mostly visual monitoring of air borne dust, surface runoff, storage and disposal of construction waste, traffic impacts, and construction safety issues. Hand-held noise meters will be used to monitor the noise levels at sensitive receptors during construction and

(ii) **Independent periodic compliance monitoring** by professional monitoring stations. An independent environmental monitoring program will also be carried out during the construction, as well as operation phase. This program will be conducted by professional environmental monitoring program with main objective to provide official records on environmental and regulatory compliance status, as shown in Table 6-3.
### Table 6-3  Environmental Monitoring Plan

<table>
<thead>
<tr>
<th>Stage</th>
<th>Env. factor</th>
<th>items</th>
<th>Sampling site</th>
<th>Frequency</th>
<th>Component Applicability</th>
<th>Applicable standards</th>
<th>Implementation units</th>
<th>Fund source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Air</td>
<td>TSP</td>
<td>Construction site near sensitive receptors</td>
<td>1 time/month during intensive construction period;</td>
<td>All components</td>
<td>Integrated Air Pollution Emission Standard (GB16297-1996), Class II</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Project Owners</td>
</tr>
<tr>
<td></td>
<td>Noise</td>
<td>L_{Aeq} (dB)</td>
<td>Construction site near sensitive receptors</td>
<td>1 day/month, 2 times (day and night)</td>
<td>All components</td>
<td>Noise Limit of Construction Site Border; GB12523-93</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Project Owners</td>
</tr>
<tr>
<td>Operation</td>
<td>Air</td>
<td>SO₂, NO₂, PM₁₀</td>
<td>2 ambient environmental air quality monitoring sub-station (together with 7 existing sub-stations)</td>
<td>Automatic</td>
<td>AQM Component</td>
<td>Ambient Air Quality Standards; GB3095-1996</td>
<td>Xi’an Environmental Air Monitoring Center</td>
<td>Operation cost from Xi’an Government</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOₓ, CO, CmH₇n</td>
<td>2 road side traffic pollution monitoring sub-stations</td>
<td>Automatic</td>
<td>AQM Component</td>
<td></td>
<td>Xi’an Environmental Air Monitoring Center</td>
<td>Operation cost from Xi’an Government</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SO₂, NO₂, Dust</td>
<td>Discharge of boiler (NG)</td>
<td>1 time/year</td>
<td>AQM Component</td>
<td>Air Emission Standard for Boiler; GB13271-2002, NG boiler</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost from Xi’an Government</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>pH, N, H₃PO₄, NCOD, BOD₅, oil</td>
<td>Bus terminal, depot, BRT parking lot wastewater discharge outlet</td>
<td>1 time/year</td>
<td>Public transport Component</td>
<td>Integrated Sewage Discharge Standard (GB8978-1996), Sewage Discharge Standard for Weihe River - Shaanxi Section (DB612242006)</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost from Xi’an Government</td>
</tr>
<tr>
<td>Stage</td>
<td>Env. factor</td>
<td>items</td>
<td>Sampling site</td>
<td>Frequency</td>
<td>Component Applicability</td>
<td>Applicable standards</td>
<td>Implementation units</td>
<td>Fund source</td>
</tr>
<tr>
<td>-------</td>
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<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wastewater discharge outlet of Xi’an Environmental Air Monitoring Center</td>
<td>1 time/year</td>
<td>AQM Component</td>
<td>Noise Standard for Industrial Enterprises Border (GB12348-90, Class II)</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost</td>
</tr>
<tr>
<td>Noise</td>
<td>L&lt;sub&gt;Aeq&lt;/sub&gt; (dB)</td>
<td>Border of bus terminal, depot, BRT parking lot</td>
<td>2 days/year (day and night/time)</td>
<td>Public Transport Component</td>
<td>Noise Standard for Industrial Enterprises Border (GB12348-90, Class II)</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Border of Xi’an Environmental Air Monitoring Center</td>
<td>2 days/year, (day and night/time)</td>
<td>AQM Component</td>
<td>Noise Standard for Industrial Enterprises Border (GB12348-90, Class I)</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Key sensitive receptors along the roads</td>
<td>2 days/year (day and night/time)</td>
<td>Xi’an Road Network, Huxian Road</td>
<td>Urban Regional Noise Standards (GB3096-93)</td>
<td>Xi’an Environmental Monitoring Station</td>
<td>Operation cost</td>
<td></td>
</tr>
</tbody>
</table>
6.5 Cost Estimate

The cost estimated for environment management covers both the capital cost and recurring cost, including monitoring cost, for environmental facilities. All of the cost has been included in the overall budget of the project.

6.5.1 Cost Estimate for Environmental Engineering

The estimated costs for the impact mitigation works, as part of the project is given in Table 6-4, and estimated unit costs for pollution control facilities used in different project components are show in Table 7-8-2.

<table>
<thead>
<tr>
<th>Table 6-4 Estimated Costs for Impact Mitigation Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 6-5 Estimated Cost for Pollution Control Facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Noise reduction measures

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pump, Boiler, fan of Environmental Air Monitoring Center, air presser and generator in bus terminal/park and depot</td>
</tr>
<tr>
<td>4</td>
<td>Air emission stack</td>
<td>Air Monitoring Center</td>
</tr>
<tr>
<td>5</td>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

#### 6.5.2 Cost Estimate for Construction Phase

**Table 6-6 Cost Estimate for Environmental Engineering in Construction Phase**

<table>
<thead>
<tr>
<th>Environmental concern</th>
<th>Engineering</th>
<th>Cost ($10^4$ RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. schedule of construction</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>2. construction camp, mixing station and stockpiles be at least 100 m from sensitive receptors</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>3. selection and maintenance of operation equipment, installation of noise barrier</td>
<td></td>
<td>50.0</td>
</tr>
<tr>
<td>4. health safeguard for operating staff and supervisory staff on site</td>
<td></td>
<td>90.0</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. septic tanks and solid waste transport on site</td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td>2. construction wastewater treatment</td>
<td></td>
<td>25.0</td>
</tr>
<tr>
<td>3. water pollution control for bridge construction</td>
<td></td>
<td>50.0</td>
</tr>
<tr>
<td>4. stockpile guard from rush by rainfall</td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>5. clearance on construction site</td>
<td></td>
<td>10.0</td>
</tr>
<tr>
<td>6. soil erosion control</td>
<td></td>
<td>40.0</td>
</tr>
<tr>
<td><strong>Air</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. water spray on site</td>
<td></td>
<td>10.0</td>
</tr>
<tr>
<td>2. powder material management</td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td>3. safeguard of operating staff’s health on mixing station and asphalt melting station</td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>4. cover of transport trucks</td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td>5. site location and equipment selection for mixing station and asphalt melting station</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td><strong>Environmental management</strong></td>
<td></td>
<td>60.0</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. contractor, environmental supervisory staff, project management staff and environmental engineers</td>
<td></td>
<td>36.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>456</td>
</tr>
</tbody>
</table>

#### 6.5.3 Cost Estimate for Operation Phase
Table 6-7 Cost Estimate for Environmental Engineering in Operation Phase

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Cost ($10^4$ RMB/a)</th>
<th>Cost ($10^4$ RMB)*</th>
<th>Implementing agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental management</td>
<td>Daily management (salary and operation cost)</td>
<td>2.0</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation, maintenance and depreciation</td>
<td>3.0</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance of greenbelts</td>
<td>10.0</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Old waste collection and disposal</td>
<td>4.0</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Environmental monitoring</td>
<td>Environmental monitoring for construction and</td>
<td>1.0</td>
<td>32.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>operation phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>Staff training</td>
<td>1.0</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>Contingency</td>
<td>1.5</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Operation for 20 years (2010–2030)</td>
<td>22.5</td>
<td>478.5</td>
<td></td>
</tr>
</tbody>
</table>

In summary, the total environmental related investment is 431 million RMB, accounting for about 14.48% of total project investment of 2,979.9 million RMB.
7. Public Consultation and Information Disclosure

7.1 Approach and Methodology

According to Article 15 of the Guidelines for Environmental Protection for Construction Projects of the State Council, other applicable laws and regulations, as well as OP4.01 of the World Bank, the EA must include public consultation programs. The public consultation may include the following aspects:

- Topics and issues: related to the natural and socio-economic environments;
- Scope: the environmental impact assessment is conducted, and areas which will be impacted by the project;
- Objects: affected public, such as urban and rural residents, schools, etc.;
- Method: mainly public opinion questionnaire surveys and dedicated interviews;
- Contents: opinion questionnaire, public opinions record, the response from public consultation, measures to address or respond public concerns.

7.2 Public Consultation Program

This EA includes two rounds of public consultation conducted for all project components around Xian and in Huxian county by the EA team.

The first round was during the EA preparation stage in March 2007 through public meetings and questionnaire survey. In this round, the EA team introduced the project contents, locations and other project information as well as the potential impacts to the public. Public feedback is sought for their concerns and opinions. During the first round of public consultation, 100 questionnaires were distributed for each of the project components, in the ring road area, walled area, Weiyang Palace, Huxian and other project locations, totaling 700 copies.

The second round of public consultation was conducted after the draft EA reports had been prepared. The main method of consultation included meeting with project-affected public (including residential households, farmers, representatives from schools, enterprises and institutions, and related cultural relics authorities. EA team provided introduction of the project, main contents of EIA reports, positive and negative environmental impacts and proposed mitigation measures. Following the meeting, questionnaire survey was conducted. A total of 600 copies of questionnaire were distributed across the city, equivalent to 100 copies in each of the six project components.

<table>
<thead>
<tr>
<th>Component</th>
<th>Road upgrading</th>
<th>Huxian Road</th>
<th>Public transport</th>
<th>Weiyang Palace site road</th>
<th>Bicycle lane</th>
<th>Air emission inspection station</th>
</tr>
</thead>
<tbody>
<tr>
<td>First round</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The main concerns and issues raised by the public during the public consultation and dedicated interviews included resettlement, construction noise and dust, traffic disruption during construction, effectiveness of the mitigation measures, continued public consultation, site rehabilitation, vibration to cultural properties, bicycle lane safety, and tourist development. These concerns have been addressed in the EA, communicated to the relevant authorities and project engineers/planners as appropriate and responded to the parties concerned.

**Table 7-2  Key Issues from Public Consultation and Responses**

<table>
<thead>
<tr>
<th>Issues</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resettlement: while most surveyed as well as stores/shops, institutions and other live, work or have their businesses in the project affected areas, support the project and are willing to relocate and resettle, they concern the compensation will be fair, paid on time and the disruption of life will be minimum.</td>
<td>The concern has been passed along the project resettlement action plan RAP team. As part of the project safeguard preparation and clearance procedure, all affected will be compensated with the standards fully compliance with the relevant government regulations and standards, as well as the World Bank’s policies and principles on involuntary resettlement. All levels of governments and executing agencies have committed to paying the compensation on time and arrangement resettlement activities so that the impacts and interruption would be controlled to the minimum. The relocated housing will be fully furnished with modern household appliance such as water supply, toilets, space heating, etc., representing a huge and significant improvement in living conditions when compared with the current housing.</td>
</tr>
<tr>
<td>Some residents, as well as schools, are concerned with the noise and dust during project construction.</td>
<td>all construction sites near sensitive receptors will take specific mitigation measures, including public notice billboards for construction schedule and contact persons and their telephone numbers, detailed construction management and monitoring plans, careful locating of noise construction machines, for the sensitive receptors where noise exceeds the applicable standards, some mitigation measure such as double glazed windows ahead of time, etc.</td>
</tr>
<tr>
<td>Traffic disruption during construction, including disruption to bus services and access by non motorized vehicles and access to services and commercial areas.</td>
<td>A detailed traffic management plan will be developed for the construction roads especially in the urban built up and congested areas where some of the project components will be located. All project areas will maintain traffic even at the reduced capacity. Local traffic will be controlled and non local traffic may be</td>
</tr>
</tbody>
</table>
While over 60% feel the impacts during operation will be acceptable, many demand mitigation for operational phase be taken to really control the adverse impacts.

Some concerned whether they would have the channels to voice their concerns in the future which they may not be aware today.

Following construction, all construction waste should be removed from the site promptly, damaged roads, side walks, greens, and other community facilities be repaired, restored and rehabilitated as needed.

The road will be added to the top of the existing roads, minimum excavation into the ground; the drainage system will be installed to improve site drainage.

The project EMP will be on the same Han Dynasty road system. No creation of the new road alignment. Will not change the ancient road layout.

Requests noted and will be adopted.

The bicycle lanes are virtually based on the existing roads with road improvement. No direct linkage with cultural properties. Small amount of construction and no impact to cultural properties. The bicycle lanes will help reduce motor vehicle traffic and thus emissions, noise, vibration in the cultural property areas and help cultural relics protection.

Bicycle lanes will be dedicated and separated from the motor vehicle lanes and pedestrians to ensure safety.

The bicycle lanes will connect many tourist attraction sites, provide a healthy, fun and convenient transportation option.

<table>
<thead>
<tr>
<th>Concerns from Weiyang Palace management:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction methods</td>
</tr>
<tr>
<td>Effects to Han dynasty road system</td>
</tr>
<tr>
<td>Request to use small equipment where possible, minimize vibration, use experienced contractor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concerns from Drum tower, Bell Tower, Calligraphy stones, 8th Army Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects to the view and protection of the cultural relics</td>
</tr>
<tr>
<td>Bicycle lane safety</td>
</tr>
<tr>
<td>If the bicycle lane will help tourists</td>
</tr>
<tr>
<td>Request to minimize vibration, construction conducted in phases and good site management</td>
</tr>
</tbody>
</table>

7.3 Public Consultation in Project Design

In addition to the public consultations required for environmental impact assessment and resettlement planning under Chinese law and Bank regulations, the project also incorporated a public participation process as a separate strategic input into the project preparation to enhance project design. Built upon international good practices, public participation is integrated into the XUTP and carried out in three phases: (a) Project Design and Feasibility Stage Public Participation, when participation is designed to identify key issues of public concern; (b) Appraisal Stage Public Participation, when solutions to issues raised were presented to the public for review and comments; and (c)
Implementation Stage Public Participation, when the satisfaction level of the public with project implementation and outcomes will be ascertained. The Design and Feasibility Stage Public Participation was carried out in September 2006. A summary of the main findings is presented below.

**Participatory Methods:** For each stage of public participation, an independent consultant was (and will be) hired to conduct an extensive three-fold efforts - open meetings, focus group discussion and questionnaires. Special efforts were made to ascertain the needs of women and of vulnerable groups, such as the elderly, migrants, the disabled, and the low income populations. Findings from the Design and Feasibility Stage Public Participation led to special attention to involve pedestrians, bicyclists, and bus users in the Appraisal Stage Public Participation. The design institutes and city authorities will respond to issues raised in the project design and implementation.

**Main findings:** The most urgent transportation issues and concerns included: (a) traffic congestion, (b) insufficient bus service, inappropriate routing, (c) NMV and MV mixed traffic, (d) illegal occupation of NMV lanes by MV, (e) safety concerns with pedestrian crossings, (f) poor drainage system condition, (g) insufficient parking, (h) poor traffic management, and (i) poor street lighting conditions.

**Major barriers:** The consultation also identified major barriers of travel for NMV, PT riders, and other mode users, including:

- **Walkers:** safety concerns with crossings and junctions, and poor pedestrian facilities,
- **Bicyclists:** lack of parking facilities, and safety concerns related to mixed traffic, crossing, and road condition when it snows,
- **PT riders:** short PT service duration, poor stop locations or stop facilities, and service sensitivity to the senior (and other vulnerable),
- **Commuting bus riders:** limited service time, routing and short service duration
- **Motorcyclists:** lack of parking and safety concerns related to mixed traffic, and unclear function of right of way – e.g. bike lane used as bus lane,
- **Taxi users:** cost
- **Cars drivers** (major trip purposes are shopping and entertainment): congestion

**Vulnerable Users:** From the vulnerable users perspective, the major barriers to travel and the major demand for improvements included:

- **Senior (mainly PT riders and walkers)**
  - Barriers: safety concerns, poor road and sidewalk conditions, and lack of sensitivity of PT service to the needs of the senior
  - Needs: more public toilets, higher PT driver qualifications, increased provision of protected pedestrian crossing time, improved road and sidewalk conditions, and expanded coverage of senior discount bus fare
- **Women (mainly PT riders and Bicyclists)**
  - Barriers: poor road and sidewalk conditions and peak hour congestion
  - Needs: improved road and sidewalk conditions, improved PT service level (reduced crowd-ness, extended service duration), improved street light and traffic light conditions, and proper management of the use of bike lanes.
- **Disabled (wheeled chair riders, bicyclists, and PT riders)**
Barriers: poor road conditions, and safety concerns with mixed traffic, and crossing
Needs: improved road and sidewalk conditions, provision of more disable road facilities, and improved junction traffic management

• Immigrant (PT riders, Bicyclists and Walkers)
  Barriers: congestion, mixed traffic, and poor sidewalk management
  Needs: properly maintained the sidewalk, improved road condition and pavement, strengthened traffic management, less congestion, and improved crossing facilities (e.g. under and over passes)

• Pop under poverty (motorcycle, walking, and tricycle)
  Barriers: poor secondary road and sidewalk conditions, and illegal parking on sidewalks
  Needs: improved pavement conditions, move cars from sidewalks, improved drainage and snow treatment facility, improved traffic management and enforcement, and proper resettlement for population under poverty

**Incorporating the Pubic Consultation Findings into the Project:** A list of location-specific issues for each project component was provided by the Public Consultation consultant. The design teams have addressed the specific issues identified in the feasibility studies for each component. The proposed solutions will be the subject of the Appraisal Stage Consultation

**7.4 Information Disclosure**

According to the requirements of relevant environmental laws, regulations and government decrees of China as well as OP4.01 of the World Bank, project information has been disclosed to the public. The information disclosure is summarized in Table 7-2.

**Table 7-2 Summary of Information Disclosure**

<table>
<thead>
<tr>
<th>Time</th>
<th>Venue</th>
<th>Method</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 18/07</td>
<td>Internet</td>
<td>Public notice</td>
<td>Project information and invitation for public comments and inputs</td>
</tr>
<tr>
<td>May 17/07</td>
<td>Huxian government and meeting houses of the three project affected villages</td>
<td>EIA report display</td>
<td>The draft Huxian component EIA report was placed in these locations for public review</td>
</tr>
<tr>
<td>May 19/07</td>
<td>Xian Public Library</td>
<td>EIA report displays</td>
<td>Six draft component EIA reports have been placed in the Xian library for public review</td>
</tr>
<tr>
<td>May 21/07</td>
<td>Newspaper (Xian Daily)</td>
<td>Public notice</td>
<td>Announce the availability of EIA reports and invitation for public comments and inputs</td>
</tr>
<tr>
<td>May 25/07</td>
<td>Xian Public Library</td>
<td>CEA report display</td>
<td>The CEA is placed in the library for public review</td>
</tr>
</tbody>
</table>