Environmental Monitoring Report

Annual Report (English)
January 2011

PRC: Zhengzhou-Xi’an Railway Project

Prepared by the Project Management Office and The Third Railway Survey and Design Institute Group Corporation for the Asian Development Bank.
Environment Monitoring Report

Upon Zhengzhou-Xian Railway of Passenger Special Line Newly Built by Using Asia Development Bank Loan Item

(January 2011)

The Third Railway Survey and Design Institute Group Corporation
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1. Forewords

1.1 Introduction of project conditions

Zhengzhou to Xi’an railway line for passenger traffic (hereafter referred to as “Zhengxi Railway”) is a loan project of Asian Development Bank. The line starts from the existing Zhengzhou Train Station by way of Zhengzhou, Luoyang, Sanmenxia and Weinan and Xi’an in Shanxi Province, and finally led into Xi’an Railway Station, with the total length of 459.53km, where the newly constructed main line of the railway is 405.35km, the tie line is 27.53km, and 26.65km of existed line is utilized.

There are 9 railway stations in the whole line, including New Gongyi Station, Luoyang South Station, New Mianchi Station, New Sanmenxia Station, New Huashan Station and New Weinan Station (which belongs to a middle station for transaction of passenger traffic newly constructed), New Lingbao Station (which belongs to a slowly running station), New Lintong Station (which belongs to an overtaking station) and New Xingyang Station (which belongs to a block post).

Zhengxi Railway is located in Yuxi mountainous area and Weihe River alluvial Plain, where the south upon the Qinling Mountains and its east branches, and Yellow River and its tributaries in the south, with overall topography high in south and low in north. The line passing area can be divided into five geomorphic units: low mountainous area, loess flatland area, loess hilly area, piedmont plain area and river flat area, which are generally spread in a banded form extending from east to west and north-south alternating.

The line section of Zhengzhou to Mianchi is located at the lower reaches of the Yellow River, passing through Yellow River and Huaihe River, where the terrain is relatively flat. For the section from Yanzhen to Guanyintang, the line runs through Jianhe, south of Luo River watershed (front edge of Xiao mountain slope), all of which belongs to Luohe River. The source of rivers and ravines of the section from Mianchi to provincial boundaries (Henan and Shaanxi) are mainly atmospheric precipitation, where the Sanmenxia Reservoir can greatly regulate the Yellow River water level located between Tongguan and Sanmenxia. The section from Xi’an to the provincial boundary line runs on Weihe River terraces, which belongs to Weihe River.

The areas passed by the line are warm temperate sub-humid monsoon climate zone and warm temperate semi-humid continental monsoon climate, which is dry and windy in spring, hot and rainy in summer, plenty of sunshine in autumn and cold and snowy in winter; the annual average temperature is 14.0℃, with the average temperature of coldest month (January) is -0.3℃, and the hottest month (July) of 27.5℃; the extreme maximum temperature is 44.2℃, extreme minimum temperature is -19.1℃; the annual average rainfall is 727mm, the maximum frozen soil depth is 21-44cm, while the maximum snow thickness is 29cm.

Henan and Shanxi provinces are China's ethnic and cultural birthplaces with a long history and numerous cultural relics. Xi'an (Xianyang) and Luoyang are the ancient Chinese capital cities, and the historic cities firstly included as well.

The nature reserves within the area are Yellow River Wetland Reserve, Jili Wetland Nature Reserve, Mengjin Yellow River Beach Nature Reserve, Sanmenxia Reservoir Nature Reserve Xiaojinling Nature Reserve, Sanhe Wetland Nature Reserves in Shaanxi, where the Yellow
River Wetland Nature Reserve is included within the influence scope of work, and the rest are outside the scope.

There’re numerous scenic spots and cultural relics along the line, such as Shaolin Temple in Zhengzhou, White Horse Temple, Longmen Grottoes, Guanlin in Luoyang and the Annual Peony Festival, Huashan Mountain in Weinan, Terracotta Warriors, Huaqing Hot Spring, Former Site of Xi'an Incident, the Big/Small Goose Pagoda, as well as Xi'an City Wall.

The total investment for this project is up to 34.25 billion yuan, in which the static investment reaches 33.41 billion yuan.

The project was completed in December 2009, and transferred to the stage of trial run. The initial trial operation is scheduled to be carried out in February 2010 to February 2011.

1.2 Monitoring contents in this phase

The whole line of Zhengxi Railway was put into test run on December 28, 2009, and opened on February 6, 2010. Therefore, the construction work in this monitoring period has been completed and now is in the 1-year test run period. The monitoring contents include the recovery & management of the borrow (abandoned) site, protection and afforestation of subgrade (cut) slope; recovery & management of the construction roads and camps, implementation of environmental protection/water and soil conservation measures for Yellow River Wetland Nature Reserve and Xiliu Lake drinking water source protection area; noise, vibration and electromagnetic radiation produced by railway operation; as well as the review and summary of previous monitoring.

This report is the environmental monitoring report for the test run period from January 2010 to January 2011, which is the final phase of environmental monitoring report of Zhengxi Railway, and includes the review and summary of previous monitoring report, the overall assessment of engineering environmental impact, as well as the staffing and reporting.

Feng Guoqiang Senior engineer
Mu Zhongxia Engineer

2. Process of work and completed work amount

2.1 Process of work

The monitoring of the full range of construction has been all over, works at the trial operation period. Pilot run of the bus were opened (Hexie EMU) 7 pairs / day, maximum operating speed of 350km/h.

The whole railway construction for this monitoring period has been completed, and is currently in test run period. During such period, 7 pairs/day of passenger trains (and “Hexie” EMU) are opened, with the maximum running speed of 350km/h.

2.2 Completed work amount

2.2.1 Work amount
Zhengxi Railway was commenced in September 2005, and completed in December 2009, with the total construction time of 4 years and 3 months. The quantities of the entire project include 137 bridges with total length of 311.983 km, 38 tunnels with total length 76.92 km; earth work of 32,035 million cubic meters (where excavation is 24,177 million m$^3$, and roadbed fill is 7,858 million m$^3$), main line track laying of 1006.6 single-line km and the station line track laying of 808 single-line km. There are seven station buildings and two sets of signal building, with the building construction of 85,000 m$^2$.

There're 10 traction substations, 11 section posts, 18 AT stations, 8 power distribution substation, 203 cubicle-type substations, 3133.5 km of 10KV power cables, 1133.46 km of contact line catenary erected and 1133.46 km of wires; installing 40 main transformers, traction power supply and a set of electric power SCADA system; 163 new GSM-R base stations, 133 fiber optic repeater (remote machine) and 1,947 km signal trunk cable are installed and erected; and there're 2404 transponders, 183 annunciators, 113 sets of turnouts devices; laying the communications optical cable of 1010 km, cable of 83.2 km; installing 216 steel towers.

The land acquisition for whole line is 1808.4hm$^2$ and demolition of various types of housing of 2.26 million m$^2$.

### 2.2.2 Quantities completed by the tender section

See the table below for the work quantities completed by each construction section:

<table>
<thead>
<tr>
<th>No.</th>
<th>Construction units</th>
<th>Name of Project</th>
<th>Unit</th>
<th>Accumulative Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7th Bureau under Chinese Railway</td>
<td>Bridge</td>
<td>Erection of precast beam</td>
<td>Hole</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Track</td>
<td>Ballastless track</td>
<td>km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Four electricity</td>
<td>Contact line foundation</td>
<td>Piece</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wire drawing foundation</td>
<td>Piece</td>
</tr>
<tr>
<td>2</td>
<td>16th Bureau under Chinese Railway</td>
<td>Bridge</td>
<td>Pier body</td>
<td>Block</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cast-in-situ beam</td>
<td>Hole</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Erection of precast beam</td>
<td>Hole</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tunnel</td>
<td>Tunnel body excavation</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd liner of tunnel body</td>
<td>m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Track</td>
<td>Ballastless track</td>
<td>km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Four electricity</td>
<td>Contact line foundation</td>
<td>Piece</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wire drawing foundation</td>
<td>Piece</td>
</tr>
<tr>
<td>3</td>
<td>25th Bureau under Chinese Railway</td>
<td>Subgrade</td>
<td>Foundation treatment</td>
<td>m$^2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excavation</td>
<td>10$^4$m$^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Filling</td>
<td>10$^4$m$^3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Four electricity</td>
<td>Contact line foundation</td>
<td>Piece</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wire drawing foundation</td>
<td>Piece</td>
</tr>
<tr>
<td>4</td>
<td>12th Bureau under Chinese Railway</td>
<td>Bridge</td>
<td>Cast-in-situ beam</td>
<td>Hole</td>
</tr>
<tr>
<td></td>
<td>Tunnel</td>
<td>Tunnel body excavation</td>
<td>m</td>
<td>28174.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd liner of tunnel body</td>
<td>m</td>
<td>28174.0</td>
</tr>
<tr>
<td></td>
<td>Track</td>
<td>Ballastless track</td>
<td>km</td>
<td>153.0</td>
</tr>
<tr>
<td></td>
<td>Four</td>
<td>Contact line foundation</td>
<td>Piece</td>
<td>1862.0</td>
</tr>
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</table>
### Table 2-2  Work quantities completed by years and investment

<table>
<thead>
<tr>
<th>No.</th>
<th>Project</th>
<th>Year</th>
<th>Earthwork (section)</th>
<th>Bridge (Linear meter)</th>
<th>Tunnel and open cut tunnel (Linear)</th>
<th>Track laying (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Work quantities completed by years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2.3 Work quantities completed by years
### Labor/material quantities completed by years

<table>
<thead>
<tr>
<th>Year</th>
<th>Labor (0,000 days)</th>
<th>Steel (hundred tons)</th>
<th>Timber (hundred m³)</th>
<th>Cement (hundred tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>2482.3</td>
<td>66498.36</td>
<td>29143.2</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>1063.8</td>
<td>124703.96</td>
<td>37774.4</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>39835.62</td>
<td>8931.8</td>
<td>829.003</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>4155.67</td>
<td>3247.07</td>
<td>143.11</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>2305.44</td>
<td>1801.38</td>
<td>79.39</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3546.1</td>
<td>231036.94</td>
<td>76703</td>
<td></td>
</tr>
</tbody>
</table>

### Total investment (static) and annual investment (hundred million)

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>7.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>90.9</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>119.8</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>101.2</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>Total investment</td>
<td>334.1</td>
<td></td>
</tr>
</tbody>
</table>

#### Implementation of Measures for Environmental Protection and Water and Soil Conservation

**3.1 Reclamation and afforestation**

**3.1.1 Reclamation**

1. The detailed land reclamation plan was prepared during the construction process, which is intended to recover the farmland and forest land temporarily occupied by the project, and level and transfer the excavation and filling area formed by the borrow (abandoned) area to the farmland and forest land based on the topographic conditions.

2. The whole line is focused on large-scale beam fabrication field, track-laying base, mixing station and construction camp that are temporarily occupied by the project. Prepare the detailed reclamation plan after completion of project, and restore the original farmland as fully as possible by combining with the construction conditions of temporary works. There’re 16 reclamation of temporary works totally implemented, covering area of 42 hectares.

3. Implement the leveling plan for the excavation and filling area formed by the borrow (abandoned) area by combining the topographic conditions, and open up the farmland and forest land conditionally, with 73 farmlands and forest lands finished covering total area of 848 hectares.

**3.1.2 Afforestation**
(1) Plant the shrubs and arbors on both sides of the railway embankment land based on the subgrade height and line conditions, which are used for creating green channel, greening and beautifying the environment.

(2) To stabilize the slope, the subgrade slope with different heights will use the full-slope protection of planting grass by spraying seeds or stone arc skeleton protection by cement mortar with cutoff trench, where the skeleton is planted with shrubs, which is used for slope protection and landscaping of ecological environment.

(3) Green ecological restoration will be performed after implementing the protection and leveling measures for partial borrow (abandoned) area set by the project.

(4) Plant the trees, flower beds and lawns on the open space around the newly constructed housings, which is used to greening and beautifying the environment.

(5) Plant trees within the scope of 50m at both sides of line within the test area of Yellow River Nature Reserve, and restore the vegetation within the reserve and other functions.

(6) According to above greening principles, the project is totally planted with 88,000 trees, 176,000 shrubs, and subgrade slope is planted grass with area of 828 thousand m², and the greening area for borrow (abandoned) area more than 600 million m², with the greening construction investment of above 1600 million, which greatly reduce the damage to the vegetation caused by the project construction; the vegetation coverage and ecological environment along the project will be gradually recovered and improved with the implementation of greening measures.

3.2 Prevention of noise, vibration, electromagnetism and dust

3.2.1 Prevention of noise and vibration

(1) Noise and vibration prevention in construction period

For the environmental noise and vibration pollution produced in the construction, the construction unit has developed the relevant noise and vibration reduction measures in accordance with the requirements of "Law of the People's Republic of China on Prevention and Control of Pollution from Environmental Noise" and "Noise limits for construction site", including:

a) Proper arrangement of construction site, for which, the construction site is far away from the sensitive points located inside the residential areas; reasonable arrangements for the construction machinery with high noise and vibration indie the construction site, which shall be placed on one side of the sensitive points far away from the residential areas.

b) Arrange the construction site in a reasonable and scientific manner, and conduct the measurement or evaluation for the noise and vibration within the field according to the actual conditions of the site, especially the side of those with sensitive points; and if the noise and vibration exceed the limits, it shall then use the vibration pads, coating and acoustic enclosures, to reduce noise and vibration pollution.

c) Arrange the operating time properly, and the operation with high noise and vibration shall be arranged in the daytime. As the production process requires the continuous
operation or has special requirements, the construction units shall make apply to the local construction administrative authorities prior to construction where the night construction is necessary, while report to the local environmental protection departments, and the night construction can be performed after approval. The company is responsible for make interpretation and promotion work to the surrounding residents together with the construction unit, and publicizes the construction period.

d) Necessary measures shall be adopted for the night construction, to minimize the construction noise and vibration. The rigorous management systems and noise reduction measures shall be provided to the man-made construction noise and vibration, to minimize the noise and vibration nuisance.

e) Rationally plan the construction roads and travel time of carriers, do not try to wear away from the village or far away from villages, to reduce the impact of transport noise on residents.

f) For the strong vibrations possibly caused by some compactions, it shall improve it in terms of construction process, to change the compaction construction process close to the sensitive points to the compacted column, and thereby control the impact of vibration.

g) The tunnel blasting shall strictly control the amount of explosives, and give small blasting where the conditions of construction excavation are met, to control the impact of vibration on the environment.

h) Publicize and promote the scientific management and civil construction. The construction units shall gain the support from the local government before the construction, post the construction notices and instructions, to obtain the understanding of local residents; while, conduct the environmental awareness education to the construction workers, to reduce the noise pollution caused by human factors.

i) Strengthen the environmental management, and strictly implement the relevant national and local regulations.

j) Perform the environmental noise monitoring with the construction site during the construction period, and the noise value monitoring shall be conducted in accordance with the requirements of "Measurement method for noise from construction site", to ensure that the noise value will not exceed the noise discharge standards.

k) The environment management and noise monitoring developed by the company provide the provisions for environment management monitoring program, and the relevant units shall strictly comply with the regulations during the construction process, to control the noise of construction site within allowable limit, and thereby minimizing the impact of railway construction to the living environment.

(2) Prevention of noise and vibration during the operation period

a) Noise barrier

   Adopt the noise control measures of the noise barrier for the 160 sensitive point with
the excessive noise close to the line, with the height of noise barrier of 2.15-3.95m, and there’re 65.05 single-line km of the noise barrier set for the entire line.

b) Soundproof window

For the excessive sensitive points scatteredly distributed not suitable for taking noise barrier measures and the sensitive points existed after using the noise barrier, it shall use the soundproof windows. There’re 14860m² soundproof windows designed for the entire railway, which will be appropriately implemented in accordance with the preliminary results of noise monitoring acceptance and whether they exceed the limits.

c) Strengthen the maintenance of car body and tracks

Perform the regular maintenance for the car body and grind the tracks in a regular manner, to ensure it is in good working condition, and help to reduce the noise and vibration pollution produced by the train running.

3.2.2 Prevention of electromagnetic radiation

(1) The impact of electromagnetic radiation produced by the train on the television receiving of the surrounding residents can be eliminated by accessing the cable television, while completely eliminating the reflection and occlusion of car body, for this, the project has provided the compensation for accessing cable TV network. Furthermore, it also offers the economic compensation of cable TV access for the sensitive points that the TV receiving quality is significantly reduced in accordance with the test results of environmental protection acceptance of the actual operation, to completely eliminate the electromagnetic effects.

(2) Protective measures for the impact of traction substation

The magnetic induction of power-frequency electric field and power frequency produced by the enclosure if traction substation, which is in line with the relevant limit requirements specified in HJ/T24-1998. To reduce the electromagnetic effect and eliminate the fear of the residents, the traction substation shall be selected to far away from the environmentally sensitive areas such as residential areas, schools and hospitals.

3.2.3 Dust prevention

(1) The house demolition construction site shall be set with effective and clean anti-dust separation;

(2) Engineering garbage, dregs and waste that may produce the dust shall adopt the spraying and use the vehicles with cover in the loading process;

(3) Set the appropriate separation around the construction site close to the sensitive points, to isolate the dust;

(4) Perform the hardening treatment for the major road located inside the construction site, and employ the staff for cleaning work; install the related watering equipment, and timely spraying and cleaning, to reduce the dust pollution;
(5) Conduct the greening and beautification to the office area and living area inside the construction site; and the boilers and cooking stoves shall use the clean fuels;

(6) The vehicle used to transport the bulk sand and other bulk materials use the seal, dressing and cover, to prevent the leakage and loss along the way;

(7) The cement, sand and prepare materials used by the mixing plant shall be possibly placed in the room, to effectively control the spread of dust;

(8) The burning of waste at the construction site is strictly prohibited, as which may produce toxic or harmful gases, smoke and odor substances.

3.3 Soil and Water Conservation Measures

3.3.1 Importance of soil and water conservation in loess area

Located in Yuxi Mountains and Weihe River alluvial plain, Zhengxi Railway is the high-speed railway firstly constructed in loess collapsed area in the world. The area is characterized by the wide area of soil erosion, high soil erosion and great losses. It is mainly the grit with even texture, loose structure, high ratio and high compressibility, which may be easily disintegrated and produce the collapsibility.

The types of water and soil loss are complex in loess areas, which are either endowed by the natural factors and human factors, and changed by the hydraulic power, wind and gravity. Moreover, the dry climate and water source would be the major obstacle to the improvement of plants growth and ecological environment, and thereby have very significant impact on the ecological environment.

3.3.2 Soil and water conservation measures implemented in the project and effects

The prevention measures of water and soil loss involves each aspect of the project, including subgrade (cutting) protection, borrow (spoil) area protection and greening, construction site and road protection, drainage works and greening works, most of which are either the measures to ensure the engineering safety and measures for protection of eco-environment, and the main measures for prevention of soil and water conservation. The measures for soil and water conservation include:

(1) Subgrade and cutting slope use the spraying grass by seeding or arc-type skeleton, to ensure the slope stability, while prevent the soil and water erosion and beautify the environment.

(2) Adopt the principles of “entry early and exit late” for the exit/entrance of the tunnel, to reduce the excavation and filling of mountain and vegetation deterioration; protect the full-slope of the excavation face of exit/entrance of the tunnel, while set the catching and drainage system at the top of tunnel, to ensure the hole stability, and control soil erosion.

(3) Remove the earth for growing and temporarily store at the near place when borrowing the earth, and set the sack cofferdam and dense mesh for blocking and protection; for the borrow area removed with partial mountains, it shall build the intercepting ditch on the top of borrow area before borrowing, to introduce the rainfall gathered to the drainage ditch located outside the borrowing area; clean up and level the slope after borrowing, for
which, the ground shall be possibly connected with the surrounding terrain smoothly, and the in-situ soil and surface mellow soil cleaned from the subgrade shall be filled back, to implement the greening recovery.

(4) The spoil ground shall be built with necessary spoil-retaining wall, intercepting (drainage) ditch and slope protection in accordance with the terrain and gathering conditions, to maintain the stability of spoil, and prevent soil erosion.

After the spoil removal, the afforestation works shall be done. The plant protection measures shall be planned in combining with the local soil and water conservation and forest plans, and choose the dominant species widely distributed in local area based on principles of ecology restoration, to restore the vegetation as soon as possible.

(5) As the excavation earthwork of bridge foundation are prone to soil erosion in the rainy season, therefore, the temporary block measures shall be taken by setting the temporary soil accumulated place within the bridge acquired land, and the temporary spoil shall be concentratedly stocked and packed with the straw bags. After the completion of the foundation construction, fill the soil and clean up the construction site, and the remaining earthwork shall be abandoned to the spoil ground near the line, and adopt the relevant protective measures.

(6) In the railway construction, the impacts on environment are distributed in a banded shape. After the implementation of above soil and water conservation, the subgrade, cut slope, pyramid bridge, tunnel entrance, station section and living area, borrow (spoil) area, temporary access and site shall be adopted for the engineering, plant measures or the control and protection of combination of both measures, which effectively control the human-induced soil and water erosion during the construction process, to increase the area of green vegetation, and protect the ecological environment along the line.

After the implementation of water and soil conservation, the comprehensive protection system combined by the engineering and plant measures can effectively control the man-made water and soil erosion, especially in eliminating the landslides, mudslides, landslides and other natural disasters induced by the engineering construction in low mountainous areas, which ensure the safety of railway operations and the agriculture production and residents property within the area directly influenced by the project.

The comprehensive greening measures combining various plants beautify the area along the railway, to create the beautiful landscape, and establish a good social image of rail traffic.

3.3.3 Implementation of water and soil conservation measures

(1) Spoil ground

The subgrade, bridges and tunnels ballast piling shall be implemented in accordance with the site specific circumstances and requirements of the local villages, and strive to increase the land area by making locally available land; the engineering protection measures of spoil ground shall be implemented prior to or at the same time as the implementation of spoil, to maximize the effects of protection measures. After the completion of spoil handling, it shall level and repair the spoil ground, or re-cultivated as
the farmland or plant the trees and grasses according to the design and actual conditions. The commencement of spoil disposal area shall be approved by the local environmental protection, land and water departments, to meet the local environmental requirements. The spoil disposal process shall be directed by the special personnel, and stocked in layered manner, and timely refurbishment of rolling cover.

(2) Bridge works

The mud sump and sedimentation tank shall be built prior to the construction of bored pillar of each bridge, and after the sedimentation and recycling; the remaining mud and drill ballast shall be dried and transferred to the spoil disposal area. The bored piles inside the river shall be possibly constructed in the dry season, to reduce the river pollution. During the construction, the spoil inside the bridge foundation pit shall be removed, to ensure that the foundation pit will not be washed out by the rain and surface runoff, ensuring smooth flow of river water.

(3) Tunneling works

Before the excavation of tunnel portal, construct the temporary intercepting/drainage ditches, to improve the drainage systems, and prevent the erosion of excavation of side slope and slope water and soil erosion. The tunnel slope shall drill the anchor bolt, hung the reinforcement fabric, spray the concrete, and timely block the excavation face in accordance with the design requirements. During the tunnel construction, it shall strictly perform the principles of proof and drainage by using the method as emphasis on “Blocking and Releasing within Limitation”, to prevent the serious loss of serious loss arising from the construction.

The tunneling shall in strict accordance with the principle of New Austrian Tunneling Method to strengthen the adjoining rock monitoring and measurement. According to convergence condition and second lining, prevent the surface soil sink arising from the convergence and settlement of tunnel adjoining rock and destruct the original surface structure. Improve the internal/external drainage system in during the construction process to discharge the wastewater, and discharge after reaching the target after the secondary precipitation; intensify the ventilation of the tunnel, to ensure that the contents of dust and other harmful substances are controlled within the range of national standards. The spoil inside the tunnel shall be shipped to the spoil disposal area, and free disposal is prohibited.

(4) Construction road

The construction unit is required to conduct the site survey and the planning and construction of construction road shall follow the principle of “construct based on potential”, and minimize the use of land acquisition. The route of temporary construction road shall be properly planned, to save space, and farmland accounted for less as far as possible; make full use of existing roads, and avoid the blocking of roads, lay the reinforced concrete pipe with the corresponding the diameter for drainage during the construction.

The earthwork of construction road shall be properly regulated based upon the certain principle, to save space, reduce the spoil and vegetation destruction, and prevent the water and soil erosion. The construction road shall be maintained by the designated
persons who are responsible for keeping the cleanliness and timely watering, to keep running in good condition, and reduce the dust pollution. When constructing and re-constructing the access roads, it shall build the drainage system at the road side, to ensure the smooth flow of surface runoff, reduce the slope erosion, and prevent soil erosion. After the construction has been completed, restore the original function of the temporarily occupied land.

(5) Temporary housing

Unified plan and develop the temporary construction standards for the construction site, and each temporary house shall be provided with the capital planning drawing, and then for construction. The greening for the arrangement of production and living, construction of access, sewage, household waste discharge and production and living areas shall be made in a scientific planning and environmental protection manner. Construct the atmosphere of "people-oriented and caring environment". The overall layout shall be uniform and well-proportioned.

4. Environmental Management

4.1 Environmental Monitoring System

Owner of Zhengzhou west passenger special line (ZXPSL) is Zhengzhou West Passenger Special Line Liability Co., Ltd (Company), liable for environment protection during construction period of ZXPSL. The operating units of ZXPSL (Zhengzhou Railway Bureau and Xi’an Railway Bureau) are liable for environment protection during operating period of ZXPSL. Local environmental protection bureaus and water conservancies along the line are liable for environmental protection as well as water and soil conservation supervision and inspection in their own incumbent precincts.

Environment monitoring of ZXPSL was undertaken by The Third Railway Survey and Design Institute Group Corporation (hereinafter called as TSDI), daily monitoring during construction period was conducted by construction units and supervision units, monitoring data was acquired by Owner Unit and TSDI, monitoring report was prepared and reported to the Ministry of Railways and Asian Bank by TSDI.

Focusing on the project features and environmental problems commonly to occur in construction, the monitoring unit formulated the environmental protection system covering the following aspects

● All related construction units and supervision units are required to appoint their full-time (part-time) environmental protection managers and train them on environmental protection knowledge, which are liable to supervise and manage environment problems occurring during construction of their own units, and to assist environment administration authorities in environmental management.

● All related construction units and supervision units are required to perform corresponding environmental protection commitment in construction contracts, to set up measures for environmental protection according to requirements for environmental protection specified in design documents, to protect site construction environment, to avoid and reduce pollution and damage to environment due to improper construction methods.
Once environment impact event occurs, active countermeasures shall be taken. If problems cannot be solved by themselves, related experts and units shall be promptly engaged to assist settlement.

- The project supervision units are required to be responsible for daily environmental supervision, and to urge construction units to timely solve environmental impact problems occurring during construction, if any, according to environment protection requirements in supervision contracts.

### 4.2 Environment Management System

To enhance the environmental management during construction, regulate the environmental protection and water and soil conservation, Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd. has made a number of rules and regulations for environmental protection and soil and water conservation, and management practices:

1. The company has developed the “Soil and water conservation management methods for Zhengzhou-Xi'an Passenger Dedicated Line (tentative)” (ZXKZG [2005] No.44) in accordance with the relevant legal regulations in terms of environmental protection, and soil and water conservation, which defines the construction, consulting, supervision and division and responsibilities of construction units. To implement the measures and suggestions in environmental protection and soil & water conservation proposed in the “Environmental Impact Report” and “Soil and Water Conservation Plan”, the company, in April to June, 2006, prepared the “Design for guiding construction organization for environmental protection, soil and water conservation and Historic Preservation of Zhengzhou-Xi'an Passenger Dedicated Line (tentative)” (ZXKZG [2006] No.129), which requires the construction units to prepare the design for guiding construction organization for implementation environmental protection and soil and water conservation in compliance with the unified requirements of the issued documents, where the possible environmental problems and proposed environmental protection measures of each project shall be specified and reported to the company for future reference.

2. To comprehensively control the environmental pollution, mitigate the environmental impact caused by the works, the company developed the “Annual inspection plans for environmental protection, soil and water conservation of Zhengzhou-Xi'an Passenger Dedicated Line” (ZXKZ [2007] No.44) in early 2007, which requires to perform the environment and water protection inspection once a quarter since January 2007, where the inspection covers all aspects of the construction, focusing on protection measures construction noise control measures, water and soil conservation measures, water pollution control measures and dust control measures for various types of protected areas. When it comes to the on-site control, we also take the environmental and water protection implementation plan as one of approval conditions for the commencement of construction, and which shall be reviewed by the on-site supervision units.

3. The company together with the construction, supervision and design units shall implement the relevant environmental management systems in accordance with the requirements of ISO14001; the units shall be equipped with specialized or part-time environmental managers, strictly implementing the regulations or implementation plans of
environmental and water management, while adopting the monthly inspection system, to achieve the constant improvement of environmental and water management levels during the construction period.

(4) The consultation unit is primarily responsible for reviewing the water conservation design programs and measures, and when reviewing the construction design, the water conservation measures and programs shall be reviewed. The amendment opinions shall be proposed for the programs and measures that failed to meet the regulations and technical requirements; when reviewing the construction design, the soil and water conservation measures, programs and implementation methods adopted by the construction unit during the construction shall be involved, and the reviewing amendments shall be proposed; often visit the construction site, to instruct the implementation of water &soil conservation measures, and propose the disposal opinions and provide coordination once there's problems found.

(5) The design units are mainly responsible for the design of soil and water conservation, while fully implement the "Report of Soil and Water Conservation", and give reply to such measures and relevant costs, in particular that of borrow (spoil) areas, construction sites and construction roads; visit the site on regular basis, to provide guidance to the implementation of water conservation measures, and promptly dispose the problems being detected.

(6) The supervision unit is responsible for the implementation of soil and water conservation measures and programs of construction units, and the supervision and inspection as well; examining and approving the soil and water conservation measures and programmes developed by the construction unit; when the construction organization design is required during the reviewing, it shall review the soil & water conservation measures, programmes, and implementation approaches in construction process developed by the construction units, and propose the modifications; when preparing the supervision plan, it should specifically the list the supervision contents of soil and water conservation, employ the professional supervision engineer to prepare the supervision implementation rules; know the environmental characteristics of construction site at the time of checking the construction drawings and the participating in design disconcertion, include the contents of soil & water conservation, while master the engineering measures and requirements of water conservation; supervise and urge the construction units and local environmental sectors to establish the normal relationship with the local environmental protection authorities; understand the local requirements and relevant standards on water & soil conservation; check the on-site soil & water conservation institutions, full-time personnel and the establishment of relevant measures and systems; track and check the implementation of water & soil conservation construction units in construction process in the on soil and water conservation measures during the construction process, while conduct the inspection acceptance on soil & water conservation project; visit and investigate the construction site, and coordinate and solve the problems being found in a timely manner.

(7) The construction unit is primarily responsible for the preparation and implementation of water & soil conservation plans and measures, while develop the detailed supervision approval plans for the water & soil conservation measures prior to construction; know the environmental characteristics of construction site at the time of checking the construction
drawings and the participating in design disconceirion, include the contents of soil & water
conservation, while master the engineering measures and requirements of water
conservation; prepare the water and soil erosion monitoring plan during the construction,
while provide assistance to the local water and soil administration department for regular
water & soil erosion monitoring and inspection; for the fail in implementation of water &
soil conservation in accordance with the drawing requirements and direction of
supervision engineer in a time manner due to the careless and negligence of the
construction unit, the costs incurred by the adopting of additional protection measures
shall be borne by the construction unit.

(8) The consultation and supervision units shall employ the personnel specifically
responsible for the management and coordination of soil and water conservation. The soil
and water conservation managers shall visit the site and perform regular inspections, to
understand the implementation of soil & water conservation measures. Check the key
processes and construction sites, to know the soil and water conservation progress.

(9) The soil and water conservation project in the design document shall be accepted based
on the relevant requirements. And, the soil and water conservation project shall be
accepted together with the main construction, and no acceptance will be conducted for
the soil & water conservation projects that are failed to meet the standards.

(10) The bill of quantities shall be listed with the costs used in soil and water conservation, and
no cost will be paid for the soil & water conservation projects that are failed to meet the
standards.

(11) The units that ignore or failed to adopt the appropriate measures for soil and water
conservation shall be given with the notice of criticism, and the dismal records shall be
included in their comprehensive performances.

4.3 Environmental Management during Test Run in January 2010 to January 2011

4.3.1 Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd. will continuously improve the
environmental management during late construction

During this monitoring period, Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd., as the
owner of project, will continue to attach great importance to environmental management in the
later construction. Each level is assigned with the leadership in charge of environmental
protection and soil & water conservation. The specific management is conducted by the
equipment department subordinated to the company. Due to the completion of the construction,
the earthwork that has great impact on the environment will not be required, with the
environmental management focusing on the treatment and recovery of borrow (spoil) ground,
large temporary works (such as beam fabrication field, mixing station), as well as the
construction roads. On January 2010 to January 2011, Zhengxi Company conducted the
inspection on the demolition & recovery works of construction roads, large construction sites
and the later control and greening of borrow (spoil) ground, while accept the daily environment
and water & soil conservation prevention management conducted by the local environment and
water departments of Henan and Shaanxi provinces.

According to the arrangements of Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd., the
project departments will continue to clean the construction sites of the entire line and check the
environment protection and soil and water conservation, while inspect the control and recovery works of spoil ground and large construction sites. There’re 10 borrow (spoil) grounds, 15 large construction sites and 30 construction roads, as well as the construction works within the Xiliu Lake Water Source Protection Area and Yellow River Wetland Nature Reserve, all of which shall be comprehensively inspected for the remaining issues of environmental protection, soil and water conservation. Properly dispose and solve the environmental protection and soil & water conservation requirements proposed by the relevant local government departments at all levels, and the public environmental complaints as well.

4.3.2 Continue to maintain the environment management level in accordance with the requirements of ISO 14001

Each construction unit of Zhengxi Railway shall continue to conduct the monthly inspection system in accordance with the regulations of environment and water protection under the guidance of ISO14001 in the end of construction, to rectify the remaining problems of environment and water protection, and continue to improve the measures for project environmental protection and soil & water conservation.

4.3.3 Environment supervision

The environment supervision of Zhengxi Railway shall be completed by the three project supervision stations of the project and its affiliated stations. With the end of the construction, the supervision has been basically completed the tasks specified in the contract, and the remaining work is primarily working with the departments concerned, to continuously the perform the environmental supervision, supervise and inspect the control & restoration of environment of borrow (spoil) ground, large-scale temporary works (including the beam fabrication field, mixing stations) and construction roads, and provide the technical supervision services to the remaining environment and water protection projects.

In January 2010 to January 2011, the environmental supervision is focused on following aspects: the greening and restoration of borrow (spoil) ground, management and recovery of large construction sites and access roads, as well as the improvement of intercepting and drainage facilities. The staffs working at each supervision station shall adhere to all management systems of environmental supervision, and elucidate the achievements and problems of environment and water protection work at each tender section in the monthly supervision report, to provide the detailed on-site information to the environmental management.

4.3.4 Acceptance and investigation of environmental protection at the completion period

According to the requirements of "Management Measures of Inspection and Acceptance of the Environmental Protection of the Construction Projects" (December 27, 2001) issued by the former State Environmental Protection Administration, the Zhengzhou-Xi’an Passenger Dedicated Line Co., Ltd. entrusted the China Academy of Railway Sciences to conduct the acceptance and investigation to the completion environment of Zhengxi Railway, and prepare the relevant report in October 2010, and as of January 2011, the relevant investigation,
monitoring and report preparation work have been in progress.

5. Monitoring and Inspection of Influence Points

5.1 Water quality monitoring for Xiliu Lake Drinking Water Source Protection Area in Zhengzhou

The construction unit hasn’t set the construction camps, large construction sites and other temporary works that may affect the water quality in the water source protection area, and has no sewage, construction and household waste discharged into the protected areas.

The 7 trains allowed for running on the Xiliu Lake Bridge during the test run are all the fully-closed Hexie EMU, which have no sewage, garbage, manure and oil discharged within the scope of protection area, therefore, there’s no impact in the water source protection area during the operation period.

5.2 Environment and water protection monitoring of Yellow River Wetland Nature reserve in Henan Province

The major project within the Yellow River Wetland Nature Reserve is Shanxian Super Major Bridge, which passes through the edge of experimental area of the protection area. The Yellow River Wetland Nature Reserve was inspected and checked in this monitoring period, with the contents including the construction sites, access roads, buildings and domestic garbage, as well as the train running noise. The inspection results shall be as follows:

(1) The surplus earth and drill ballast along the line of Shanxian Super Major Bridge have been cleared up, and the construction sites are cleaning, and the environment along the bridge has been properly protected.

(2) The pavement crossing through the construction road has been hardened, which can be used as the railed maintenance road or country road.

(3) The noise produced by the trains is about 88.5dB at 25m distance from the railway, and attenuate to approximately 67dB at 300m, 56dB at 1000m, which is close to the background noise value. As the distance between project and birds gathering area (the core area of protected area) is over 1000m, there’s no significant impact of train operation on the habitat of wildlife habitated within the area. As the train running normally stop after 23:00, and the train lights have strong projectivity, where the hard lights are basically emitted on the railway track (straight line), which will not influence the core area of protected areas, while the night lighting of trains will also not interfere the rest of birds within the protected areas.
5.3 Other Engineering

5.3.1 Wastewater Treatment

(1) Construction protection and domestic sewage

Because all of construction works have been completed, there’s no production and domestic sewage produced in this monitoring period.

(2) Domestic sewage of station

There are 7 stations opened at current (including New Gongyi Station, Luoyang South Station, New Mianchi Station, New Sanmenxia, New Huashan Mountain, New Weinan South Station), and the wastewater produced are all the domestic sewage from the daily life of the station staff and waiting passengers, with the volume of 5-15m$^3$/d; all sewage will discharged to the urban sewage pipe network after the pre-treatment in septic tank, and finally transferred into the urban sewage treatment plant.

The station wastewater of Zhengxi Railway is generally the domestic sewage with no special pollutant, and will be treated together with the urban sewage after being discharged, which has no pollution on the surrounding environment.

5.3.2 Borrow and spoil yards

Zhengxi Railway is across through numerous hilly loess areas, hilly areas, bridges, tunnels and cuttings with great length. The earthwork quantities of whole project are more than 30 million m$^3$, and the new soil erosion, situation of farmland and roads, river pollution will be caused in case that the borrow and spoil yards are not properly disposed.

As shown in monitoring investigation, the construction of earthworks of the whole line have been completed, and the spoil (slag) produced in the engineering have been properly disposed (most of the spoil are abandoned in the disposal site), and most of the spoil (slag) has been disposed in accordance with the design requirements, and the set of retaining wall has played a positive role in the prevention of soil erosion and environment protection. Most of the spoil sites have been subject to the site flattening, and implemented with the rehabilitation and afforestation measures. The ecological environment within the spoil area has been initially recovered with good eco-environment. However, there are still drainage facilities and greening measures of the some spoil fields shall be strengthened and improved.

(1) Spoil yard at Yuding Tunnel

The spoil yard at Yuding Tunnel is designed with the spoil amount of 360,000 m$^3$, and has been completed for treatment currently. The retaining wall has been constructed, and the outside slope of spoil has also been renovated for masonry; the grass at the top of the spoil has been densely grown, yet the drainage facilities located on the top of the spoil are not well improved, existing the risk of catchments overflow, which has been asked for repairing and improvement.

(2) Spoil ground at Luoyang South Railway Station

The spoil ground at Luoyang South Railway Station is designed with the spoil amount of
280,000 m³ and has been completed for treatment currently. The spoil ground is located in deep loess gully, and after the gully is filled, the top of spoil has been restored as the drylands, with good ecological effect.

(3) Borrow area at Yiyang Beam Field

The borrow area is located in the south of Yiyang Beam Field, for which, the land occupied by it is the flat dry land, with the borrowing depth of 6m. The steep slope will be formed after the borrowing, and the site has been restored as farmlands, with excellent ecological effect.

5.3.3 Subgrade (cutting) slope protection

At the end of this monitoring period, each section of subgrade fill and cutting slope are well protected, with the protective measures including arch framework + planting grass inside the framework, concrete grid + planting grass inside grid, hexagonal concrete block + planting grass inside the block, mortar rubble all-slope protection, as well as the reinforced concrete retaining wall. The plant protection measures for the slope have also been fully implemented, which are characterized by good grass growth and excellent ecological effects. Most of the intercepting/drainage facilities of subgrade (cutting) (drainage ditches on both sides of subgrade, intercepting ditches and flumes at the top of cutting) have been completed, which has positive significance in reasonable water dispersion, maintaining slope stability and oil & water erosion prevention.

Excellent ecological and landscape effects appeared in the cutting protections provided at DK24 km, DK81 km and front area of New Sanmenxia Station, and slope protections provided at both sides of Huanglongjian Super Major Bridge and exit of Zhangmao Tunnel.

5.3.4 Large temporary works

The large temporary facilities of Zhengxi Railway have been completed for use, and most of housing and mechanical equipments have been removed and transferred, some sites have been reclaimed, and some of remaining ground are left for other purpose, yet there’re still some spaces haven’t been cleaned due to various reasons, and the site is left with construction waste and abandoned mobile homes, which are required to be disposed properly.

(1) Lime mixing plant of China Railway No.7 Engineering Group Co. Ltd

The lime mixing plant of China Railway No.7 Engineering Group Co. Ltd covers an area of more than 15 hectares, and its hardening ground was removed after the completion of construction, and the site has currently been restored as the farmland, which completed eliminate the environmental impact of temporary land occupation. See the image right for the site restoration conditions:

(2) No.1 Beam Field of China Railway No.23 Engineering Group Co. Ltd
All equipments and faculties installed inside the No.1 Beam Field of China Railway No.23 Engineering Group Co. Ltd. have been completely removed, while a large amount of construction debris are left for cleaning, and has been overgrown with weeds due to the prolonged lack of management. The construction units have negotiated with the relevant units to determine the effective solutions, and the construction waste will be cleaned up and site will be leveled. The final restoration plans shall be negotiated with the land owners.

(3) Lingbao Beam Field

The site equipments and faculties installed inside the Lingbao Beam Field site equipment and facilities have been completely removed, yet the concrete hardening ground is left; the ground is flat, and the non-hardened exposed ground has been overgrown with weeds due to the long-time vacant. The site has been used as other construction projects, and the hardening ground shall be removed and the construction waste shall be properly disposed and removed in case of restoring to the farmlands and forest lands.

(4) Yiyang Beam Field

The concrete faculties installed in Yiyang Beam Field are under dismantling, and some of temporary housing is still abandoned in the field, and the control and restoration of the entire beam field is still under the way. The construction units and construction units should speed up the treatment and recovery of beam field, and restore the ecological functions of the temporary occupation in accordance with the determined final utilization programme.

5.3.5 Construction access road

Zhengxi Railway across the mountainous areas and hilly areas, and most of construction sites are far away from the existing road, while the construction access roads are generally longer. Most access roads are newly constructed, and some are renovated and expanded on the basis of the original township roads, while some are paved with cement or asphalt pavements. With the completion of the project, these access roads will be used as the permanent roads for local residents. With the restoration of natural vegetation, the sign of interference of construction roads to the natural environment has been not obvious, and the use of them as the village roads would facilitate the farming and traveling of surrounding residents.

5.3.6 Construction camps

The self-built construction camps by each section have been basically dismantled, and majority have been rehabilitated or leveled in accordance with the proposed restoration measures, while a small amount of lands are preserved for hardening ground, and used as the construction
place with of other projects by combining with the local conditions.

5.3.7 Noise and vibration control

(1) Construction noise and vibration

During the railway construction, the bulldozers, excavators, drilling rigs and concrete mixer trucks, road rollers and a variety of transportation vehicles will generate noise and vibration pollution. The construction works of this monitoring period have been completed, with no influences produced by construction noise and vibration.

(2) Operation noise and vibration

In this monitoring period, Zhengxi Railway has been in trial operation period, with 7 "Hexie" EMUs allowed for running each day, and the noises and vibrations produced by the operation of trains become major pollution sources of the project. But as the number of current running trains is far below the designed value (107 trains are allowed to run per day in the design), the impact of noises and vibrations caused by the trains are minimal, and state monitoring values do not represent the noise and vibration levels under normal running condition. China Academy of Railway Sciences entrusted the local environmental monitoring organization to perform the relevant noise and vibration monitoring. Therefore, some of noise and vibration-sensitive points have been initially monitored in this monitoring period, and the monitoring results are shown in table 5-1. As the number of trains allowed for running is relatively small, all noise sensitive points can basically achieve the standards of noise limits.

<table>
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<tr>
<th>No.</th>
<th>Names</th>
<th>Mileage</th>
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<th>Measured value (Leq)</th>
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6. Review and Summarization of Environment Monitoring Works

6.1 Review of environment monitoring

Zhengxi Railway is one of ADB’s loan projects, an external monitoring agency (hereinafter referred to as the “monitor”) is employed to conduct the investigation for the construction sites of the entire line on a regular basis in accordance with ADB's requirements, and submit the environmental and soil & water conservation monitoring report based on the investigation results (in English and Chinese Edition).

In March 2006, XXXXX Company won the tender and was granted to undertake the environmental monitoring work of project in the tender of environmental monitoring project during construction period held by Ministry of Railway and Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd.

From November 2006 to December 2009, XXX has prepared 5 environmental monitoring reports in November 2006, June 2007, December 2007, December 2008 and December 2009, respectively. It also conducted the full range of environmental monitoring to the construction process, with the main contents including: the implementation of protection measures of water environment, atmospheric environment, noise environment, solid waste, borrow/spoil field, soil & water conservation facilities, Yellow River Wetland Nature Reserve and Xiliu Lake Drinking Water Source Protection Area, as well as the environmental problems caused to the local economic development as a result of the construction of the Railway.

6.2 Summarization of environment monitoring

Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd. undertake the construction of Zhengxi Railway, and is responsible for the environmental protection work of construction period. Zhengxi Railway preparation units (Zhengzhou Railway Department and Xi'an Railway Bureau) will be responsible for the environmental protection work of Zhengxi Railway. The environmental protection agencies and water conservation bureaus along the railway are responsible for the supervision and inspection work of environmental protection and water protection within the areas.

The environmental monitoring work undertaken by XXX shall be completed in following manner: the daily monitoring is performed by construction and supervision units; construction units and XXX are responsible for collecting monitoring data, and XXX then prepares the monitoring reports and submits to the Ministry of Railways and ADB. Through 5-phase environment monitoring, monitoring, it is intended to strengthen the environmental awareness and improve the level of environmental management during construction, regulate the environmental management procedures, and thereby ensuring that the degree of environmental impact during construction period has played a positive role.

(1) The environmental monitoring existed throughout the construction process of the whole railway. It was started in September 2005 and completed in December 2009. Working with Zhengzhou-Xi'an Passenger Dedicated Line Co., Ltd., the monitor performed the comprehensive supervision and inspection to the sewage, noise, solid waste, dust, borrow (spoil) site and large construction site during the construction period, and discovered the hazards existed in environmental protection and soil & water erosion, and required the construction units to conduct the rectification and improvement work in
accordance with the requirements of environmental protection and soil and water conservation, which effectively mitigate the environmental pollution and ecological damage of construction period.

(2) The environmental monitoring is focused on the protection, management and restoration of borrow/spoil area, pollution control and ecological management of construction sites and camps, control of construction noise and dust, protection and greening of subgrade and cut slope, special monitoring on nature reserves and water resource protection areas, which basically covers the ecological disruption and pollution of construction, comprehensively reflects the pollution and environmental protection standards during construction.

(3) The environmental monitoring reports were prepared by cooperating with Zhengxi Railway Corporation, construction units and supervision units, and the monitoring data was provided by the construction units, and checked by the supervision units, while gathered and collected by the report preparation unit.

(4) The use of most of beam fields, mixing stations and other large temporary works have been completed, and it is recommended to give an early planning to the used temporary sites, and perform the landscape restoration and site, utilization works.

7. Overall Evaluation of Environmental Impact

7.1 Ecological environment

(1) The project covers a total of permanent land of 1808.4hm², where the agricultural land accounts for most. The permanent area of the project is large, which will pose a limited effect to the land use pattern along the railway, and it may minimize such impact through economic compensation used for land reclamation, restoration and other measures.

(2) The temporary site of project is mainly the dry land. The temporary works gives priority to the combination of permanent and temporary land use, making full use of existing sites or the permanent land and urban land within the range of site, and thereby reducing the new area.

(3) There’re 88,000 arbors and 176,000 shrubs planted for the whole railway, with the grassing and greening areas of 82.8hm², which greatly improve the ecological environment.

(4) The bridge and culvert works have taken into account the requirements of drainage, irrigation, surface runoff, staff travel and animal corridor in the design. There’re totally over 130 Super Major Bridges and large and medium bridges and 254 small bridges and culverts constructed in the project, with an average 3.6 per kilometer subgrade, which minimize the impacts on rivers, drainage, irrigation, overland flow and animal corridor.

(5) This project also provides the protection design by planting the vegetation, engineering or vegetation + engineering for both sides of the slopes and subgrade.

(6) 95% of soil erosion induced by the project has been effectively controlled by taking a variety of protective management measures (slope protection and greening, slag walls, flattening reclamation and afforestation), and the soil erosion hazards have basically
eliminated.

(7) The total amount of earthwork and stonework of the whole line is $3203.5 \times 10^4 m^3$, where the fill is $785.8 \times 104 m^3$, and the excavation is $2417.7 \times 104 m^3$. By taking the relevant engineering protection and greening measures, such as the allocation of earthwork and stonework, borrowing area, spoil ground, subgrade slope, spoil of bridge foundation, to mitigate the impacts of earthwork and stonework on the ecological environment, and reduce soil erosion.

(8) The excavation foundation surplus and drill ballast produced in the Yellow River Wetland Nature Reserve in Shanxian have been completely removed and cleaned, and the construction site is clean, the environment along the bridge has been properly protected, with no soil erosion risks. No construction machinery with high noise and vibration and high-power beam equipments have been used in the nature reserve during the construction, night construction works are also rarely seen, which have no direct impact on the habitat of wildlife within the protection areas. The construction access roads crossed have been hardened, and be used as the railroad maintenance accesses or for agricultural use.

(9) As the distance between the project and birds gathering area (core area of the protected areas) of Yellow River Wetland Nature Reserve is more than 1000m, therefore, the train operation would has no obvious impact on the habitat of the wildlife living within the protection areas.

7.2 Noise environment and environmental vibration

The construction noise and vibration protection measures adopted in the construction period include: a) list the noise protection measures as the contents of construction organization design, and specify in the contract; b) the machinery with high noise level, such as generators and air compressors, shall be placed in a remote place, and away from residential areas, schools, hospitals and other noise sensitive points, while the distance between mixing field, stirring field, and prefabrication field and residential areas shall be generally ≥ 200m, and the points difficult in selection shall use the closed soundproof measures; c) arrange the construction time in a reasonable way, and do not conduct the construction work at night or just arrange the low-noise construction works. The construction machinery with high noise level shall be stopped in the night (22:00-6:00), and do the communications works with the residents; d) perform the environmental noise monitoring for the construction site, and the noise value monitoring of construction site shall be performed in accordance with "Method for Noise from Construction", to ensure that the noise values would not exceed the noise emission standards.

The noise control measures taken for the operation period are as follows: a) relocate the residential located within 30m and other scattered sensitive points by combining with engineering demolition, to move them to the place beyond the impact range of noise; b) set the noise barrier of 2.15-3.95m high for the sensitive points located close to the railway, and totally 65.05 single-line kilometers of noise barrier are arranged along the whole railway; c) use the acoustic ventilation windows for the sensitive points that are not suitable for using the noise barrier or exceeding the limits after using of noise barrier, with the acoustic ventilation windows designed area of $14860m^2$ for the whole line, which will be implemented in accordance with the
preliminary noise measurement results.

Through the implementation of above noise and vibration protection measures, there’re no significant noise and vibration pollution complaints appeared during the entire construction period, and the impacts of local noises and vibrations have also been timely improved; the noise pollution has not obviously appeared due to the less number of running trains, while the sufficient number of noise barriers and acoustic ventilation windows would effectively reduce the noise level, and thereby ensuring to meet the relevant requirements of environment standards.

7.3 Water environment

(1) This foundation construction requiring across the rivers, water and bridges shall be conducted during the rainy season, to reduce the impact of mud and machinery oil leakage caused due to the construction in rainy season on the water quality, while strengthening the management and maintenance of construction equipments, to prevent the leakage and the petroleum contaminants and delivered construction materials, thereby reducing the water pollution.

(2) During the construction, the spoil produced in the excavation of bridge foundation shall not be stacked at both sides of river way and water, and shall be transferred to the spoil ground for uniform treatment in a timely manner.

(3) The selection of construction camps and stock ground of crossing bridge shall leave a certain buffer distance of above 20-30m to the river bank, to prevent the discharge of domestic sewage and production oily wastewater produced by the construction machinery and repair.

(4) The concrete mixing plant shall be arranged at a place at least 300m away from to the residential area. The water used for washing the ballast shall be set with the sedimentation tanks, and be re-used, while the discharge of the construction sewage shall meet the relevant standards. When delivering the concrete mixture to the pier, it shall avoid the falling of materials and thus affecting the water quality. The constructed concrete mixing plant shall be equipped with the dust removal equipment, to avoid the pollution of dust to the environment, air and water.

(5) Due to the relative dispersion of the construction camps, the camps for construction personnel shall be set with dry pail latrines, which shall be timely cleaned and drained and used as the farmyard manure.

(6) The construction sites with oily water shall be arranged with small grease/oil traps, and the oily water will be discharged after the treatment of oil removal.

(7) The construction machinery maintenance point shall use the hardened ground and drying bed, to prevent the pollution of mechanical maintenance and sewage to the water and soil.

(8) The stock ground is stacked with special materials, such as asphalt, cement, which shall be provided with canopy cover, to prevent the erosion caused by rain wash, and thus polluting the environment.

(9) Tunnel sewage shall be discharged after being precipitated in the sedimentation tank.
(10) Xiliu Lake Drinking Water Source Protection Area: there’re no construction camps and large construction site that may affect the water quality constructed by the construction unit, and no discharge of sewage, construction and domestic waste entered into the protection areas.

To construct the Xiliu Lake Bridge, a steel pipe pile temporary bridge constructed by the construction unit has been removed after construction, and the water resource area protection has been strengthened during the removal, therefore, there is no pollution of water source.

(11) All station sewage of Zhengxi Railway produced during the operation shall be the general domestic sewage, with no special pollutants and sewage quantity of 5-15m³/d, which will be treated together with the urban sewage after subject to pretreatment in septic tank, with no pollution produced to the surrounding environment.

7.4 Atmospheric environment

During the construction process, the effective prevention measures are used for the dust produced in the earthwork and transportation and the temporary small boiler equipped in each construction camp (including the hardened road, water spraying, separation barrier, coverage, use of clean fuel, prohibition of burning of waste), will minimize its impact, and these effects have disappeared with the completion of corresponding construction works.

In the engineering operations, the required air-conditioning and hot water are operated by power, and no new boilers and other air pollutants distributed.

7.5 Electromagnetic radiation

(1) The impact of electromagnetic radiation produced by the trains on the television receiving of residents along the railway can be eliminated by accessing the cable television, while completely eliminating the impact of reflection and occlusion of the train body, for this, the project has provided with the compensation of cable TV network, which is offered to the sensitive points that have significant decrease in receiving the television in accordance with the preliminary test results of environmental protection acceptance after actual running, to make them access to the cable TV, and completely eliminate the impact of electromagnetism. This work has still not been implemented, requiring the final acceptance results of electromagnetic environment.

(2) The power frequency electric and power magnetic induction density at the enclosures of newly constructed substation is very low, which is in line with the relevant limit specified in HJ/T24-1998. To reduce the electromagnetic effect, eliminate the fear of the residents, the traction substation shall be possibly far away from the residential areas, schools, hospitals and other environmentally sensitive areas.

7.6 Solid wastes

The solid waste prevention measures adopted for the construction period include: a) the
household garage by the construction camps shall be collected and cleaned by the special personnel, and then sent to the environment authorities for concentrated treatment; b) completely clean and remove the construction waste generated after the evacuation of construction camps, and transported to the designated spoil ground or other places for disposal.

The solid waste prevention measures adopted for the operation period include: a) provide the garbage bags on the passenger train, and fully implement the system of fixed garbage throwing point; b) the garbage bins shall be provided for the garbage produced by the passengers and station staff, and shall be uniformly disposed by the urban sanitation department after being collected; c) promote the environmental protection education at the station, to enhance the passengers’ awareness of environmental protection, and minimize the phenomenon of throwing garbage anywhere.

By taking the above solid waste control measures, there's no major solid waste pollution incidents occurred during the construction and operation periods.

7.7 Conclusions

Zhengxi Railway project is located in the Yuxi mountains and the Weihe River alluvial plain, of which, the topography is complicated, and loess is developed, with high utilization rate of land; the construction works will inevitably have a certain impact on the ecological environment, sound, vibration environment, water and air atmospheric environment within the certain areas along the railway, while the effective measures for ecological protection and restoration, control measures for soil erosion and pollution control measures have been implemented by combining with the local characteristics, which have been greatly improved in the actual construction, and the impact and pollution of construction on the environment and the pollution have been effectively controlled or mitigated.

As seen from the monitoring programmes, the project is helpful in improving the traffic conditions along the railway and promoting the regional economic development. After the implementation of each environmental protection and soil conservation measures, the construction of the project did not significantly and adversely affect the regional environment, and it is a new passenger line characterized by environmentally friendly, energy saving, fast and high efficiency.
Photos of Some of Sites

Xiliu Lake Bridge (water conservation area)

Shanxian Super Major Bridge (Yellow River Wetlands Reserve)

DK24 Cutting Protection

Side Slope Protection of Huanglongjian Super Major Bridge

Cutting Protection at the Front of New Sanmenxia Station

Cutting and Contact Line

Continuous Beam at Weihe Super Major Bridge

Weinan Weihe Super Major Bridge
Qindong Tunnel Exit

Tongluochuan Bridge

Hongnongjian Super Major Bridge

Yaojiazhai Traction Substation

Tunnel Line Connection of Pandong Tunnel Bridge

Weinan North Railway Station

No. 23 Bureau, No.1 Beam Field

Lingbao Beam Field

Environment Monitoring Report upon Zhengzhou-Xian Railway of Passenger Special Line in 2010
Spoil Ground of Cutting near DK82

Slag Yard at Exit of Pandong Tunnel

Spoil Ground at Entrance of Guanyintang Tunnel

Borrow Area of Yiyang Beam Field

Noise Barrier of Dongguan Elementary School

Noise Barrier at Dailu Village

Integrated Noise Barrier

Zhitian Middle School (no noise barrier erected)
Slag Yard at Yuding Tunnel

Spoil Ground at Entrance of Hanguguan Tunnel

Reclamation Site of Lime Mixing Plant of No.7 Bureau

Environment Acceptance Investigation Site