Technical Assistance Consultant's Report

TA-8440-PRC

March 2015

Shaanxi Mountain Road Safety Demonstration Project PPTA

Consultant Report – Final Report

Prepared by MMM Group Ltd, Canada

CURRENCY EQUIVALENTS

(as of 16 January 2015) (BOC middle exchange rate)

Currency Unit	=	Chinese Yuan
CNY 1.00	=	$0.163417
$1.00	=	CNY 6.1193

ABBREVIATIONS

AKTB	-	Ankang City Traffic Bureau
ADB	-	Asian Development Bank
DI	-	Design Institute
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
EIR	-	Environmental Impact Report
EIRF	-	Environmental Impact Registration Form
EIRR	-	Economic Internal Rate of Return
EMP	-	Environmental Management Plan
EPB	-	Environmental Protection Bureau
FD	-	Final Design
FFPO	-	Foreign Fund Financed Project Office
FSR	-	Feasibility Study Report
GAP	-	Gender Action Plan
GDP	-	Gross Domestic Product
HDM-4	-	Highway Design and Management 4
HH	-	Household
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
IRI	-	International roughness index (IRI m/km)
IRAP	-	International Road Assessment Program
MGV	-	Medium Goods Vehicle
MOC	-	Ministry of Communications
MOT	-	Ministry of Transport
Mu	-	Unit of measure: approximately 666 m2 or 1/15 Hectare
PD	-	Preliminary Design
PPTA	-	Project Preparation Technical Assistance
PRC	-	People’s Republic of China
RED	-	Roads Economic Decision Model
ROW	-	Right of Way
RF	-	Resettlement Framework
RP	-	Resettlement Plan
RUC	-	road user costs
SCG	-	Shangnan County Government
SDAP	-	Social Development Action Plan
SPTD	-	Shaanxi Provincial Transport Department
SPHB	-	Shaanxi Provincial Highway Bureau

NOTES

(i) The fiscal year (FY) of the Government and its agencies ends on 31 December.

(ii) In this report, "$" refers to US dollars.

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Revision Sheet

Release	Date	Revision Description
Rev. 0	February 2015	Fact Finding Phase – Pre Mission
Rev. 1	March 2015	Fact Finding Mission

ACKNOWLEDGMENTS

The PPTA was performed under a contract between ADB and MMM Group Ltd, Canada, referred to in the report as “the Consultant”.

The Consultant expresses their sincere thanks to all those who have provided their time and advice during this phase and to our hosts.

PROJECT AT A GLANCE

1. Project Name: Shaanxi Mountain Road Safety Demonstration Project **2. Project Number:** 46042

3. Country: China, People's Republic of **4. Department/Division:** East Asia Department/Transport and Communications Division

5. Sector Classification:

Sectors	Primary	Subsectors
Transport, and information and communication technology	√	Road transport

6. Thematic Classification:

Themes	Primary	Subthemes
Economic growth	√	Promoting economic efficiency and enabling business environment
Regional Cooperation and Integration		Cross-border infrastructure
Capacity development	√	Institutional Development
Governance		Economic and financial governance

6a. Climate Change Impact

No Climate Change Indicator available.

6b. Gender Mainstreaming

Gender equity theme (GEN)	
Effective gender mainstreaming (EGM)	√
Some gender elements (SGE)	
No gender elements (NGE)	

7. Targeting Classification:

General Intervention	Targeted Intervention		
	Geographic dimensions of inclusive growth	Millennium development goals	Income poverty at household level
√			

8. Location Impact:

Regional	Moderate
Rural	High

9. Project Risk Categorization: Complex

10. Safeguards Categorization:

Environment	A
Involuntary resettlement	A
Indigenous peoples	C

11. ADB Financing:

Sovereign/Nonsovereign	Modality	Source	Amount ($ Million)
Sovereign	Project loan	Ordinary capital resources	200.0
Total			200.0

12. Cofinancing:

No Cofinancing is required.

13. Counterpart Financing:

Source	Amount ($ Million)
Government	199.96
Total	199.96

14. Aid Effectiveness:

Parallel project implementation unit	No
Program-based approach	No

I. THE PROPOSAL

1. Shaanxi Province is one of the least developed provinces with per capita GDP, per capita urban income and per capita rural income at about 100%, 84% and 73% of the national averages in 2012, ranking in 14th, 18th and 26th respectively among the 31 administrative provinces and regions in PRC. Fifty of Shaanxi's 107 counties have been officially designated national poverty counties. The project will (i) upgrade 187 kilometers (km) of trunk roads, (ii) rehabilitate 140 km of earthen rural roads to a sealed condition and iii) improve the road safety measures on these roads, plus an additional 570 km of rural roads and implement institutional capacity development in road safety planning and awareness, through training and software.

II. THE PROJECT

A. Rationale

2. **Background.** The Government of the People's Republic of China (PRC) has requested Asian Development Bank (ADB) financing for a project to rehabilitate and upgrade provincial and rural roads and to improve road safety. Shaanxi Province is one of the least developed provinces with per capita GDP, per capita urban income and per capita rural income at about 100%, 84% and 73% of the national averages in 2012, ranking in 14th, 18th and 26th respectively among the 31 administrative provinces and regions in PRC. Fifty of Shaanxi's 107 counties have been officially designated national poverty counties. The project is in the Qinba Mountains[1] area in southeast Shaanxi Province, one of the 11 poorest regions targeted for concentrated interventions under the 2011–2020 poverty reduction strategy of the PRC Government. The project area had an overall poverty incidence of over 30% in 2012.[2]

3. The project investments will be located in Ankang and Shangluo, two prefecture-level cities[3] in the Qinba Mountains area that have populations of 2.95 million and 2.41 million, respectively. Together, these municipalities account for almost 15% of Shaanxi Province's population. Both Ankang and Shangluo have strong potential for expansion of agriculture and related processing, mineral and hydropower industries, and the development of tourism. Lack of adequate transport accessibility and highly unsafe road conditions are major constraints on the social and economic development of the region.

4. **Trunk Roads.** The existing highways in the project area are narrow, have tight curves and low axle load limits. Vehicle ownership has grown rapidly in the area and ongoing major construction projects have led to increased heavy truck traffic and degraded road conditions. Traffic on provincial highways in the project area has been growing at almost 10% per year and the existing trunk roads are expected to reach capacity within 5 years. Rehabilitating and upgrading area roads will ensure that adequate road capacity is available to facilitate economic development and improve accessibility for the large local population.

5. **Rural Roads.** The local economy and people's livelihoods remain largely dependent on agriculture. Local farmers often travel along unpaved rural roads to towns along the provincial highways to sell their produce. In remote areas, buyers travel to villages to purchase agricultural production but poor roads and high transport costs reduce the prices received by farmers. During rainy periods, unpaved roads become impassable and perishable crops cannot reach the market. Paving these roads would provide many poor farmers with improved access to economic opportunities, education, health and other services.

[1] Qinba Mountains Area refers to the areas of the Qinling and Bashan mountain ranges.

[2] Based on the latest poverty line of CNY 2,300. The poverty incidences for 2011 are Xunyang County (32.6%), Hanbin District (41.8%) and Shangnan County (41.9%).

[3] In the PRC, prefectural level cities are not usually large continuous urban settlements, but are an administrative unit below the provincial level and above counties. They comprise, typically, a main central urban area and its much larger surrounding rural area containing many smaller cities, towns and villages.

6. **Road Safety.** Lack of transport access is compounded by severe road safety problems. The project area contains many high-risk roads with significant traffic volume and a mix of heavy vehicles, automobiles, motorcycles, non-motorized vehicles and pedestrians. An initial assessment of road crashes in the Qinba Mountains area indicates a crash rate about 4 times the national average for roads of similar class in the PRC. Fatality rates are also exceptionally high at over 12 times the average rate reported for national highways of the same class.[4] There is an urgent need to improve road safety throughout the Qinba Mountains area.

7. Road deaths have large economic and social costs that fall disproportionately on the poor.[5] For a 1,000 kilometers (km) sample of roads in the project area, there were over 500 road fatalities between 2007 and 2012 with an estimated economic cost of CNY1.4 billion ($228 million equivalent).[6] The PRC Government reports that only 28% of road deaths are car or truck drivers.[7] The rest are pedestrians (26%), bicycle riders (17%), and motorcycle riders (28%), and others (1%), which are the travel modes most often used by the poor. Reducing road crashes and related impacts will contribute to inclusive economic growth and poverty alleviation in the region.

8. The government recognizes that urgent action is needed to reduce traffic deaths and injuries in the PRC. It is a signatory of the United Nations “Decade of Action for Road Safety, 2011-2020”. In 2011, the State Council of the PRC issued the “Safety Plan in the 12th Five-Year Plan” which establishes quantitative planning objectives for road safety at the national level. Provincial and local governments, however, need help to achieve major reductions in road crashes and the resulting injuries and fatalities. They must learn and apply international best practices to accelerate progress towards safer roads. ADB participation in the project will mobilize resources and international expertise to demonstrate innovative solutions that improve road safety in an area where it is badly needed. The project is also aligned with the ADB's Country Partnership Strategy, 2011–2015 for the PRC in the areas of safety and social sustainability.

9. In 2010, ADB established the Sustainable Transport Initiative to align its transport operations with ADB’s long-term strategic framework, Strategy 2020. As part of the Sustainable Transport Initiative, ADB is committed to scaling up road safety operations. ADB’s Road Safety Action Plan states that ADB will proactively identify opportunities for improving and scaling up road safety, mainstream and strengthen road safety components in ADB financed projects, and eventually introduce stand-alone road safety interventions. This project is a major opportunity to put these plans into action.

B. Impact and Outcome

10. The expected impact of the project is that safe and efficient all-weather accessibility is provided in southeast Shaanxi Province.

11. The expected outcome of the project is an improved transport network in southeast Shaanxi Province, consistent with the objectives of the 12th five-year development plan.

C. Outputs

12. The project has three main outputs.

[4] Data and calculations provided by Research Institute of Highway, Ministry of Transport, PRC.

[5] ADB. 2012. Road Safety Action Plan. Manila. (see Appendix 2)

[6] Calculated by Research Institute of Highway, Ministry of Transport, PRC. Costs include medical expenses, loss of economic output, property damage, traffic delays, environmental impacts, and other costs.

[7] Ministry of Public Security. 2008. Annual Statistical Report on Road Traffic Accidents. Traffic Management Bureau. Beijing.

13. **Trunk roads.** Approximately 187 km of trunk roads will be upgraded from Class III/IV[8] to Class II/III standard incorporating major safety design enhancements. The current cost estimate[9] for this component is CNY 1,508.6 million (of civil works including road safety, excluding contingencies and land acquisition).

14. **Rural roads.** Approximately 139.6 km of rural roads in poor agricultural areas will be upgraded from earthen roads to paved Class IV standards including improved safety design enhancements. The current cost estimate for this component is CNY 288 million (of civil works including road safety, excluding contingencies and land acquisition).

15. **Comprehensive road safety program.** The project will include (i) road safety investments on an additional 569.66 km of roads in southeast Shaanxi, (ii) improved capacity of road safety unit in Shaanxi Provincial Transport Department (SPTD) and local traffic bureaus, and (iii) a road safety education campaign. The project will introduce the International Road Assessment Program (iRAP)[10] assessment methodology[11] to guide the road safety design and monitoring processes. The project will demonstrate the impact of rigorous and data driven road safety assessment and design practices to reduce crash rates and provide a model that can be replicated in other provinces as well as in other developing countries. An initial assessment of roads in the project area indicates that most of these roads require improved delineation and signage, intersection improvements, installation of well-designed roadside barriers, traffic calming, pedestrian crossing upgrades, and footpaths to protect pedestrians in towns and villages along the roads.

16. A capacity development and training component will establish the data collection and analysis capability within SPTD and local governments to track road crashes, analyze the causes, and design and implement appropriate solutions. The iRAP software and assessment capabilities will be transferred to the SPTD safety unit and serve as the basis of a project impact assessment. Enhanced road safety education is needed to achieve better safety awareness for the population residing in the project area. Targeted awareness campaigns for specific risk factors (improper licensing, non-use of helmet, non-use of seat belts, excessive speed, drinking and driving) will be implemented in local communities. The preliminary budget for road safety upgrades, capacity building and safety education is CNY 298.2 million. A further CNY 7.9 million has been estimated for contingencies, design, procurement and supervision costs of component 3 additional rural roads)

D. Investment and Financing Plans

17. The project cost is estimated at US$ 434.71 million equivalent out of which ADB will finance $ 200 million (about CNY 1,224 million) from its ordinary capital resources. The remaining balance would be financed by the Shaanxi Provincial Government (SPG).

Table II-1: Tentative Financing Plan

Source	Amount ($ million)	Share of Total (%)
Asian Development Bank	200.0	50.01
Government	199.96	49.99
Total	399.96	100.0

[8] In the PRC, Class IV roads are small paved two-lane roads with a total width of 7 meters, Class III roads are higher standard two-lane roads with a width of 8.5 meters, and Class II roads are usually two lane highways with substantial shoulders and a width of 12 meters. Some variation is allowed within the published standards.

[9] All Current cost estimates are based on preliminary designs with iRAP reviews and implementation of suggestions

[10] iRAP is an international charity dedicated to creating “a world free of high-risk roads.” In 2010, ADB and iRAP signed a memorandum of understanding establishing a non-exclusive framework of cooperation to promote programs and projects that improve road safety in ADB's member countries.

[11] Details on the iRAP methodology are available at http://www.irap.net/about-irap-3/methodology.

Source: ADB and Government estimates

18. The estimate for the Project based on the final design estimates (including agreed and approved road safety improvements) is shown in Table II-2.

Table II-2: Tentative Investment plan

($ million)

Item			Amount[a]
A.	**Base Cost**		
	1.	Trunk Roads Improvement	294.61
	2.	Rural Road Upgrading	36.6
	3.	Road Safety Investments	13.11
	4.	Institutional Strengthening	2.36
		Total (A)	**346.68**
B.	**Contingencies**		**40.91**
C.	**Financing Charges**		**12.37**
TOTAL			**399.96**

[a] Includes taxes and duties to be financed by the PRC

Source: ADB and Government estimates

E. Implementation Arrangements

19. Shaanxi Provincial Transport Department (SPTD) will be the executing agency (EA) of the project. Shaanxi Provincial Highway Bureau (SPHB), on behalf of SPTD, will be in charge of overall project organization, coordination, guidance and supervision. The Foreign Fund Financed Project Office of SPTD (FFPO) is responsible for the daily work during the project preparation stage, the project coordination and liaison with ADB during the implementation stage in order to ensure that the project will be implemented in accordance with ADB's guidance and requirements. Ankang City Traffic Bureau (AKTB) and Shangnan County Government (SCG), as the implementation agency (IA), will respectively manage the implementation of trunk roads, rural roads and road safety component located inside Ankang City and Shangnan County. For this, daily management responsibility will be assigned to the PMO under jurisdiction of AKTB and SCG.

20. Under the leadership of AKTB, ADB Financed Project Management Office (AKPMO) will be in charge of management and overall coordination related to the construction of two trunk roads (S102 and G316), 7 rural roads and several road safety projects.

21. The Construction Management Office for Shaanxi Mountain Road Safety Demonstration Project financed by ADB, established by SCG, will be in charge of managing the implementation of project components located in Shangnan County.

Table II-3: Implementation Arrangement

Aspects	Arrangements		
Implementation period	December 2015–December 2019		
Estimated closing date	30 June 2020		
Management			
(i) Oversight body	Shaanxi Provincial Transport Department		
(ii) Executing agency	Shaanxi Provincial Transport Department		
(iii) Key implementing agency	Foreign Fund Financed Project Office (FFPO), Ankang City Traffic Bureau (IA), Shangnan County Government (IA)		
(iv) Implementation unit	Project Management Office (PMO) and sub-PMO		
Procurement (ADB financed contract packages)	NCB		$ 285.8 million
	Shopping (goods)	None	$ 0 million
Consulting services (ADB financed contract packages)	QCBS (90:10) 18 person-months international consulting services 16 person-months national consulting services ICS External Monitoring – Environment (4 pm) SSS Road Safety Capacity Building Road Safety Audit and training services Walkwise Pilot		$ .75 million $ 0.040 million $ .654 million $ .409 million $ .300 million

Aspects	Arrangements
Retroactive financing and/or advance contracting	Advance contracting and retroactive financing is proposed for the recruitment of the trunk roads.
Disbursement	The loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2012, as amended from time to time) and detailed arrangements agreed upon between the government and ADB.

2. ADB = Asian Development Bank, NCB = national competitive bidding, QCBS = quality- and cost-based selection.

3. ICS = Individual Consultant Selection, SSS = Single Source Selection

Source: ADB.

F. Implementation Readiness and Plan

1. Implementation Readiness

	Indicative Activities	Months												Who is responsible
		2015									2016			
		Q2			Q3			Q4			Q1			
		4	5	6	7	8	9	10	11	12	1	2	2	
1.	Advance contracting actions													SPTD, AKTB, SCG
2.	Retroactive financing actions													SPTD, AKTB, SCG
3.	Establish project implementation arrangements													SPTD, AKTB, SCG
4.	ADB Board approval													ADB
5.	Loan signing													SPTD, MOF
6.	Government legal opinion provided													SPTD
7.	Government budget inclusion													SPTD, MOF
8.	Loan effectiveness													SPTC, MOF

ADB = Asian Development Bank, AKTB = Ankang City Traffic Bureau, MOF = Ministry of Finance, SCG = Shangnan County Government, SPTD = Shaanxi Provincial Transport Department.

2. Overall Implementation Plan

ID	Task Name	2015				2016				2017				2018				2019				2020			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	**Trunk Roads Improvement**																								
	G316 - Xunyang to Ankang																								
1.1	Procurement																								
1.2	Civil Works																								
1.3	Resettlement																								
	S102 - Xunyang to Xiaohe																								
1.4	Procurement																								
1.5	Civil Works																								
1.6	Resettlement																								
	S224 - Shangnan to Yunxian																								
1.7	Procurement																								
1.8	Civil Works																								
1.9	Resettlement																								
2	**Rural Roads Improvement**																								
2.1	Procurement																								
2.2	Civil Works																								
2.3	Resettlement																								
3	**Road Safety Improvement**																								
3.1	Procurement																								
3.2	Civil Works																								
4	**Institutional Development**																								
4.1	Consultant recruitment																								
4.2	Project Management																								
4.3	Road Safety Programme																								
4.4	Road Safety Awareness																								
4.5	Ext Monitor – Environment																								
4.6	Ext Monitor - Resettlement																								
4.7	Social and Gender Monitoring																								

Source: ADB estimates.

Preparation Implementation Maintenance Bid Period

III. DUE DILIGENCE

A. Minor Project Scope Adjustments

22. This section outlines minor changes to the original project scope. The previously proposed road-safety-enhancements only for the Weijiatai-Hubei section of S224, has now been proposed for rehabilitation due to its rapidly failing condition. Preliminary designs and road safety enhancements have been prepared for this 37.963 km section. Minor adjustments have been made to subproject lengths and cost estimates as designs have been progressively developed. The original 660 km estimate for additional rural roads for road safety intervention has reduced to 569.88 km due to i) reduction in the length of X213 (Han Bin), ii) reclassification of a section of X304 (Xunyang) as a "rural road", and iii) exact lengths of roads are not always known, and in some circumstances, roads do not have distance markers in place and/or markers are incorrect. The current project is proposed to comprise:

- Component 1: The original 193 km of trunk road rehabilitation is now 186.95 km
    - National road G316 34.357 (was 36.42) km from Xunyang to Ankang, Class III/IV to Class II
    - Provincial road S102 60.246 (was 64.13) km from Xunyang to Xiaohe, Class III/IV to Class II
    - Provincial road S224 92.347 (was 92.22) km from Shangnan to Yunxian, Class III/IV to Class II/III, comprising 54.384 km of upgrading, and 37.963 km of rehabilitation
- Component 2: 139.658 (was 139.656) km of rural roads upgraded from earth to paved.
- Component 3: 569.66 (was 660 km) of rural roads will receive road safety investment. The road safety methodology and investments will also be applied to Components 1 and 2. Total road safety budget is around CNY 300 million. This includes Institutional strengthening of related agencies and bureaus, specifically Shaanxi Provincial Transport Department (SPTD), with a road safety focus.

B. Project background

23. Shaanxi Province is one of least developed provinces with per capita GDP, per capita urban income and per capita rural income at about 90%, 82% and 69% of the national averages in 2010, ranking in 15th, 19th and 27th respectively among the 31 administrative provinces and regions in PRC. Fifty of its 107 counties have been officially national designated poverty counties. A significant portion of the poor population in Shaanxi lives in two northern and three southern cities. Lacking transport infrastructure is one of the contributing factors behind the depressed economic conditions in these counties.

24. The project is located in Ankang and Shangluo, two prefecture-level cities of southern Shaanxi. Ankang accounts for 11.4% (23,391 km2) of the Shaanxi Province and for about 8% (2.95 million) of its population. Shangluo accounts for 9.4% (19,293 km2) of the Shaanxi Province and for 6.5% (2.41 million) of its population. Located in the Southern highly mountainous territory of the province, both Ankang and Shangluo have strong potential for expansion of agricultural (e.g., tea and mushroom), mineral and hydropower industries, and the development of tourism activities. Lack of adequate transport accessibility and a road network of insufficient quality condition are major constraints on the social and economic development of the region.

25. The proposed project is located in Qinba mountain area, one of the 11 poorest regions targeted for concentrated interventions under the 2011−2020 poverty reduction strategy of PRC Government. The proposed project will have direct impact of three counties (Xunyang County, Hanbin District and Shangnan County), all of which have been designated as national poverty counties since 1990s. The overall poverty incidence of the three project counties, using latest national poverty standard of CNY 2,300 is over 35% as of 2011.

26. The main causes of poverty include (i) low profit margin of local special products due to lack of market access and local processing; (ii) lack of access to non-farm employment opportunities as a result of limited investments in processing of the local special products and development of rich tourism resources; (iii) vulnerability to illness, traffic accidents and high schooling expenses; (iv) vulnerability to natural disasters of floods and snow storms; and (v) lack of high quality farmland in the mountainous region; and (vi) lack of access to credit, social services and information. In summary, remoteness and lack of access, as root causes of poverty; are main constraints of poverty reduction in the project area.

27. The ongoing government poverty reduction programs include: (i) concentrated (targeted) poverty intervention by providing CNY 1.0−1.2 million of poverty funds for each poor village; (ii) industrial development through subsided loans and some forms of self-help cooperative approach; (iii) the "Rain-Dew Plan" (employment training) that targets poor farmers of 16-35 years old; (iv) piloting the village mutual fund of the microcredit approach; and (v) partnerships between government agencies and poverty villages.

28. The proposed project will directly contribute to poverty reduction by providing better access to market and other social services. The implementation of the Social Development Action Plan (SDAP) and Gender Action Plan (GAP) will target and benefit the poor. It will also provide employment opportunities for the poor as unskilled labors during project construction. The proposed project will also help timely delivery and distribution of relief materials in case of severe natural disasters of flooding and snowing. The project will contribute to poverty reduction indirectly by facilitating (i) good access of locals to regional central markets so as to add values to specialized local products; (ii) good access of outsiders to tourist attractions; (iii) the implementation of various on-going and forthcoming poverty reduction programs; and (iv) external investments for processing industry and tourism development that could generate large number of employment opportunities and add value to local agro-products.

29. This project will directly benefit a total population of approximately 1.7 million in the poverty counties of Hanbin District, Xunyang County and Shangnan County. Indirectly, it will benefit the populations of approximately 3 million in Ankang City and 2.5 million in Shangluo City. (See **Appendix A** for Project Maps.) For a more detailed assessment of the road sector see **Appendix B**.

C. Technical Due Diligence

1. Component 1: Trunk Road Rehabilitation

30. The three proposed trunk roads have undergone a series of revisions since initial proposal in 2012. The following presents a history of each road.

G316 Xunyang to Ankang	S102 Xunyang to Xiaohe	S224 (X201) Shangnan to Yunxian
Date of Mission: April 2012	**Length: 187 km**	**Cost: CNY 2,739 million**
Existing 41 km to become 36.3 km Pcu/day: 3,988 Cost: CNY 680 million EIRR: unknown Issues: half the alignment required construction, lower than nominated traffic	Existing 73.7 to become 64.1 km Pcu/day: 2,550 Cost: CNY 1,050 million EIRR: 11% Issues: observed higher traffic than other two projects, estimates close to FSR	Existing 98 km to become 87 km Pcu/day: 1,338 Cost: CNY:1,009 million EIRR: < 11% Issues: 4.7 km of tunnels, observed lower than estimated traffic. From Shangnan to Xiaohe (45 km) in poor condition with FSR traffic levels From Xianghe to Zhaochuan (53 km) good condition, lower than predicted traffic, due to high traffic accidents, focus should be road safety
Date of Mission: July 2012	**Length: 192.7 km**	**Cost: CNY 1,839 million**

G316 Xunyang to Ankang	S102 Xunyang to Xiaohe	S224 (X201) Shangnan to Yunxian
Route optimization allowed 88.8% use of existing road. Higher traffic than observed in April. K0+000-K9+260 Class III applied, design speed of 30 kph. K9+260-K26+080 Class II with design speed of 40 kph K26+080-K36+425.5 Class II with design speed of 60 kph. Tunnel 390 m, Cost reduced to CNY 410 million EIRR: 18%, **review traffic forecasts!**	Route optimization allowed 81% use of existing road. Standard 10m road base for Class II reduced as follows: 17.3 km of 8.5 m width, K28+000-28+900, K31+900-K34+000 K40+500-K52+500, K52+920-K55+500 7.5 m wide for 3 km K28+000-K31+900 Overall length unchanged. EIRR: 17% and assumes a high rate of traffic growth New Cost: CNY 994 million	Route optimization allowed 80.8% use of existing road. 44km will have no realignment of widening, but including good drainage and road safety. The 44 km includes the first 6 km (expressway link) and last 38 km (Weijaitai-Yunxian). 600 m tunnels (reduced from 4.7 km). EIRR: 18%. Requires investigation of supplemental historical traffic growth, freight and passenger movements and detailed traffic by section. New Cost: 435 million Length: 87 km
Date of Mission: March 2013	**Length: 192.7 km**	**Cost: CNY 1,839 million**
No major trunk road changes noted, focused on developing road safety component		
Preliminary Designs: late 2013	**Length: 149.34 km**	**Cost: CNY 1,838 million**
Length: 34.368 km Major construction in first 24 km in Xunyang County. Now 19 bridges (18 in FSR). Tunnels: 78 m (FSR 300m). Bridges are being reused and generally no widening of bridges. 6 km of realignment. PD reduces LA by increasing earthworks. Road safety: there are 4 line of sight stations included (cutting into hillside to improve corner visibility). First 24 km design speed of 40 km/h and width of 8.5 m. Next 10 km to Ankang design speed 60 km/h and width of 12 m. The majority of the road parallels the Hanjiang river, which is Class II drinkable water. 70 drainage and filtering collection pits have been planned. Cost: CNY 323 million	Length: 60.488 km Whole road design speed of 60 km/h and 10m width, except for: K27+600-K30+200 – 2.6 km new section, was rebuilt 3 years ago, has defects only, 7.5m wide, terrain too difficult to allow change. Built alongside power plant reservoir (Class III river). K40+900-K49+300 – 8.4 km 8.5 m wide First 7.3 km pavement defects only, next 6km new alignment (was Class IV), K30+200-K60+482 predominately pavement defects. 8 tunnels, 2846 m in total length, 11 large bridges. Cost: CNY 1089 million	Length: 54.483 km. Standard widths of 10m with 12m in urban areas. 5 km of realignment and 3 tunnels totalling 800 m. Bridges Large: 1 large bridge (built in 2010), Medium: 11 bridges 760 m total, 8 of which are new, Small: 4, all new. Design speed K0-9.5 is 60 km/h and from K9.5-K54 is 40 km/h. 4 rivers are crossed which may be Class II water supply (?). From K54.483 on requires road safety intervention only (approx. 32.52 km) 40 drainage and filtering collection pits have been planned. Cost: CNY 426 million
Inception Status:		
Cost: CNY 323 million Length: 34.368 km Approved Amount: CNY 313 million	Cost: CNY 1089 million Length: 60.488 km Approved Amount: CNY 1078.24 mill	Cost: CNY 426 million Length: 54.483 km Approved Amount: CNY 423.9 million EA proposed to rehabilitate the pavement of the southern section due to its poor condition for which a detailed design was received in July. Cost for this section initially was CNY 94.45 million (section 2)
Preliminary Design: July 2014	**Preliminary Design: July 2014**	**Preliminary Design: July 2014**
Cost Estimate: CNY 292.53 mill Length: 34.39 km	Cost Estimate: CNY 1,071.15 mill Length: 60.25 km	**Section 1: (to Weijiatai)** Cost Estimate: CNY 432.86 mill Length: 54.45 km **Section 2: (Weijiatai-Hubei)** Cost Estimate: CNY 61.02 mill Length: 37.96 km
Final Design: December 2014	**Final Design: December 2014**	**Final Design: December 2014**
ChinaRAP software has been applied to the PD of each trunk road. Through ongoing discussions and mentoring from RIOH, the Design Institutes have prepared new designs that include all		

G316 Xunyang to Ankang	S102 Xunyang to Xiaohe	S224 (X201) Shangnan to Yunxian
practical road safety enhancements.		
PD safety estimate: CNY 9.3 million Additional safety: CNY 41.6 million New Cost Estimate: CNY 312.4 million Length: 34.357 km During Domestic Approval process, 1 tunnel was replaced by a bridge with net increase of CNY 26.61 million	PD safety estimate: CNY 25.3 million Additional safety: CNY 67.9 million New Cost Estimate: CNY 1,076 million Length: 60.246 km	PD safety estimate: CNY 21.1 million Additional safety: CNY 29.9 million New Cost Estimate: CNY 489.1 million Length: 92.347 km
Notes:		
These costs include land acquisition and resettlement cost estimates (DI) and a contingency of around 3%		

31. A full technical summary and review of the trunk road preliminary designs (FSR and PD) is included in **Appendix C** and **D**. Subsequent road safety reviews and recommendations of the PD are included in **Appendix N**.

32. The S224 trunk road from Weijiatai to Hubei border was to receive only road safety enhancements. During the site visit, the Director of the Shangnan County Transport Bureau and the Vice Mayor requested the EA to consider upgrading this section to Class II also, to complete a vital connection between the northern (proposed) section (Class II) and the Hubei province connecting road (Class II). The proposed design was to include two tunnels (2km in length at KM56 and 550m at KM84-86) and major realignment with an expected cost of at least CNY 11.6 million per km. However it was subsequently agreed that only rehabilitation of the road pavement would be implemented. This is considered appropriate as during the site visit a serious decline in pavement condition was noticed from that reported by previous ADB missions.

33. This due diligence review only considers the FSR and PD designs. Further changes (and not reviewed by the Consultant) have been made through the incorporation of RIOH and ChinaRAP road safety enhancement recommendations. Domestic approvals of the PD (S102 Nov 28 2014, S224 Oct 17 2014, G316 – not yet known) made further recommendations including some minor realignment adjustments and for G316 the replacing of a tunnel with a bridge for safety reasons.

34. The road safety recommendations for trunk roads may include: realignments, roadside safety barriers, barrier ends, increased lane widths (at certain sections), improved pavements, paved shoulders, curve delineation signs, vehicle activated signs, enhanced skid resistance, lateral vibration lines, speed humps, reflectorized markers (cat-eyes), warning piles, road signs, pedestrian crossings, flashing yellow lights, tunnel entry delineation, marked parking areas for buses, ditch shape improvements, footpaths in village sections, protection works are highway and rail intersections, anti-stone nets, and separation of residential areas and roads.

2. Component 2: Rural Road Upgrading

35. The rural road list proposed in the July 2012 Memorandum of Understanding (MOU), which contained 13 roads totalling 148.1 km and estimated cost of CNY 149.55 million, was replaced with a new list in week #2 of the PPTA. This was further revised during the Inception Mission. The reason given was that the upgrading of the majority of those roads was already complete or had commenced. Road #4 Yangpo-Liangheguan village road was the only road from the initial list.

36. The list proposed at Inception (refer Table III-2), comprised 8 roads (1 county, 2 township and 5 village roads) totalling 136.4 km with a cost estimate of CNY 152 million. Seven of the roads are in Ankang Prefecture and one in Shangluo Prefecture. The shortest is a 4.16 km village road in Hanbin district of Ankang Prefecture and the longest is a 45 km Township road in Shangnan County.

37. The average cost per km at that time, varied from CNY 700,000 to CNY 1,330,000 per km with an average of CNY 1,110,000 per km. There were two Class IV roads (#1 and #8) with the remainder being Underclass roads. All will receive concrete cement surfacing.

38. Detailed designs for the rural roads were received early June. The total cost was CNY 353.8 million, an average of CNY 2.5 million per km. Road #5 is now also proposed as Class IV. The designs were checked technically and for road safety measures. The Consultant believed that the rural roads were overdesigned. The issues were discussed with the EA and the design teams. The EA issued a note based on the Consultants initial comments, (see **Appendix E**) requesting the designs to be revised to make them cheaper and more appropriate to the Class and traffic on the roads. Revised designs for roads #6, #7 and #8 were received July 3rd. Another complete set of revised detailed drawings was received 28th July. The total cost is CNY 235.35 million. Price reductions have been achieved by:

- Using slightly lower technical standards, principally reduced width
- Making use of non-standard sections, where geometry and terrain conditions are difficult
- Choosing appropriate radius of curvature
- Reduction in pavement thicknesses
- Road safety considerations

39. Initial design review comments are attached in **Appendix F**. Classified traffic counts were requested and were received during May and are presented and discussed in **Appendix G** Traffic Forecasting.

40. The road safety recommendations considered for these roads include: roadside safety barriers, increased lane widths (at certain sections), improved pavements, paved shoulders, enhanced skid resistance, lateral vibration lines, speed humps, warning piles, road signs, pedestrian crossings, flashing yellow lights, village entry treatments, marked parking areas for buses, ditch shape improvements and passing points.

Table III-1: Rural Road Project List

No.	City/ County	Name of Project (road)	Admin. Level	Proj. km	Before improvement			After improvement			Townships to benefit from improvement		Administrative villages and population to benefit from improvements						Traffic Volume
			C County T Township V Village		Road Class	Subgr. Width	Pave. Type	Subgr. Width	Pave. Width	Pave. Type	#	Names	#	Names	Total Village Pop.	Total Poverty Pop.	Village Pop. benefited	Poverty Pop. benefited	
		TOTAL		**136.4**							**9**		**34**		**53,742**	**26,422**	**52,500**	**22,848**	
I	**Ankang City**			**91.4**							**7**		**22**		**32.378**	**8,467**	**31,136**	**7,893**	
1	Xunyang County X304	Shuhe-Xiaohe (Shangma-Xiaohe)	C	38	IV	5	AC	6.5	6	CC	1	Xiaohe Town, Hongjun Town	13	Xiaoyang, Bangzi, Zhangjiagou, Beigou, Longwngtan,Xigou, Liangheguan, Xiaohe Community, Shangma Kangjiaping,Tiechang, Zhagnliang,Xintianwan	19,806	2,445	19,806	2,445	NA
2	Xunyang County C347	Lijiaba-Baiguo Road	V	7.2	U	3	U	5	4.5	CC	1	Duanjiahe Town	1	Baiguoshu village	1,046	560	1,046	560	NA
3	Xunyang County C559	Beiguo - Luojia	V	11	U	3	U	5	4.5	CC	1	Xiaohe Town	1	Beiguo Village	1,283	781	1,283	781	NA
4	Xunyang County C852	Yangpo-Liangheguan	V	11.9	U	3	U	5	4.5	CC	1	Xiaohe Town	1	Liangheguan Village	4,035	1,809	4,035	1,809	NA
5	Hanbin District Y305	Yanba-Dongqiao	T	12	U	3	U	6	5	CC	1	Yanba Town	4	Heihu, Tangtai, Guiping, Dongqiaocun	4,252	1,700	3,401	1,360	NA
6	Hanbin District CH69	Zaobao-Yousheng	V	6.3	U	3	U	5	4.5	CC	1	Zaoyang	1	Yousheng village	1,153	691	922	553	NA
7	Hanbin District CH39	Zaobao-Wujiashan	V	5	U	3	U	5	4.5	CC	1	Zaoyang	1	Maliu village	803	481	643	385	NA
II	**Shangluo City**			**45**							**2**		**12**		**21,364**	**17,955**	**21,364**	**14,955**	
8	Shangnan County Y338	Xianghe-Shuigou	T	**45**	IV	4.5	S	6.5	6	AC	2	Xianghe, Shuigou	12	Xianghe, Lianhuatai, Henglinghe, Shuigou, Taibai, Tangou, Balipo	21,364	17,955	21,364	14,955	NA

All Construction is improvement
There is no new Construction

AC - Asphalt Concrete
U - Unpaved
S - Sand & stone

Table III-2: Rural Road Design Details

No.	County or District	Project Name	Project Description	Detailed Design Length (Km)		Current Conditions		Detailed Design			Detailed Design Budget (CNY)	Detailed Design Unit Cost (CNY/km)
				Class IV	Under Class	Total Width	Pavement Type	Total Width	Pave-ment Width	Pavement Type		
		Sum		94.414	45.242						237,734,886	1,700,000
I	Ankang City			49.102	45.242						153,893,481	
1	Xunyang County	Shuxiao Road Shangma to Xiaohe Section	The Project is a part of X304 Shuhe Town (very close to G316 National Highway) to Xiaohe Town (very close to G065 Expressway) County Road Started at Shangma Village and ended at Xiaohe Town linking with S102 Provincial Road. The section from Shuhe to Shangma has been upgraded and this section is the remaining section.	38.405		4.5-5.5	Asphalt (Partial Cement)	6.5/5.5	6/5	From K52 to K76+646, 20cm cement concrete+20cm cement stabilized crushed stone+16cm sand gravel; From K76+646 to K90+404, 22cm cement concrete+18cm cement stabilized crushed stone+18cm sand gravel	87,632,497	2,280,000
2	Xunyang County	Lijiaba to Baiguo Road	A 7.879Km village road linking between Baiguo Village and the Village Road of Lijiaba to Lvhe Town, including 5.540Km Main Road and 2.339Km Feeder Road From Xiangjiana to Xiefangliang		7.879	2.5-4.0	K0—K4+256 Macadam,K4+256—K4+840 Unpaved,K4+840—K5+54 Macadam,Feeder Road K0—K1+660 Macadam,K1+660—K2+336 Unpaved	5	4.5	18cm cement concrete+18cm aggregate crushed stone	6,243,005	792,000
3	Xunyang County	Beigou to Luojia Road	A 7.253Km village road linking Beigou Village and Luojia Village of Xiaohe Town to X304 Shuxiao County Road, including 6.551Km Main Road and 0.702Km Lijiayazi Feeder Road		7.253	3.0-4.0	K0—K5+468 Macadam,K5+468—K6+552 Cement,Feeder Road Macadam	5	4.5	18cm cement concrete+18cm aggregate crushed stone	5,718,403	788,000
4	Xunyang County	Yangpo to Liangheguan Road	A village road linking 5 villages of Yangpo, Qipan, Zhangjiagou, Shuangni and Liangheguan in Xiaohe Town to S102		16.618	2.0-5.0	Unpaved	5	4.5	18cm cement concrete+18cm aggregate crushed stone	12,194,341	734,000
5	Hanbin District	Yanba to Dongqiao Road	A village road linking Yanba Town to S207 Ankang to langao Provincial Highway started at Yanba Town and ended at Dongzigou Bridge in Yinghe Town connected with S207	10.697		4.0-6.0	K0—K5+635 Cement,K5+635—K10+697 Macadam	6.5	6	20cm cement concrete+18cm cement stabilized crushed stone+18cm sand gravel	29,987,425	2,800,000
6	Hanbin District	Zaobao to Youshengcun Road	A village road linking Youshengcun to Zaobao Village Road		4.157	3.5-4.5	Unpaved	5.5	4.5	18cm Cement Concrete Slab+18cm Cement Stabilized Sand Gravel	3,870,764	930,000
7	Hanbin District	Zaobao to Wujiashan	A 9.335km village road linking Wujiashan to the Zaobao Village Road,		9.335	3.5-4.5	Unpaved	5.5	4.5	18cm Cement Concrete Slab+18cm Cement	8,247,046	883,000

		Road	including 4.319km Main Road and 5.016km Tianzhuang Feeder Road							Stabilized Sand Gravel		
II	Shangluo City			45.312							83,841,405	
8	Shangnan County	Xianghe to Shuigou Road	A village road linking Xianghe Town (linked with S224 Shangnan to Yunxian Provincial Highway) to Shuigou Town started at Xianghe Town and ended at Balipo of Shuigou Town	**45.312**		5.5	K0—K6+300 Asphalt，K6+600—K15+660 Cement，K15+660—K24+850 Asphalt，K24+850—K45+390 Macadam	6.5	6	20cm Cement Concrete Slab (24cm From K34+200 to K35+200)+18cm Cement Stabilized Sand Gravel+15cm Sand Gravel	83,841,405	1,850,000

41. The PPTA visited 4 of the 8 rural roads technically, 8 roads for environment, 7 roads for social surveys, and 8 roads for resettlement.

3. Road Safety Roads

42. During the mission it was agreed that a road safety star rating of 3 would be targeted for the majority of the roads. A list of roads for this component (604 km) was provided by the EA (see below). It includes 5 County and 20 Township roads. Traffic counts were not been requested as the ChinaRAP team indicated that they had sufficient data for their analysis. A preliminary review was made by the PPTA and findings are presented in **Appendix F**. A full review of all project roads and full recommendations can be found in **Appendix N**.

43. The road safety enhancements for these roads are limited to: roadside safety barriers, lateral vibration lines, speed humps, warning piles, road signs, pedestrian crossings, flashing yellow lights and marked parking areas for buses.

Table III-3: Road Safety Road List

County/ District	No.	Name of Road	Existing Length (km)				Design Cost (CNY)
			County Road	Township Road	Subtotal	Design Length	
Hanbin District			**140.492**	**61.386**	**165.878**		
	1	X213 Hengkou-Yeping	43		43	43	6,488,132
	2	X210 Wucilukou-Dongzhen Town Road	61.492		61.492	62.67	9,931,734
	3	Y103 Zhangtan-Qingtao Village		40.186	40.186	40.114	7,029,322
	4	Y201 Aijiahe-Baoheqiao		11.5	11.5	11.5	1,766,625
	5	Y202 Longtangou-Gongjin Town		9.7	9.7	9.7	1,544,968
Xunyang County			**50.56**	**205.15**	**255.71**		
	6	X304 Shuhe Hanjiang Bridge (North)-Xiaohe Town	50.56		50.56	50.56	6,420,063
	7	Y201 Shagoukou-Liulitan Road		20.56	20.56	20.56	3,713,919
	8	Y203 Bailiu Town-Bailiu Nursing Home Road		25.56	25.56	25.56	3,576,502
	9	Y206 Xiaohe Bei-Shiliwo Road		15.809	15.809	15.809	2,510,931
	10	Y212 Mogou-Yangshan village Rd		20.2	20.2	20.2	3,200,798
	11	Y301 Hongjun Town-Dongchuan village Rd		10.5	10.5	10.5	1,840,537
	12	Y302 Liangheguan-Sanhe Road		10.95	10.95	10.95	1,408,690
	13	Y303 Shuanghe Bridge-Guochang Village		24.56	24.56	24.56	1,581,354
	14	Y304 Ganxiqiaotou-Maping Town		22.1	22.1	22.1	2,466,943
	15	Y305 Luhe Bridge-Lijiaba Road		5.843	5.843	5.843	1,201,141
	16	Y308 Pingding-Pailou Road		9.378	9.378	9.378	1,097,697
	17	Y311 Shenhe-Pingan Road		20.9	20.9	20.9	3,103,611
	18	Y312 Dongchuanhekou-Shengjia road		9.95	9.95	9.95	1,692,322
	19	Y313 Zongxi-Wuwang Road		8.84	8.84	8.84	1,148,263
Shangnan county			**62.25**	**84.58**	**146.83**		
	20	X313 Bailang Town-Sizhuangzi Road	23.15		23.15	23.05	3,050,300
	21	X316 Zhaochuan Town-Bailuchu	39.1		39.1	39.1	5,218,048

		Village Rd					
	22	Y206 Liangjiawen-Shizhuhekou Road		23	23	23	3,740,487
	23	Y335 Pohekou-Wenhuaping Road		21.13	21.13	21.42	3,777,365
	24	Y338 Taijihe Town-Xianghe Town Road		30.95	30.95	30.949	4,936,089
	25	Y339 Xianghe Town-Zijinguan Town Rd		9.5	9.5	9.447	1,526,753
TOTAL			**217.302**	**351.116**	**568.418**	**569.66**	**83,972,594**

D. Economic Analysis

44. Proposals to upgrade three trunk road sections and eight rural road sections, and carry out safety improvements on 25 sections of additional rural roads, are evaluated over 20 years at 2014 economic prices using the world price system and a domestic unit of account. All the trunk roads have poor vertical and horizontal alignments and poor pavement conditions; they are predominantly a mixture of Class III and IV standard highways. The proposed upgrades will, as far as possible at reasonable cost, achieve Class II standard. The rural roads are in a very poor condition both in terms of alignment and pavement (approximately 20 percent of the 140km are unpaved). The proposed rural road upgrades envisage concrete pavements.

45. The rationale for the upgrades is increased consumer surplus (i.e. reduced road user costs (RUC)), but with a much greater emphasis on safety benefits than is usually the case. The parallel consultancy, ChinaRAP, was responsible for proposing and evaluating safety interventions on the trunk and rural road sections, and on the additional roads.

46. Trunk and rural road components are evaluated using HDM-4 (version 2.08) and RED (Roads Economic Decision Model) respectively. The evaluation of the additional roads makes use of ChinaRAP values.

1. Trunk road evaluations

47. **Costs.** Financial costs are converted into economic costs by (i) excluding taxes, price contingencies and financial charges, (ii) using a 0.8 shadow price for unskilled labor costs and (iii) adjusting the prices of tradable goods for border prices, giving a weighted average conversion factor for civil works of 0.93. Construction costs are spread over four years from 2016 to 2019, with project opening in 2020. The residual value at the end of the evaluation period is 30 percent of the initial investment cost.

48. Periodic and routine maintenance costs are taken from contractors' bids elsewhere in China and standard Shaanxi rates.

49. Investment costs are shown below.

Table III-4: Trunk road economic investment costs (2014 CNY million)

Road	Km[a]	Economic base cost including physical contingencies at 5%	Economic cost/km	Safety Costs[b]
S102 – Xunyang-Xiaohe	60.2	986	16.4	89.2
G316 – Xunyang-Ankang	34.4	287	8.36	48.7
S224 – Shangnan- Hubei boundary	87.6[c]	456	5.20	57.3

Source: PD costs and PPTA consultants' estimates

Notes: (a) project road length
(b) safety costs are financial base costs and are included in economic costs. They comprise ChinaRAP safety packages and an estimate of other safety-related costs included in the design

(c) excludes first 4.9km of road (on which no works are proposed)

50. **Road user cost (RUC) savings**. Input economic values for vehicles, tires, labor and time, which form the bases for road user cost (RUC) savings calculated using HDM-4, are shown below.

Table III-5: Economic values of vehicles, tires, labor and time

Vehicle class	Unit	Motor-cycle	Car	Small bus	Heavy passenger vehicle	Light goods	Medium goods	Heavy goods	Truck-trailer
Vehicle cost	CNY	5,000	100,000	100,000	375,000	150,000	245,000	395,000	590,000
Replacement tire	CNY	150	290	300	470	350	620	700	700
Fuel	CNY/liter	6.5	6.5	6.5	6.4	6.5	6.4	6.4	6.4
Maintenance labor	CNY/h	10	19	19	19	19	19	19	19
Driver	CNY/h	10	0	19	19	19	19	19	19
Driver's helper	CNY/h	-	-	-	10	10	10	10	10
Total crew	CNY/h	10	0	19	29	29	29	29	29
Annual overhead	CNY	600	3,000	5,000	20,000	7,500	14,000	19,000	19,000
Passenger working time	CNY/h	10	50	30	20	10	10	0	0
Passenger non-working time	CNY/h	3	12	8	5	3	3	0	0

Source: manufacturers' and consultant's estimates

51. **Travel demand**. Estimates of 2014 traffic () are derived from counts reported in the FSRs, updated design institute counts in April 2014 and corroborating counts by the PPTA consultants. They are described in full in **Appendix G**.

Table III-6: Trunk road base year (2014) traffic

Road	AADT veh/day	AADTx[a] veh/day	Passenger vehicles[a]	Goods vehicles	PCU
S102	2,967	2,206	1,755	451	3,480
G316	1,792	1,421	857	564	1,983
S224	1,757	999	512	487	2,200

Note: (a) excludes motorcycles

52. Normal traffic growth rates (Table III-7) are estimated from a variety of sources (FSR forecasts, historic traffic, provincial transport statistics, energy use statistic and forecast GDP growth rates). For the S102 and S224 the adopted growth rates are similar to those in the FSRs; for the G316 they are lower.

Table III-7: Normal trunk road traffic growth

	2014-17	2018-25	2026-36
Goods	9.0%	7.0%	4.5%
Passenger	9.0%	7.0%	4.5%
Motorcycles	6.5%	4.5%	2.5%

Sources: Consultants' estimates

53. In the medium term none of the trunk roads is expected to suffer loss of traffic as the result of diversions to other roads or to other transport modes. Similarly, the upgrades are sufficiently modest that they are unlikely to attract traffic from other roads or modes.

54. **Generated traffic** is added to normal traffic within HDM-4 and its benefits calculated using the usual "rule of a half". Percentages of generated traffic are estimated by comparing the

weighted average perceived passenger and goods vehicle RUCs in the reference and project cases and applying elasticities of -0.3 and -0.2 for passenger and goods traffic respectively. This gives generated traffic of 5 and 2 percent for passenger and goods traffic. These percentages are applied throughout, except in the case of the most westerly 9.9 km of the G316. In this case, where the reduction in RUC is much less, generated traffic percentages are halved.

55. **Greenhouse gas (GHG) emission reductions**. Operational GHG emission reductions are estimated using HDM-4. The results are shown in **Appendix H**. They are not included in project benefits.

56. **Safety Benefits**. Road safety interventions and resulting changes in expected fatality, injury and crash costs were handled by ChinaRAP and are reported here in summary form. Annual fatality, injury and crash costs are shown below.

Table III-8: Annual fatality, injury and crash costs, CNY m

Road	Reference case	At preliminary design	At final design
S102	381.1	370.3	353.7
G316	230.9	193.2	170.8
S224 (Shangnan to Weijiatai)	76.4	49.1	42.9
S224 (Weijiatai to Hubei boundary)	49.7	-	28.5

Source: ChinaRAP

57. **Evaluation of the S102**. HDM-4 results by section and project are summarized below. Even without consideration of road safety benefits and costs the project EIRR is satisfactory. Safety improvements within the final design represent 13 percent of total benefits. The incremental benefit-cost ratio (BCR) of tall the safety investments is 2.1.

Table III-9: S102 evaluation results

Design scenario	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
		MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding changes in accident costs							
PD	774	438	546	-	984	211	14.8%
Analysis including safety benefits							
PD	774	438	546	57	1,041	268	15.5%
FD	765	438	546	145	1,129	365	16.8%
FD safety investments only							
FD	70	-	-	145	145	75	23.2%

Source: consultants' HDM-4 runs and ChinaRAP

Note: all PVs discounted at 12 percent

58. **Evaluation of the G316**. HDM-4 results by project are summarized below. Without consideration of road safety benefits and costs the project EIRR is less than 12 percent, but once included they bring it to 25 percent. The incremental BCR of the safety investments is 8.3.

Table III-10: G316 evaluation results

Design scenario	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
		MT VOC savings	MT time savings	Safety benefits	Total		

Design scenario	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
		MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding changes in accident costs							
PD	229	127	83	-	210	-19	11.0%
Analysis including safety benefits							
PD	229	127	83	201	389	181	20.2%
FD	222	127	83	320	530	309	25.5%
FD safety investments only							
FD	38	-	-	320	320	282	59%

Source: consultants' HDM-4 runs, ChinaRAP

Notes: (a) all PVs discounted at 12 percent
(b) the impact of traffic calming measures have been taken into account in assessing project case vehicle speeds

59. **Evaluation of the S224**. HDM-4 results by section and project are summarized below. Even without consideration of road safety benefits and costs the project EIRR is satisfactory. With safety enhancements the EIRR is increased to 27 percent. The BCR of the final design safety investment is 6.4

Table III-11: S224 evaluation results

Design scenario	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
		MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding changes in accident costs							
PD+DD	337	520	148	-	668	331	20.9%
Analysis including safety benefits							
FD	353	520	148	291	960	607	26.7%
FD safety investments only							
FD	45.3	-	-	291	291	246	50.8%

Source: consultants' HDM-4 runs and ChinaRAP

Note: PVs discounted at 12 percent

60. **Trunk road user indicators** are shown in the table below.

Table III-12: Trunk road user indicators

		Reference case				Project case		
		IRI	Car	MGV		IRI	Car	MGV
RUC[b]	G316	6.0	5.0	4.7		4.5	4.3	4.0
CNY/veh-km	S102	5.4	4.9	4.6		3.6	4.1	3.9
	S224	5.7	5.2	5.9		4.1	4.7	4.4
Time[c]	G316		1h26	2h14			1h11 (15min)	1h50 (24min)
h:min	S102		0h45	1h13			0h39 (6min)	1h01 (12min)
	S224		2h22	3h43			2h12 (10min)	3h06 (27min)

Source: PPTA consultants' HDM-4 runs

Notes: (a) IRIs shown are averages over evaluation period. VOC and time savings are values corresponding to average IRIs

(b) sum of VOC and time savings

(c) time savings shown in brackets in project case

(d) MGV = Medium Goods Vehicle

2. Rural road evaluations

61. The eight proposed rural road upgrades are evaluated using the same general approach as that adopted for the trunk roads. The values shown in table 2 are common to both evaluations.

62. In its downloaded form RED, like HDM-4, does not allow for real terms growth in the value of journey-time saving. It can be amended to do so, however, and the amendment made here includes an annual growth rate of 5 percent (below historic GDP/head growth rates). Construction is assumed to take one year, with the upgraded roads open in the following year, 2017. Within RED the evaluation period is limited to 20 years in total, from 2016 to 2033, but the final results are brought into line with those of the trunk roads, which run through to 2039.

63. **Road characteristics**. Table III-13 summarizes 2016 traffic (based on 12h DI counts) and the essential characteristics of the eight road sections. Anecdotal evidence during field visits indicated that many roads are impassable to all but motorcycles and SUVs for at least several days per year. This "denial of service" can be handled within RED by assuming that, for a few days a year, vehicles are obliged to make detours in order to reach their destinations. These few days are labeled "wet season" and it is assumed that transport demand during this wet season is the same as during the dry season but is obliged to travel a few kilometers further on a road that is in the same condition as the dry season without project road. The durations and lengths of wet season diversions appear in the "comments" column of the table below.

Table III-13: Rural road characteristics

	Road	AADTx in 2016[d]	km[b]	Economic cost, CNY million/km[c]	Reference case	Project case	Comments
1	X304 Shuhe-Xiaohe	367	38.4	2.56	Class IV bitumen, 4.5-5.5m IRI=15 Terrain=hilly	Class IV concrete, 5.5-6.5m IRI=3	All weather. Commercially and agriculturally an important road
2	C347 Lijiaba-Baiguo	14	7.9	1.67	Unclassified, 16% unpaved, remainder bitumen, 2.5-4m IRI=20 Terrain=hilly	Unclassified concrete, 5.0m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=2.5
3	Beiguo -Luojia	91	7.3	2.65	Unclassified bitumen/concrete, 3-4m IRI=15 Terrain=mountainous	Unclassified concrete, 5.0m IRI=3	Impassable at times Wet season diversion= 10d Additional km=2.5
4	C852 Yangpo-Liangheguan	44	16.6	1.83	Unclassified, unpaved, 2-5m IRI=20 Terrain=mountainous	Unclassified concrete, 5.0m IRI=3	Impassable at times Wet season diversion= 10d Additional km=5
5	Y305 Yanba-Dongqiao	129	10.7	3.47	Unclassified bitumen/concrete, 4-6m IRI=15 Terrain=mountainous	Unclassified concrete, 6.5m IRI=3	Impassable at times Wet season diversion= 10d Additional km=2.5
6	CH69 Zaobao-Yousheng	24	4.2	1.76	Unclassified, unpaved, 3.5-4.5m IRI=20 Terrain=mountainous	Unclassified concrete, 5.5m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=1
7	CH39 Zaobao-Wujiashan	35	9.3	1.55	Unclassified, unpaved, 3.5-4.5m IRI=20 Terrain=hilly	Unclassified concrete, 5.5m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=2.5
8	Y338 Xianghe-Shuigou[a]	508	45.3	2.31	Class IV bitumen, 5.5m IRI=15 Terrain=hilly	Class IV concrete, 6.5m IRI=3	All weather. Connectivity gains: links S224 and G312.

Source: PD costs and PPTA consultants' estimates

Notes: (a) DI June 2014 estimate less 3 percent contingencies
(b) project road length
(c) financial base cost plus 5% physical contingencies x CF of 0.9
(d) excluding motorcycles

64. **Travel demand**. Rural traffic growth assumptions are shown below.

Table III-14: Rural traffic growth: adopted rates

	2014-20[a]	2021-25	2026-35
Goods	5.5%	4.0%	3.0%
Passenger	5.5%	4.0%	3.0%
Motor-cycles	6.0%	5.0%	3.0%

Sources: consultants' estimates

65. RED allows users to define generated traffic using a price elasticity for each vehicle type (an option not available in HDM-4). An elasticity of -1.0 is used. The resulting percentages of generated traffic depend on IRI assumptions, but for an upgrade from unpaved to concrete it is 40 percent and for an upgrade from unimproved bitumen to concrete it is 20 percent.

66. **Safety benefits**. ChinaRAP carried out safety assessments and proposed additional works on roads 1 and 8 only, i.e. on 83.9 of a total of 140km. They estimate annual fatality, injury and crash costs in the reference case at CNY 67.8 million.

67. After application of the ChinaRAP safety interventions (base cost CNY15.7m) annual crash costs drop to CNY7 63.9 million. Scaled up to the full length of all the rural roads the annual disbenefit is CNY 63.9 million. Expressed as a present value over the evaluation period from 2016 to 2039, the annuity is equivalent to CNY 51 million, or CNY 0.37 million/km.

68. This increase in fatality injury and crash costs is largely attributable to increased numbers of cyclist and pedestrian fatalities, an unintended consequence of increased speeds.

69. **Evaluations** are shown in Table III-15. They include safety package costs and benefits, apportioned to each road at a rate of CNY 0.37 million/km. It implicitly assumes that there is no change in crash costs between the reference and FD cases.

70. The entire rural roads package has an EIRR that comfortably exceeds 12 percent. Of th3 8 roads, only two, numbers 5 and 6, fail to meet the 12% target. RR #5 has a high unit cost and #6 carries very little traffic.

Table III-15: Rural road evaluations

	Road	AADTx in 2016	km	Economic cost, CNY million/km	EIRR%[a]	NPV/km[a] CNY million	NPV[a] CNYm
1	X304 Shuhe-Xiaohe	367	38.4	1.96	21.5%	1.71	65.6
2	C347 Lijiaba-Baiguo	14	7.9	0.81	12.2%	0.01	0.1
3	Beiguo-Luojia	91	7.3	0.81	20.8%	0.59	4.3
4	C852 Yangpo-Liangheguan	44	16.6	0.76	18.1%	0.37	6.2
5	Y305 Yanba-Dongqiao	129	10.7	2.25	9.7%	-0.39	-4.2
6	CH69 Zaobao-Yousheng	24	4.2	0.89	10.9%	-0.07	-0.3
7	CH39 Zaobao-Wujiashin	35	9.3	0.85	13.8%	0.11	1.1
8	Y338 Xianghe-Shuiguo[a]	508	45.3	1.70	28.0%	2.66	121
Totals/weighted averages		220	140	1.52	22.0%	1.39	193

Source: PPTA consultants' estimates using RED

71. **Rural road user indicators** are shown below.

Table III-16: Rural road user economic indicators

		Reference case				Project case		
		IRI	Car	MGV		IRI	Car	MGV
RUC[a]	RR1&8	15	6.3	6.5		3	5.1	5.1
CNY/veh-km	RR2&7	20	7.1	7.4		3	5.1	5.1
	RR4&6	20	7.3	8.6		3	5.3	6.4
	RR3&5	15	6.7	8.2		3	5.3	6.4
Speed	RR1&8	15	23			3	28	
km/h[b]	RR2&7	20	21			3	28	
	RR4&6	20	21			3	28	
	RR3&5	15	22			3	27	

Source: PPTA consultants' HDM-4 runs

Notes: (a) sum of VOC and time savings

(b) fleet averages

3. Evaluation of additional roads

72. Unlike the trunk and rural roads, the only works proposed on 25 sections of additional rural road (566km in all) are related to safety. The evaluation is therefore taken directly from work by ChinaRAP, adjusted only to make it consistent with the conversion factor and evaluation period assumptions made for the trunk and rural roads.

73. The table below shows relevant costs and benefits.

Table III-17: Additional roads: costs and benefits

Total cost including contingencies etc.	Cost excluding contingencies[a]	Economic cost[b]	Annual fatality, injury and crash costs			Annual safety benefit of FD
			Reference case	PD	FD	
84	81.6	79.6	486.0	413.4	387.0	98.0

Source: ChinaRAP and PPTA consultants

Note: (a) assumes contingencies are 3.0% of base costs (as per rural roads)

(b) 0.93 x cost excluding contingencies plus 5 percent PPTA physical contingencies

74. The safety benefit accrues from 2020 to 2039, while the cost is incurred between 2016 and 2019. Maintenance costs are estimated by taking 20 percent of the initial economic cost and spreading it uniformly over the evaluation period. (90 percent of the additional roads are sealed. The total routine and periodic maintenance costs of trunk road upgrades over the entire evaluation period represent 12-30 percent of initial investment costs).

75. Evaluation results are shown in the table below.

Table III-18: Additional roads: evaluation results

PV incremental costs, CNYm	PV safety benefits, CNYm	Benefit-cost ratio (BCR)	NPV, CNYm	EIRR%
71.3	526	7.4	455	57%

Source: ChinaRAP and PPTA consultants

4. Summary of evaluation results and sensitivity results

76. The table below combines the net benefits of all sub-components; the EIRR for the complete program is 23 percent. Note that safety costs and benefits are already included in the roads evaluations; they are shown separately for information.

Table III-19: Evaluation results: all sub-components

Year	Net benefits in 2014 CNYm				
	Trunk roads	**Rural roads**	**Additional roads**	**All roads**	**Safety only**
2016	-362	-213	-15.9	-591	-68.5
2017	-457	37.6	-23.9	-444	-71.7
2018	-450	39.6	-23.9	-434	-71.7
2019	-362	41.7	-15.9	-336	-45.6
2020	518	44.0	98.3	661	247
2021	441	46.0	98.3	585	247
2022	488	48.1	98.3	634	247
2023	424	50.3	98.3	573	247
2024	401	52.8	98.3	552	247
2025	416	55.4	98.3	570	247
2026	418	57.7	98.3	574	247
2027	474	60.1	98.3	633	247
2028	486	62.8	98.3	647	247
2029	515	65.5	98.3	679	247
2030	519	68.5	98.3	686	247
2031	527	71.7	98.3	697	247
2032	515	75.0	98.3	688	247
2033	570	78.6	98.3	747	247
2034	413	82.5	98.3	594	247
2035	687	86.6	98.3	872	247
2036	693	86.6	98.3	878	247
2037	845	86.6	98.3	1,030	247
2038	847	86.6	98.3	1,031	247
2039	1,372	86.6	98.3	1,557	247
PV at 12%	1,282	193	455	1,931	1,092
EIRR	21.1%	22.0%	56.7%	23.3%	47.1%

Source: PPTA consultants. For more detail see Appendix H.

77. Sensitivity results are shown in the table below. Three sensitivity scenarios are tested. The switching value for a cost overrun is 220 percent. The switching value for a decrease in consumer benefits is 45 percent. The degree of uncertainty of the project's economic analysis is moderate. Benefits depend, first, on traffic forecasts that depend crucially on future regional economic growth and, second, on the linkages between road safety investment and reductions in the frequency and intensity of crashes. Overall, however, there is little risk to the project's viability.

Table III-20: Sensitivity Test Results

Test	EIRR	NPV, CNYm	Switching value
Base case	23.3%	1,931	

Costs +20%	20.3%	1,620	220%
Benefits -20%	19.7%	1,230	45%
Costs +20% & benefits -20%	17.0%	916	

5. Conclusion

78. All project components provide positive economic returns, based on the information available and assumptions made in the economic analysis.

E. Road Safety Component

79. A full description of the road safety component development and action can be found in **Appendix N**.

1. ChinaRAP assessment of Civil Works Component

80. The China Road Assessment Program (ChinaRAP), a collaboration of the RIOH and the International Road Assessment Program (iRAP), was appointed to demonstrate the impact of rigorous and data driven road safety assessment and design practices to reduce crash rates and provide a model that can be replicated in other provinces as well as in other developing countries. The project was able to leverage baseline road assessments conducted in 2012 by ChinaRAP and funded by the World Bank Global Road Safety Facility (GRSF). It also involved interactive star ratings of designs as local design institutes developed them.

81. ChinaRAP star ratings provide an indication of the relative risk of death or serious injury on a road. The assessments show that in terms of road lengths, the designs will result in modest improvements in the star ratings for all road users. These improvements will occur despite an expected increase in operating speeds – which increases risk of death and serious injury - on the trunk roads and rural roads.

82. Compared to the star ratings by road length, the percentage of roads rated three stars or better is higher when measured according to vehicle kilometers travelled (a measure of exposure to traffic). This indicates that the investments have been reasonably well targeted; focusing on roads where vehicle kilometers travelled is higher. For example, while 27% the existing roads are rated three stars or better for vehicle occupants, this figure more than doubles to 59% with the enhanced designs. Two-thirds (67%) of the roads where pedestrians are likely to be present are rated three stars or better with the designs.

Table III-21: Existing and design roads rated 3-stars or better by road length and by vehicle kilometers travelled

	Length (km)		Vehicle kilometers travelled (vkt)	
	Existing	Design	Existing	Design
Vehicle occupants	16%	41%	27%	59%
Motorcyclists	7%	22%	15%	42%
Pedestrians *	43%	52%	56%	67%
Bicyclists *	55%	80%	69%	89%

83. Design features that improve safety include: roadside safety barriers, paved shoulders, realignments, enhanced skid resistance, traffic calming and pedestrian crossings. The designs also include trials of countermeasure types not commonly used in China, such as: vehicle activated signs, flexible delineator posts, colored pavement treatments at the entry to villages and raised pedestrian crossings at schools.

84. Overall, it is estimated that 26,985 deaths and serious injuries would occur on the project roads over a 20-year period. With the designs however, it is estimated that there would be 5,407 fewer deaths and serious injuries (a reduction of 25%). The investment would generate a road safety benefit cost ratio of 6.7:1. The costs and benefits of the road safety work have been incorporated into the project economic analysis.

2. Capacity Development

85. Another project goal is to raise the road safety capacity within SPTD and local governments. During the project's development, options for road safety management and engineering design training, ensuring sustainability of data collection and management, and field trips to both countries in similar situation as Shaanxi Province and countries leading in road safety. The EA advised that its preference is for intensive introductory training to be conducted in Xian, with a focus on introducing the road safety concepts and safe road design, and for implementation of safety and road management data system for the project road network. The training should target staff from transport bureaus and design institutes. As a result a two-part plan was developed: i) Construction monitoring and post-construction evaluation and ii) Training.

86. **Construction monitoring and post-construction evaluation.** The implementation of the safety schemes will be monitored through;

- During the construction, the specific conditions of demonstration safety facilities will be verified to ensure they are being implemented effectively.
- During the construction process, opportunities to supplement the scheme with additional low-cost high-return improvements will be identified. For example adjustments to sign and line marking types and locations may be made.

87. **Post-construction evaluation of the traffic safety effects.** The overall evaluation will include an assessment general crash indicators, crash risk level, highway risk level, social appraisal and the input-output situation before and after the implementation of the safety demonstration projects.

88. The variation analysis of the crash indicators includes: crash frequency, casualty, Million-vehicle- mortality per km, and so forth.

89. The variation analysis of the average risk level: according to the major changes of highway conditions due to the implementation of facilities, updating the original basic data of the highway risk, calculating the highway risk after construction implemented and comparing the variation of the proportion of highway risk level in the network and the average highway risk level separately before and after the implementation.

90. **Economic analysis**: according to the overall cost, the economic cost caused by changes in crashes and risk level will be calculated.

91. **Developing road network safety and traffic management software**. Road network safety and traffic management software will be developed and implemented in SPTD. The software will combine risk assessment, crash, traffic and asset data. The system includes the main functions as following:

- **Management function of basic traffic safety data.** It manages the basic data of road traffic safety such as the videos, infrastructure conditions, traffic volume, traffic composition and accidents (including highway property loss) of the road. The data can be edited and searched.
- **Analysis of road risk distribution.** The road risk distribution of each road network section can be analyzed. In this part, horizontal comparative analysis between road sections and longitudinal time series analysis can be done.

- **Safety and maintenance management of the road network**. The maintenance suggestions are provided combined with the analysis of network safety and the demand of maintenance management.
- **Performance evaluation of safety countermeasures.** The performance analysis of the input of routine safety countermeasures can be conducted.

92. **Training.** As this is a demonstration project, training on the theory of road risk assessment and mode of execution will be conducted to improve the safety design and management ability of the regional safety management and design staff. It will include:

- Training in the star rating method, including: collection, assessment and analysis of data.
- Interactive safety design method based on the star rating.
- Analyzing the performance of the safety demonstration project and the experience on key demonstration facilities.
- **ChinaRAP and safety countermeasures.** The training includes helping the trainees understand and master the evaluation method of improving road safety on existing roads, and become familiar with the domestic and overseas leading engineering safety countermeasures.
- **Road safety design and safety audit.** Focusing on the road infrastructure (new roads), the training includes helping the trainees understand and master the safety audit method of the new roads, and familiar with the domestic and overseas leading engineering safety countermeasures.

93. Field trips will be held as follows:

- **Strategy and Planning on Road Safety.** Focusing on the road safety management, the training includes helping the trainees understand and master the situation of developing and implementing the sustainable road safety strategy and planning and macroscopic and feasible indicators to reduce the traffic fatality rates, to strengthen the ability to prepare and implement the regional road safety strategy and planning of the Department of Shaanxi Province.
- **Road transportation safety management.** Focusing on the road safety management, the training includes helping the trainees understand and master the laws, standards and rules of transportation (especially the transportation) and comprehensive policy and successful practices to reduce the traffic injuries in translation, to strengthen the ability to administrate the road safety of the Department of Shaanxi Province.

3. Road Safety Awareness Program

94. Another of the project goals is to provide enhanced road safety education to achieve better safety awareness for the population residing in the project area.

95. Following discussions with stakeholders in road safety education, including the Ministry of Transport, World Health Organization, Global Road Safety Partnership and Asian Development Bank, the Asia Injury Prevention Foundation (AIPF) was invited to give a presentation on “Walk Wise”, a school road safety program in Sichuan Province, during the project Interim Mission.

96. The Walk Wise Project was developed to prevent road traffic injuries and fatalities in vulnerable communities through a focus on road safety education and awareness. The project improves the skills and confidence of primary school teachers to train their students in road safety skills, and provides schools with quality curricula and teaching materials that have undergone extensive development and testing in China. Further, the project emphasizes building a supportive network among local stakeholders, promoting community-wide awareness, and encouraging community ownership to ensure long-term sustainability and impact.

97. In 2012, the Walk Wise Project was successfully piloted in two primary schools in Kai Xian County, a mountainous, rural region located in Chongqing Province of China. During the 2014-

2015 school year, the Walk Wise Project will be implemented in 36 primary schools throughout Kai Xian County. In 2016, the Walk Wise Project will reach approximately 80,000 students at 80 primary schools in Chongqing and Sichuan provinces.

98. The EA subsequently requested that AIPF provide a proposal for a pilot Walk Wise project in schools on key project roads. The expected outcomes of this program include:

- improved awareness and knowledge on road safety of road users,
- improved road safety behaviors of road users, and
- improved road safety environment in the project areas.

F. Procurement and Governance

99. All procurement for ADB-financed contracts will follow ADB's Procurement Guidelines (2013, as amended from time to time). Procurement for ADB-financed civil works under output 1 and output 2 will use the 2012 Ministry of Finance (MOF) standard bidding documents for national competitive bidding (NCB), which was agreed-upon with ADB and the World Bank in 2012. There are no non-ADB financed works and services. Procurement and financial assessments (**Appendix I and J**) were carried out as part of project preparation. Financial management risk is considered low, while procurement risk rating is considered medium-low, because of the involvement of multiple IA and multiple inexperienced PMO, and their respective inexperience with ADB. To mitigate the risk (refer Table III-24), SPTD will recruit a procurement agent and staff involved in the project will receive trainings in ADB procurement procedures and guidelines. ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the government and SPG. The specific policy requirements and supplementary measures are described in the project administration manual. An institutional assessment was carried out, which concluded that SPTD and FFPO capacity was generally appropriate but needed refreshing in the areas of planning, safety, environmental management, and procurement. The IA and PMO are deficient in these same areas and need careful attention and specific training.

G. Poverty and Social

100. The Chinese government has adjusted the national rural poverty line up to CNY 2,300 (per capita annual net income) since 2011 in order to target more population with low-income levels. In 2012, there were 99,976,378 rural poor in the PRC, which accounted for 14.9% of the total rural population. The majority of rural poor are concentrated in the western region of China.

101. There were 77 poverty counties in Shaanxi Province in 2012, of which 50 were also designated as national poverty counties. In 2012, Shaanxi provincial government revised the provincial rural poverty line from annual net income CNY 2,700 per capita up to CNY 2,785, which was higher than the national rural poverty line (annual farmer net income CNY 2,300 per capita). According to official statistics, 7,561,937 rural people in Shaanxi were poor in 2012, which was 30% of the total rural population in Shaanxi. The majority of poor people are concentrated in Qinba Mountain Region in the south and Loess Plateau in the north where poor infrastructure, high frequency of natural disaster and undeveloped industries form the major barriers of living condition improvement and well-being development.

102. In 2012, there were 795,609 rural poor in Ankang Prefecture, about 32.8% of total rural population in Ankang, and 483,479 rural people in Shangluo Prefecture (31% of the prefecture).

103. Three project counties of Xunyang, Hanbin and Shangnan are national poverty counties. By the end of 2012, total rural poverty population was 158,530 in Xunyang, 304,956 in Hanbin and 48,804 in Shangnan. The rural poverty ratio was 40% in Xunyang, 38.6% in Hanbin and 34.3% in Shangnan were higher than the prefecture and provincial average. (For full details see **Appendix K**). For social and gender development action plans see **Appendix M** and for summary poverty reduction and social strategy refer **Appendix L**.

Table III-22: Poverty Population in the Project Area

Region	Total rural population	Rural poverty population	As % of rural population
Nation-wide	674,149,546	99,976,378	14.9
Shaanxi Province	25,180,912	7,561,937	30.0
Ankang Prefecture	2,423,780	795,609	32.8
Shangluo Prefecture	1,559,611	483,479	31.0
Xunyang County	396,326	158,530	40.0
Hanbin District	790,042	304,956	38.6
Shangnan County	142,403	48,804	34.3

Source: Poverty Reduction Offices in Project Areas.

104. **Negative Impact:** Land acquisition and house demolition caused by trunk road rehabilitations are the main negative impact of the project. Little land acquisition and resettlement will occur in the rural road upgrades and none on the road safety improvement component.

Table III-23: Benefits and Issues Perceived by Stakeholders

Stakeholders	Expecting Benefits
Villagers in rural road upgrades	• Shortening travel time up to school, market place, clinic/hospital and other social services • Less damage to vehicles such as motorcycles, tractors, cars, pickup, minivan, and trucks etc. • Benefit to perishable goods transport brought by better roads • Stimulating cash crop growth, particularly perishable goods • Easier access to job place • Easier back from job place to have more time staying with family members • More comfortable travel, e.g. less bumping and dust • Ensuring all day accessibility, particularly during raining season • Safer travel
Villagers in trunk road rehabilitations	• Reduce traffic jams affected travel and roadside business • Potential job opportunities through attracting investors • Potentials to increase value of the land and property along the road • More business opportunities along road. • Potentials for expanding vegetable growth for the city. • Benefits from potential urban and industrial park expansion • Job opportunities of construction • Safer travel
Roadside business people	• Faster and easier transport • Extending business to more areas • Saving transport cost • Reduction of goods damages, particularly perishable goods. • Stimulating economic development • Increase of business opportunities during construction • More business with traffic increase after the construction
Project County Communication Bureaus	• Improvement road network that can stimulate local economic growth • Better road coverage
Poverty Reduction Offices in Project Counties	• Faster and easier transport • Saving the costs • Safety • More business opportunities • Poverty reduction through road improvement
Women Federations in	• Faster and easier transport for women • Provide more job opportunities for women during the project construction.

Project Counties	• Safer travel for women and children
Urban Residents	• Saving transport costs • More comfortable travel • Quick information • Potentials to stimulate tourism development • Faster mobility • Safer travel

Sources: Project Stakeholder Consultations and Focus Group Discussions with Local People

1. Safeguards and other Social Risks

105. **Involuntary Resettlement.** The project will involve a total land acquisition amounting to 3,429 mu with 12,778 affected people in 3,017 households. The resettlement reports have been developed to address adequately the resettlement issues. The report has also formulated the plan of livelihood restoration to mitigate the impact of project for affected people.

106. **HIV/AIDS**. As of result of continuous recent awareness building activities, knowledge on HIV/AIDS protection is widely spread among the public. The households' survey shows that around 70% of respondents have heard of HIV/AIDS and their preventive measures. However, there is still a comparative large proportion of local population with limited knowledge on HIV/AIDS prevention measures). Particularly women have less knowledge compared to men, regarding use of condoms and needles and syringes. Although local governments have mechanisms and capacity to deal with HIV/ADS spread, the proposed Project has to put specific measures on HIV/AIDS and anti-drug in its project action plans.

107. **Human trafficking.** Human trafficking became an issue as the population interaction increases and people's travel distance increases. However, villagers surveyed admitted there was seldom any human trafficking cases heard of. In the 1990s Chinese government created a special office in department of public security from central level to county level. Special funds and human resources are put in place to address this issue. The other agencies involved include education bureau and women's federation at various levels who regularly conduct awareness building training for women and girls. At surveyed villages, women are organized as a group to share related information, particularly new tricks of tramps. However, village leaders and representatives from women's federation still think it is necessary to enhance human trafficking awareness building further, particularly to incorporate it into school training.

H. Resettlement Plan and Framework

108. During the inception mission, it was decided that three full RPs for three trunk roads and three county/township roads (one for each trunk road plus its affiliated county/township road) and two short RPs (one for Xunyang county and one for Hanbin district) for the rural road component. In addition, one RF has been prepared for the road safety component. The RP and RF are presented in **Appendix P**. A summary of findings is presented here.

109. Based on field survey results, the project as a whole will affect 591 village groups in 59 administrative villages of 19 townships in 3 county/district. Total permanent land acquisition amounts to 3,429 mu including 842 mu farming land, 190 mu of housing plots, 775 mu of forestland and 1,622 mu of barren land. The project will demolish 60,986 square meters of rural houses, 1,949 square meters of rural simple house structure. In addition, the project will require about 47 mu of temporary land occupation. Total affected households will be 3,400 with 12,778 persons including 3,017 households with 11,196 persons affected by land acquisition only, 59 households with 251 persons by affected by house demolition only, and 324 households with 1,331 persons to be affected by both. All affected land is collective land and all AHs are rural households.

110. No ethnic minorities are being affected, and therefore no Ethnic Minority Development Plan is necessary.

111. **Resettlement budget.** The cost of land acquisition and resettlement under this Project, including contingencies and related taxes and duties, is estimated to be CNY 188.86 million. The cost of land acquisition and resettlement has been included in the total cost of each component. The EA will ensure that adequate counterpart funding will be made available for land acquisition and resettlement. At the implementation stage, the compensation contract will be negotiated and signed with the affected villages, affected HHs and affected organizations. Therefore, the final resettlement cost may be subject to further adjustment.

112. **Resettlement and income restoration**. Losses resulting from LAR for affected villages and households have been checked in detail and negotiations on income restoration plan have been conducted with the APs. Findings and results of participation have been incorporated in the RPs. To ensure successful resettlement of APs and restore their living standards, detailed rehabilitation plans are developed and included in the RPs. For land loss impacts, rehabilitation measures include distribution of cash compensation among village groups, promotion of cash crops, offering various skill training and job introduction for APs; and offering pension program for APs who have no land or per capita farmland below 0.3 mu. During project construction, efforts will be made to provide temporary employment opportunity to APs in order to increase their income.

113. Vulnerable groups are defined as poor families, disabled people, the elderly, and woman headed the household. In the project, there are vulnerable persons, including during the course of resettlement implementation, the project proponent will give priority support and help to rehabilitate and improve the lives of these vulnerable persons, including giving priority of introduction of employment and jobs related to the project, plus assistance with house reconstruction.

1. Resettlement Entitlement Matrix

114. A summary matrix is shown in the PAM and individual matrices are shown in each RP. The land compensation standard ranges from CNY 1,137-1,200 / mu / year depending on land type. The compensation rate for temporary land acquisition is CNY 1,137-1,300 / mu per year (though none has been identified at this time). No affected public facilities or enterprises have been identified.

2. Road safety component Resettlement Framework

115. No land acquisition and house demolition has been identified for the road safety improvements-only on the additional rural roads. A Resettlement Framework has therefore been prepared, in the event that land is required or demolition is found to be necessary.

I. Environment

116. An Environment Impact Assessment (EIA), including an Environmental Management Plan (EMP) has been prepared (see **Appendix O**) and discussed with relevant agencies and communities.

1. Adverse Impacts and Mitigation Measures

117. Shaanxi Province would be subject to climate change impacts in terms of temperature and precipitation increase from now until 2100, with increased probability of encountering higher frequencies and intensities of severe storms, floods and droughts. Design of the project roads therefore must take into consideration climate change adaption measures, especially severe storms and floods on bridge road drainage design.

118. This project would take up 252 ha of land permanently and 192 ha temporarily. These areas are mostly wooded land and un-cultivated land with shrubs and planted species being the main vegetation type. Approximately 3,312 households will be affected, with a population of 12,423 and house demolition of 62,023 m2. Compensation tables in accordance with PRC and ADB requirements have been prepared and discussed with affected communities.

119. During construction, potential impacts mainly relate to earthwork, road paving, and construction of road bridges. The project may have soil erosion, air quality, noise, water quality, ecology, solid waste and occupational health and safety impacts. Potential air quality impact may occur due to fugitive dust generated on the construction site from stockpiles of uncovered earth materials and vehicles travelling on unpaved haul roads, as well as fumes from asphalt cement during road paving. The use of powered mechanical equipment and blasting for tunnel construction during construction activities will generate noise and vibration. Construction activities will generate process wastewater and construction workers will produce wastewater. Bridge construction will stir up and re-suspend the sediment, affecting water quality as well as aquatic biota. Earthwork and construction activities will remove vegetation and ecological habitats, causing disruption and disturbance to nearby biota. Construction works will produce C&D wastes including old asphalt paving material. Workers will face occupational health and safety issues working on construction sites. Good housekeeping and effective mitigation measures will be implemented to reduce these impacts to acceptable levels. The temporary land take areas will be vegetated and landscaped upon completion of the construction stage.

120. Biological resources are dominated by common species. There is no critical or natural habitat within the project area of influence. Floral and faunal species that are under IUCN and/or national protection status have been shown to distribute widely in many provinces in the PRC. None of the species is endemic to the project area, although a subspecies of the Takin Budorcas taxicolor bedfordi is confined to the Qinling Mountains in southern Shaanxi province, with distribution recorded in 17 counties and the project counties/district of Hanbin, Xunyang and Shangnan are not among the 17 counties. The EMP specifies that the construction workers be prohibited from capturing wildlife on construction sites.

121. The Shaanxi Han River Wetland is the only protected area within the project area of influence. The existing alignment of trunk road G316 is within the wetland area, running parallel and along the Han River. Mitigation measures have been identified and will be implemented to provide protection to the section of the Han River and the Shaanxi Han River Wetland within the project area of influence during construction and operation of the project. This project in fact will provide an opportunity to improve the protection on water quality in the Shaanxi Han River Wetland, through installation of sedimentation tanks along G316 during road rehabilitation to collect road runoff during storm events. At present, road runoff from G316 drains directly into the Shaanxi Han River Wetland.

122. Operation of the project roads will generate traffic noise from the motor vehicles travelling on these roads. Mitigation measures consisting of installation of roadside wall and noise barrier, and double glazed windows would adequately protect the nearby sensitive receptors from road noise impact. Carbon dioxide emissions from motor vehicles travelling on all the project roads would exceed the ADB threshold of 100,000 t/a in the long term (year 2031), amounting to approximately 112,000 t/a, with the three trunk roads contributing 93% of this total.

123. Road runoff during rainfall events could pollute five rivers that are assigned Category II water quality especially at bridge crossings and sections near these rivers, as well as two drinking water collection sumps along trunk road S224. Retention/sedimentation tanks with specifications on their sizes, numbers and locations, will be installed along trunk roads G316 and S224 to mitigate this potential impact.

124. Based on information gathered and assessments performed by the domestic environmental design institutes, it is concluded that environmental impacts during the construction and operational stages of the project would be acceptable and in compliance with PRC regulations and standards and ADB's SPS (2009) if the prepared EMP is implemented and monitored diligently. The EMP defines mitigation measures and monitoring requirements for the design, construction, and operational stages of the project. Appropriate environmental safeguards for the planned works are proposed and form part of a comprehensive set of project management documents.

2. Risks and Assurances

125. The project has no unusual technical risks and conventional engineering designs with proven reliability and performance will be adopted for all the components. From an environment safeguards point of view, the main risk relates to the failure of the FFPO, the IAs and O&M units to monitor environmental impacts and implement the EMP during construction and operational stages. This risk will be mitigated by (i) providing training in environmental management under the project; (ii) appointing qualified project implementation consultants, (iii) following appropriate project implementation monitoring and mitigation arrangements, (iv) ADB conducting regular project reviews; and (v) project assurances covenanted in the loan and project agreement with ADB.

126. General and specific environmental project assurances are required to ensure that the project can achieve its envisaged outcome. The following sections define the assurances that will be included in the loan and project agreements.

127. **General Environmental Assurances.** SPG will ensure and cause the IA to ensure that the preparation, design, construction, implementation, operation, maintenance, monitoring and decommissioning of the project and project facilities comply with (i) all applicable laws and regulations of the Government environment, health, and safety; (ii) the Environmental Safeguards (i.e. principles and requirements set forth in ADB's Safeguard Policy Statement (2009); and (iii) all measures and requirements set forth in the domestic environmental impact reports (EIR), the environmental impact registration forms (EIRF), the soil and water conservation report (SWCR), this EIA and environmental management plan (EMP) for the project; and any corrective or preventive actions (a) set forth in a safeguards monitoring report, or (b) which are subsequently agreed between ADB and the Government. SPG will cause the IA to prepare, at the outset of component implementation, detailed internal monitoring programs to be implemented by the contractors during construction and operation phases, and to incorporate such mitigation and monitoring measures into the design of components, relevant bidding documents and construction contracts. Throughout project implementation, SPG and the IA will review any changes to the project design that may potentially cause negative environmental impacts, and in consultation with ADB, update EIA and EMP by revising mitigation measures as necessary to assure full environmental compliance.

128. SPG, FFPO and the IAs will ensure that sufficient resources and full time personnel are provided for monitoring EMP implementation and making appropriate use of external independent environmental monitoring stations. SPG will ensure that the IAs are obliged to provide semi-annual environmental monitoring reports throughout the construction period to FFPO, which will in turn prepare and submit to ADB semi-annual environmental monitoring reports in a format acceptable to ADB.

129. **Specific Environmental Assurances.** SPG will ensure that within 60 days from the loan effectiveness, FFPO establishes the project grievance redress mechanism relating to safeguards in line with the EMP and Resettlement Plan and establishes a task force functioning effectively to: (a) review and document eligible complaints of project stakeholders; (b) proactively address grievances; (c) agree with the complainants the chosen mechanism for redress; and (d) prepare periodic reports to summarize the number of complaints received and resolved, and final outcomes of the grievances and chosen actions and make these reports available to ADB on request. Eligible complaints include those related to the project, any of the service providers, any person responsible for carrying out the project, complaints on misuse of funds and other irregularities and grievances due to any safeguard issues, including resettlement, environment, and gender.

130. SPG will ensure that all temporary land take areas for construction of trunk road G316 will be located outside the boundary of the Shaanxi Han River Wetland, and that no solid waste from

the project will be disposed within the wetland boundary and also within 1 km from the boundary of the wetland.

131. SPG will ensure that all excavated spoil and construction and demolition waste generated during construction will be temporarily stored or permanently disposed of at designated locations only and that these locations shall be at least 300 m from any water body.

132. SPG will ensure that measures described in the approved EIRs and this EIA and EMP for traffic noise mitigation will be implemented. These measures include the provision of double glazed windows at sensitive receptors along all three trunk roads as identified in the approved EIRs and this EIA, and for trunk road S102 installation of barrier wall at Tangxin Primary School and noise barrier at Liangheguan Primary School.

133. SPG will ensure that measures described in the approved EIRs and this EIA and EMP for protection of five Category II rivers and two drinking water collection sumps will be implemented. These measures include the installation of 70 retention/sedimentation tanks along trunk road G316 and 40 retention/sedimentation tanks along trunk road S224.

3. Overall Conclusion

134. The domestic EIRs, EIRFs and this EIA conclude that all identified environmental impacts can be mitigated to acceptable levels if the measures defined in the EMP and assurances are carefully implemented and monitored. The project is feasible from an environmental safeguards point of view and will contribute to poverty reduction in the mountainous southern Shaanxi Province.

J. Safeguards

1. Environment

135. **Environmental impacts.** The project is classified as environment category A. The proposed activities will include rehabilitation of existing carriageway, widening of existing carriageway, and constructing new carriageway, which will be in accordance with designs and RPs for regional road rehabilitation. Construction activities may have some localized short-term negative environmental impacts that can be managed through effective implementation of the EMP. Rehabilitation activities overall will alleviate environmental issues associated with current poor road conditions, such as dust mobilization, congestion, inefficient driving practice and associated emissions. Rehabilitation also provides the opportunity to improve drainage and slope stability and to adopt resource efficient practices such as recycling of pavement materials.

136. **Environmental safeguards.** The EIA and the EMP have been prepared for the project components and are to be disclosed on the ADB website in early April. These documents address the environmental measures needed during project implementation.

137. **Implementation.** The FFPO will be responsible for establishing external environmental monitors and monitoring, evaluation and reporting system to ensure all works follow prescribed guidelines. The FFPO will also establish a project-specific grievance redress mechanism (GRM) within 60 days after loan effectiveness. The PMC will assist the FFPO in the preparation and execution of this activity.

138. During project preparation, environmental institutional capacity development needs were assessed. As described above, the FFPO has committed to appointing within the FFPO suitable qualified environmental and social specialists. The IAs are also recommended to appoint within their organizations suitable qualified environmental and social specialists. International and national environmental consultants within the PMC will be appointed to provide ongoing technical support for the FFPO and to develop and deliver environmental training for the FFPO and their contractors.

139. **Environmental monitoring and reporting.** The procedures for monitoring project implementation are described in detail in the EIA and EMP. The FFPO will undertake quarterly compliance audits of the IAs and their contractors and will evaluate performance against project environmental indicators. The evaluation will be included as an appendix in the quarterly project progress report. FFPO will also submit an environmental monitoring report semi-annually. The project team will review this environmental monitoring report and disclose it on the ADB website within 14 calendar days of receipt from the Borrower in line with ADB Public Communications Policy (2011). The effectiveness of this system of EMP reporting will be reviewed after the first annual performance and mission review. The FFPO will also prepare environmental inputs for the project completion report.

2. Social

140. The due diligence investigations of the projects indicated that there is significant land acquisition and resettlement is required on the major road components with very little required on the rural roads component. The project was classified resettlement category A. Resettlement Plans have been prepared for each trunk road (each of which includes the rural road in that county), and for the remaining rural roads. A sample resettlement framework (RF) was prepared for the additional road safety on rural road component. The EA will establish a grievance redress mechanism (one has been proposed) and a participatory consultation process and other measures as defined in the RF. Based on due diligence conducted, it is not expected that there will be any negative impacts on ethnic minorities in the project area that would trigger the indigenous peoples safeguard requirements.

K. Risks and Mitigating Measures

141. Major risks and mitigating measures are summarized in Table III-24.

Table III-24: Risks and Mitigation Measures

Risk Description	Risk Assessment	Mitigating Measures or Risk Management Plan
Country and Sub-National Risk		
Macroeconomic risk	Low	Continuous monitoring by ADB of macroeconomic conditions and assessment of impacts of external shocks.
Governance	Low	Risk assessment updated under 2012 ADB-PRC CPS. All road procurement will be under ADB processes and PMC consultant will ensure consistency in management reporting.
Sector Policies, Institutions, and Governance		
Fraud and corruption	Low	ADB's Anticorruption Policy was explained in detail and the provisions of fraud and corruption in the procurement guidelines highlighted during loan processing. EA will hire and will maintain an external procurement agency to handle all biddings, prior to procurement commencement.
Institutional capacity and governance	Low-Medium	The EA has a longstanding dedicated ADB project management office to coordinate project implementation. ADB will provide procurement and loan administration training to both IA and EA. The project will finance a project management consultant.
Inexperience in ADB safeguards requirements	Medium-Low	Engage external monitors early. Conduct training for EA, IA and PMO staff in 2015.
Project-specific risks		
Implementation Delay	Medium-Low	Early recruitment of a procurement agent with demonstrated experience on ADB projects. ADB to develop initial request for proposal documents for

Risk Description	Risk Assessment	Mitigating Measures or Risk Management Plan
		the project management consultant. Domestic approvals are in an advanced state of preparation.
Counterpart fund availability	Medium-Low	Assurance that counterpart funding will be made available in a timely manner. Bi-annual loan administration mission by ADB. Quarterly progress reporting by EA. (Before, during, and after project implementation)
Implementation capacity	Medium-Low	FFPO to monitor IAs closely and provide training and knowledge of ADB's disbursement procedures and project accounting requirements to sub-PMOs and IAs at inception or beforehand to build up staff capacity. Provide training workshops on ADB disbursement policies and procedures. (Before and during project implementation)
Lack of Coordination among Relevant Agencies	Low	Staff the FFPO and IAs with appropriately qualified staff, continually update the implementation program and frequently distribute to the involved government agencies. Establish a project reporting system that identifies delays early and prompts appropriate interventions.
Monitoring Mechanisms	Low	A separate auditor's opinion on the use of the imprest account and statement of expenditure will be part of the audit reports. The IA's audited financial statements and audited project financial statements will be submitted annually, no later than 6 months after the end of each fiscal year throughout the implementation period.
Ability to handle ADB's safeguard requirements Land acquisition and demolition	Medium-Low	The EA to implement the project's EMP, RF, RP, SDAP and GAP. Specific clauses on safeguards management included in contractors and supervision consultant contracts. The project management consultant will include environment and resettlement specialists. Quarterly monitoring and reporting to ADB as part of progress reports. Training will carried out for PMO and sub-PMO staff.
Ability to handle procurement	Medium-Low	EA (through FFPO) will hire an external procurement agency to handle all bidding. Project Management Consultant RFP documents will be ready for the procurement agent in June 2015. Training in ADB procedures will be provided during implementation. Prior review will be applied to the first ADB-financed contracts from each category. Annual financial audits will be conducted.
Financial management	Medium-Low	The IAs will receive training in ADB's financial management and procurement procedures.
Road safety	Low	The safety of the roads was assessed after preliminary design and a 3-star ChinaRAP rating is a loan covenant. A primary school education and associated community road safety awareness program will be carried out. Specialist road safety organizations will be appointed to facilitate implementation.
Overall	**Medium to Low**	

Source: PPTA Consultant

IV. PROCUREMENT PLAN, IMPLEMENTATION PLAN AND DMF

142. The SPG has requested that advance contracting and retroactive financing be applied to the procurement of the trunk roads component. This is to ensure that SPG are able to utilize the MOF subsidies that these projects will attract if started in 2015. PMO has requested that there be two IA appointed, namely, Shangnan County Government (SCG) and Ankang City Traffic Bureau. SCG will manage 11 contracts and Ankang City Traffic Bureau will manage18 contracts.

143. **Trunk road procurement.** Shangnan County Government have proposed nine (9) contracts for the upgrade and rehabilitation of S224, of which there are five (5) subgrade contracts, two (2) pavement contracts, one (1) landscaping and road safety and one (1) for the rehabilitation-only section. All contracts will be NCB. Of these, advance contracting is being sought for the subgrade contracts. Ankang City Traffic Bureau have proposed ten (10) contracts for the upgrading of G316 and S102, of which there are five (5) subgrade contracts, two (2) pavement contracts, two (2) landscaping and road safety contracts and one (1) tunnel equipment and tunnel fit out contract. All contracts are NCB. Advance contracting is being sought for the trunk road subgrade packages.

144. **Rural road procurement:** 85% ADB financing is requested for the rural road upgrading and 100% ADB financing for the road safety contracts. All contracts are NCB and rural road upgrading will involve 7 contracts. The road safety works for the 25 additional roads have been packaged into three contracts.

145. All advance contracting will be undertaken in conformity with ADB's Procurement Guidelines (2013, as amended from time to time) [12] and ADB's Guidelines on the Use of Consultants (2013, as amended from time to time).[13] Under advance contracting, the issuance of invitations to bid, bidding documents and bid evaluation reports will be subject to ADB no objection. Advance contracting will include advertisement, issuance of bidding document and evaluation of bids and up to the recommendation of contracts award. The contracts proposed for advance contracting and retroactive financing are shown in the PAM.

A. Design and Monitoring Framework (DMF)

146. The DMF has been prepared based on the Concept paper proposal and the Updated DMF Guidelines 2014 and in consultation and agreement with the EA.

Table IV-1: Design and Monitoring Framework

Impact
The project is aligned with the provision of safe, efficient, all-weather road access in southeast Shaanxi Province consistent with the 12th Five-year plan objective of having all administrative villages connected by paved roads by 2015.

Project Results Chain	**Performance Indicators with Targets and Baselines**	**Data Sources or Reporting Mechanisms**	**Assumptions and/or Risks**
Outcome			**Assumptions**
The transport network in southeast Shaanxi was improved	Crashes, fatalities and injuries per vehicle kilometre travelled on project roads, reduced by 25% in 2019 from 2011 baseline figures of 517 crashes, 96 deaths, 1636 injuries. Average travel frequency per month for rural households increases from 16.4 in 2014 to 20 by 2020 Rural roads are passible all year round by 2020	Traffic police data PPTA Survey + similar follow up survey EA project monitoring reports	Traffic police continue to cooperate Local residents change behavior in vehicles and near roads Roads are maintained **Risks** Expected economic growth fails to materialize

[12] Available at: http://www.adb.org/Documents/Guidelines/Procurement/Guidelines-Procurement.pdf.

[13] Available at: http://www.adb.org/Documents/Guidelines/Consulting/Guidelines-Consultants.pdf.

	Average travel speed on trunk roads increased from 40 km/hr to 60 km/hr by 2020 Percentage of 3 star rated project roads[14] increases from 27% to 59% by 2020	Before and after survey Based on feasibility and final designs and ChinaRAP evaluation	Increased quality of road surface leads to unsafe higher speeds and thus more fatalities and traffic incidents
Outputs			**Assumptions**
1. 187 km trunk roads upgraded	1a. 187 km of roads upgraded from Class III/IV to Class II/III by 2019 1b. Trunk road iRAP 3-star ratings targets by lengths are: • Vehicle occupants: 79% • Motorcyclists: 53% • Pedestrians: 55% • Bicyclists: 79% 1c. 30% of unskilled labor to be women	1a. ADB review missions and PMC progress reports 1b. ChinaRAP assessment reports 1c. SDAP	Counterpart funding sufficient and available in a timely manner Procurement Agent and Project Implementation Consultant hired in a timely manner Good coordination between EA and local agencies
2. 139.6 km earthen rural roads upgraded	2a. 139.6 km of roads upgraded to paved Class IV standard by 2019 2b. 57% of these rural road lengths have 3 star safety rating or better 2c. 20% of unskilled labor to be women	2a. ADB review missions and progress reports 2b. ChinaRAP assessment reports 2c. SDAP	**Risks** Difficulties in complying with ADB procurement procedures Delay to project commencement affects MOT subsidies
3. Comprehensive road safety improvements and capacity development implemented	3a. 569.66 km of existing rural roads have improved safety standards by 2018 3b. 24% of these road lengths now have 3 star safety rating or better 3c. Safety awareness campaign participants in 3 schools reporting enhanced knowledge of subject area(s) implemented 3d. The community safety awareness campaign should target 50%/50% men and women participation 3e. 110 iRAP training participants reporting enhanced knowledge of subject area(s) 3f. 100 of iRAP participants passing test	3a. ADB review missions and PMC progress reports 3b. ChinaRAP assessment reports 3c. Road Safety consultant reports 3d. 3e. 3f. Road Safety consultant report	Low cooperation with local agencies related to road safety awareness SPTD reluctant to embrace iRAP philosophy
Activities with Milestones **Outputs** 1. **Trunk Roads Rehabilitation (Q4/2018)** 1.1 Conduct detailed design (Q1/2015) 1.2 Land acquisition, advance recruitment and resettlement activities (Q4/2015) 1.3 Construct civil works (Q4/2018) 1.4 Monitor/implement environmental management (Q4/2018)			

[14] All star ratings in DMF are based on rating for vehicle occupants

2. Rural Road Improvement (Q4/2018)
2.1 Conduct detailed design (Q1/2015)
2.2 Land acquisition, advance recruitment and resettlement activities (Q4/2015)
2.3 Construct civil works (Q4/2017)
2.4 Monitor/implement environmental management (Q4/2017)
3 Road Safety Component (Q1/2019)
3.1 Project design, consultant selection, safety program engineering design (Q2/2015)
3.2 Construct civil works of road safety (Q4/2018)
3.3 Safety program implementation, equipment (Q3/2018)
3.4 Conduct capacity building/iRAP training (Q1/2018)
Inputs **Loan** **ADB: $200 million (OCR)** • Civil works - $185.48 million • Equipment and software - $0 million • Consulting services and Capacity Building – $ 2.15 million • Financing charges – $12.37 million **SPG**: **$199.96 million** • Civil works - $104.03 million • Design, Procurement, Supervision - $27.17 million • Equipment - $0 million • Environment and Social Mitigation - $ 27.86 • Contingencies - $40.91 million

ADB = Asian Development Bank, EA = executing agency, iRAP = International Road Assessment Program, km = kilometer, OCR = ordinary capital resources, SPTD = Shaanxi Provincial Transport Department, SPG = Shaanxi Provincial Government

Source: PPTA estimates.

V. FINANCIAL ARRANGEMENTS

A. Project Institutional Arrangement

147. Shaanxi Provincial Transport Department (SPTD) will be the executing agency (EA) of the project. Shaanxi Provincial Highway Bureau (SPHB), on behalf of SPTD, will be in charge of overall project organization, coordination, guidance and supervision. The Foreign Fund Financed Project Office of SPTD (FFPO) is responsible for the daily work during the project preparation stage, the project coordination and liaison with ADB during the implementation stage in order to ensure that the project will be implemented in accordance with ADB's guidance and requirements. Ankang City Traffic Bureau (AKTB) and Shangnan County Government (SCG), as the implementation agencies (IA), will respectively manage the implementation of trunk roads, rural roads and road safety component located inside Ankang City and Shangnan County. For this, daily management responsibility will be assigned to the PMO under jurisdiction of AKTB and SCG.

148. Under the leadership of AKTB, ADB Financed Project Management Office (AKPMO) will be in charge of management and overall coordination related to the construction of two trunk roads (S102 and G316), 7 rural roads and several road safety projects. The organization structure is as the following:

- G316 Xunyang-Ankang Road Upgrading Engineering Construction Headquarters is in charge of managing the implementation of G316 Xunyang-Ankang Road.
- S102 Xunyang-Xiaohe Road Upgrading Engineering Construction Headquarters is in charge of management of the implementation of S102 Xunyang-Xiaohe Road.

- Hanbin District PMO and Xunyang PMO will respectively be responsible for managing the construction of local rural roads and road safety projects in Hanbin District and Xunyang County.

149. The Construction Management Office for Shaanxi Mountain Road Safety Demonstration Project financed by ADB, established by SCG, will be in charge of managing the implementation of project components located in Shangnan County.

1. Institutional Responsibilities

150. SPTD is responsible for (i) overall development and implementation of the laws, policies and regulations related to transport in the Shaanxi Province; (ii) directly or by providing financial support and technical guidance for the construction of highway and waterway infrastructure.

151. SPTD is directly responsible for investments on Shaanxi's national and provincial highway, and through the cities and counties is responsible for supporting the development of the county and township roads, and through villages for village roads. Investment on expressways was separated from SPTD in 2010. SPTD complies with general sector policies and technical guidelines by the Ministry of Transport (MOT) PRC. Similar division of responsibilities of the administration and maintenance of road network in SPTD are set as per arrangements in MOT. By the end of 2012, there were 4,083 km of expressway, 974 km of Class I highway, 8,377 km of Class II, 14,795 km of Class III and 118,061 km of Class IV roads. The administration and maintenance of Shaanxi road network takes place at three levels: (i) Shaanxi Provincial Highway Bureau (SPHB) which is responsible for trunk road (about 9,500 km); (ii) city/prefecture transport bureaus; and (iii) county transport bureaus. SPHB is responsible for maintenance of national and provincial highway and three county roads. City/Prefecture Government is responsible for rest county roads maintenance. Expressway companies are responsible for expressway's maintenance and operation.

152. SPTD (SPCD previously) established the Foreign Fund Financed Project Office (FFPO) to coordinate project implementation, process and authorize disbursements, manage procurement and monitor implementation progress. SPTD, through the FFPO, will be directly responsible for (i) management and implementation of proposed project as well as for the contracting; (ii) data collection; (iii) implementation of training program and ensuring the participation of staff from cities/prefecture and counties; and (iv) monitoring implementation. At project completion, SPHB will take over the responsibilities for the operation and management of the national and provincial highway and cities/prefectures and counties transport bureaus will take over the rural roads.

153. The FFPO was established in October 1989 under the name of the World Bank Fund Financed Office (with the purpose of implementing the first World Bank-finance highway project in Shaanxi) and was later renamed Foreign Fund Financed Project Office in November 2002 (when it became responsible for implementing projects financed by other donors). FFPO has extensive experience in project implementation. FFPO has implemented three World Bank funded projects and one ADB funded project during last 20 years.

154. Ankang City Transport Bureau is responsible for: (i) respectively responsible for organizing the construction and management of the Ankang City's trunk roads, rural roads and comprehensive road safety components under the project; (ii) oversee day-to-day activities of the Project Management Office; (iii) coordinate the activities between Sub-PMO at Hanbin District and Xunyang County; (iv) responsible for approvals of the project, EIA, land acquisition and resettlement, recruitment of design institute and other domestic approval procedures; (v) review and approve the design for rural roads and road safety project in accordance with its administrative authority; (vi) assist FFPO in submission of necessary materials and documents to ADB at the project preparation stage; (vii) preparing, updating and the procurement plan to ADB through FFPO; (viii) recruit design institute, contractors and construction supervision company; (ix) in charge of procurement activities of preparation of bidding documents, bid opening, bid evaluation, contract award and contract negotiation, etc.; (x) responsible for implementation and acceptance of completed works of the project components located within Ankang City; (xi)

responsible for work progress, quality, safety, land acquisition and resettlement, environment protection, contract payment, design variation, final accounts of the project, handover of works at the implementation stage; (xii) timely submission of progress report, monitoring report, evaluation report and implementation completion report prepared by IA to ADB; (xiii) establish strong financial management system and fund utilization control system, and process withdrawal applications, payments to contractors, suppliers and consultants; (xiv) review interim payment certificates, variation orders, prepare statement and payment certification, and made payment timely; (xv) accept the project audit conducted by ADB and concerned departments; (xvi) oversee Sub-PMO at Hanbin District and Xunyang County to implement project components, and provide concerned assistance as needed; and (xvii) monitor the work quality, safety and management activities during the implementation period; and providing respective coordination and facilitation as needed.

155. Shangnan County Government is responsible for: (i) respectively responsible for organizing the construction and management of Shangnan County's trunk road, rural roads and comprehensive road safety components under the project; (ii) oversee day-to-day activities of the Project Management Office; (iii) responsible for approvals of the project, EIA, land acquisition and resettlement, recruitment of design institute and other domestic approval procedures; (iv) review and approve the design for rural roads and road safety project in accordance with its administrative authority; (v) assist FFPO in submission of necessary materials and documents to ADB at the project preparation stage; (vi) preparing, updating and the procurement plan to ADB through FFPO; (vii) recruit design institute, contractors and construction supervision company; (viii) in charge of procurement activities of preparation of bidding documents, bid opening, bid evaluation, contract award and contract negotiation, etc.; (ix) responsible for implementation and acceptance of completed works of the project components located within Shangnan County; (x) responsible for work progress, quality, safety, land acquisition and resettlement, environment protection, contract payment, design variation, final accounts of the project, handover of works at the implementation stage; (xi) timely submission of progress report, monitoring report, evaluation report and implementation completion report prepared by IA to ADB; (xii) establish strong financial management system and fund utilization control system, and process withdrawal applications, payments to contractors, suppliers and consultants; (xiii) review interim payment certificates, variation orders, prepare statement and payment certification, and made payment timely; and (xiv) accept the project audit conducted by ADB and concerned departments;

B. Financial Management Assessment

1. Summary

156. The financial management assessment was conducted in accordance with ADB's *Guidelines for the Financial Management and Analysis of Projects* and the *Financial Due Diligence a Methodology Note*. The FMA considered the capacity of the Ankang City Transport Bureau and Shangnan County Government, which are the two implementing agencies (IAs), and SPTD (executing agency (EA)) and Foreign Fund Financed Project Office (FFPO), including funds flow arrangements, staffing, accounting and financing reporting system, internal and external auditing arrangements, and financial information systems.

157. The assessment concluded that the EA and FFPO have adequate experience in managing foreign-financed projects, while the two IAs do not. The FFPO received significant training and experiences during previous projects. The assessment indicated

(i) the project will have an adequate project financial management system that can provide accurate and timely information on the status of the project in the reporting format agreed and as required by ADB;
(ii) there are established financial management policies in the PRC, which are followed strictly by the two IAs;
(iii) Ankang City Transport Bureau has sound financial management capability, have conducted a previous World Bank project and is experienced in managing locally-

funded projects while Shangnan County Government has no experience in foreign fund project, rather only in locally-funded projects, and

(iv) the number of staff of the two IAs are mostly fixed, and staff are used to the overall management and day-to-day work.

(v) Training of all FFPO, IA and PMO staff is recommended as they have none or on recent training in new ADB policy and procedures

(vi) Internal audit mechanisms are inadequate for SNPMO. There are no functional departments and regular staff of internal auditing, nor routine internal auditing.

158. The Shaanxi Provincial Department of Finance (SPDOF), which will operate and administer the imprest account, has sufficient experience on foreign-funded projects. The completed FMAQ are presented in **Appendix I**.

159. The FMA recommended capacity development measures to ensure that the implementing agency is able to meet the project's financial management requirements. It is proposed that the IAs should strengthen their financial management capability to manage the project, including (i) undertaking training, particularly on ADB policy and procedural requirements; (ii) establishing internal audit arrangements; and (iii) seeking external financial management assistance as needed.

160. No outstanding audits or audit issues exist with any of the IA staff involved in the proposed project. The overall financial management risk rating of the Project is **Low** provided adequate training is given. Specific risks are tabled below.

Table V-1: Risk Analysis of Financial Organizations

Particulars	Risk Assessment	Remarks
EA and FFPO		
EA and FFPO	Low	SPTD is one part of Shaanxi Province Government. SPTD and FFPO have experience in managing and implementing transport projects financed by international funding institutions.
Funds Flow	Low	SPTD and FFPO have knowledge and working experience in foreign funded project. Adequate training on ADB's special feature should be arranged.
Staffing	Medium	EA and FFPO have experience staff but have not fully involved in ADB project. Staff of FFPO burdened other domestic projects at same time. The finance staff should be trained in ADB financial management and disbursement procedures. At same time, enough labor sources should be provided.
Accounting policies and procedures	Low	Accounting policies and procedures are based on generally accepted accounting standards. Financial management manual and procedure manual (for WB project, which for ADB project will be prepared referring to WB project's) are available to staff.
Internal Audit	Low	An internal audit is in place.
External Audit	Low	Project accounts are audited by an independent external auditor annually. The audit is done in accordance with the Chinese National Accounting and Auditing System and complies with the requirements of SPDOF
Reporting and monitoring	Low	The project operation and financial reports comply with the reporting requirements of SPDOF and ADB. Financial reports are regularly submitted to ADB and SPDOF.
Information systems	Low	EA and FFPO used an automated accounting system.
Ankang City Transport Bureau		

AKTB	Low	AKTB will be responsible for the implementation of components in Ankang. AKPMO will be responsible for day-to-day work. AKTB has experience in managing and implementing foreign-funded projects.
Funds Flow	Low	AKTB has knowledge and working experience in foreign funded project. Adequate training on ADB's special feature should be arranged.
Staffing	Medium	AKTB has experience staff but have not fully involved in ADB project. The finance staff should be trained in ADB financial management and disbursement procedures. At the same time, enough labor sources should be provided.
Accounting policies procedures	Low	AKTB will adopt an accounting policy that is based on National Accounting Standards.
Internal Audit	Low	An internal auditor is in place.
External Audit	Low	Project accounts are audited by an independent external auditor on an annual basis. The audit is done in accordance with the Chinese National Accounting and Auditing System and complies with the requirements of ADB.
Reporting and monitoring	Low	The project operation and financial reports comply with the reporting requirements of similar corporation in PRC.
Information systems	Low	AKTB used according system software for financial reporting for the Project.
Shangnan County Government		
SCG	Low	SCG will be responsible for the implementation of components in Shangnan. SNPMO will be responsible for day-to-day work. Both institutions have no experience in managing and implementing foreign-funded projects. But under leadership of EA and FFPO, SCG can manage the project well.
Funds Flow	Medium	SCG and SNPMO have no knowledge and working experience in foreign funded project. Adequate and enough training on ADB's special feature must be arranged.
Staffing	High	SCG has no experience staff in ADB project. The finance staff should be trained in ADB financial management and disbursement procedures. At same time, enough labor sources should be provided.
Accounting policies and procedures	Low	SCG will adopt an accounting policy that is based on National Accounting Standards.
Internal Audit	Medium	An internal audit will be in place.
External Audit	Low	Project accounts are audited by an independent external auditor on an annual basis. The audit is done in accordance with the Chinese National Accounting and Auditing System and complies with the requirements of ADB.
Reporting and monitoring	Low	The project operation and financial reports comply with the reporting requirements of similar corporation in PRC.
Information systems	Low	SCG used according system software for financial reporting for the Project.

2. Funds Flow

161. The proposed fund flow arrangement is shown in Figure 1. Funding sources of the project include ADB loan, MOT subsidies and local City and County counterpart funds sourced from appropriations from city and county governments. These appropriations will be provided to IA and PMOs by AKTB and Shangnan County Finance Bureaus (representing SCG). ADB loan proceeds will flow from ADB into imprest account, which was set up and managed by Shaanxi Provincial Department of Finance, and then to implementing agencies, and finally to contractors and suppliers. A loan agreement will be signed between ADB and PRC through the MOF, and on-lending agreements will be signed between MOF and SPG through its SPDOF, and then between SPDOF and SPTD. SPTD will transfer the loan to FFPO.

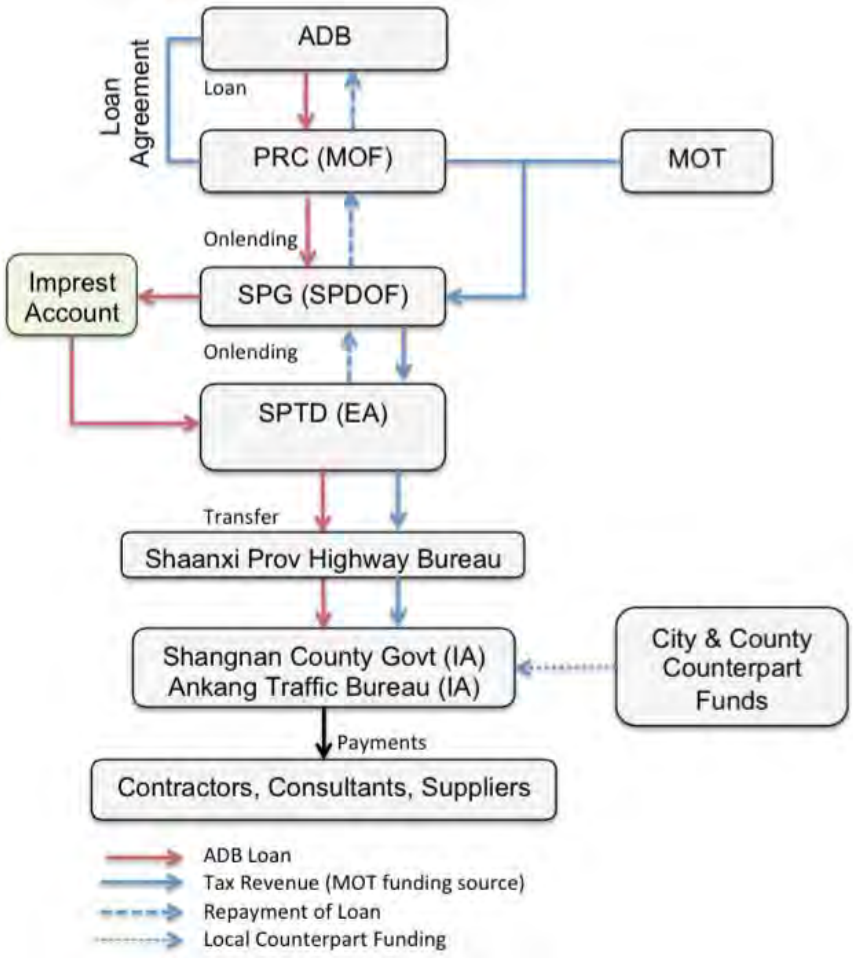


Figure 1: Funds Flow (Tentative)

3. Audit Arrangement

162. ADB requires that project financial statements are audited in accordance with standards acceptable to ADB. In line with foreign financed projects in China, the project will be audited in accordance with the Government Auditing Standards of PRC. China National Audit Office (CNAO) will appoint Shaanxi Provincial Audit Office (SPAO) as auditors for ADB project. SPAO will issue annual audit reports and CNAO will review all annual audit reports. At current, ADB accepts audit reports issued by CNAO or SPAO.

4. Disbursement Arrangements

163. ADB loan proceeds will be disbursed in accordance with the procedures set out in ADB's Loan Disbursement Handbook (2007, as amended from time to time), and detailed arrangements agreed upon between the Government and ADB.

164. To facilitate project implementation through timely release of loan proceeds, SPDOF, on behalf of Shaanxi Provincial Government, established an imprest account that was established for the last ADB fund project at a commercial bank acceptable to ABD. The FFPO, on behalf of the SPTD, will establish and administer a special account at a commercial bank acceptable to SPDOF at the same time.

165. For the domestic funds, Central Government and SPG will provide subsidy for highway and rural road. SPTD and FFPO have submitted a five-year plan for MOT subsidies, and funds will be allocated according to annul plan. FFPO will allocate the designated funding for the project and monitor the provision of the funds, and disbursements to contractors, consultants, suppliers, etc., according to project progress.

166. The disbursement process will be: (i) based on project progress, project IAs will submit a disbursement request to the EA through FFPO, and SPDOF; and (ii) once approved, counterpart funds will be disbursed to the FFPO, AKPMO and SNPMO.

5. Accounting Procedures and Financial Reporting

167. The existing accounting departments and accounting staff of the project IA are effective for the current organizations. All accounting staff in the EA have enough experience on foreign fund accounting, government accounting and received appropriate accounting training at least once a year. The accounting staff are not frequently transferred. Accounting staff of AKPMO who come from Ankang Transport Bureau which implemented World Bank project before, are experienced while accounting staff of SNPMO have no experience on foreign fund accounting. AKPMO and SNPMO's accounting staff have experiences in government accounting and receives appropriate accounting training at least once a year. There are detailed descriptions and regulations on the accounting positions, such as head of the department, accountant, and cashier in the project EA. The two IAs' organization, document, and staff arrangement are sufficient. Presently the two IAs have detailed descriptions and regulations on the accounting positions while the PMO have not. As discussed with the two PMOs, their description and regulations on the accounting position will reference IA's.

168. The current accounting procedures are adequate for the two PMOs. The accounting procedures such as transaction recording, chart of accounts, controls, and cost allocations are well established and are effective. The general ledger and subsidiary ledgers are always reconciled and in balance. All accounting and supporting documents and financial statements are retained on a permanent basis.

169. The accounting system is computerized. All financial statements are produced from the automated accounting systems. The financial staff also receives training from the accounting software company and understands electronic accounting.

170. FFPO will maintain project account and records of ADB loan. Consolidated project financial statements will be prepared annually by FFPO in accordance with applicable guidance and regulations, where these are generally consistent with internationally recognized accounting principles and practices.

6. Internal Audit

171. The EA maintains an internal auditing system, which is not ensured through functional department or permanent positions, but through task force. For special purposes, financial staff is

recruited from inside organization to conduct internal auditing. The results of the internal auditing will be submitted to the Director of FFPO.

7. External Audit

172. Shaanxi Provincial Audit Office will be responsible for the external audit. The audit is conducted based on the national standards on auditing issued by the central government. No major accountability issue has been found in the audit report in the past years. FFPO will be audited by SPAO every year and a separate accounting and auditing company will audit its supporting units.

173. The EA, IAs and PMOs will cause the annual consolidated project financial statements to be audited in accordance with National Standards on Auditing and the Government Auditing Standards of the PRC (where these are consistent with International Standards on Auditing). PMOs and IAs will submit to ADB as required:

(i) the annual consolidated project financial statements;
(ii) an audit report which includes a separate audit opinion on the use of the imprest accounts and the SOE procedures; and
(iii) an audit management letter

8. Reporting and Monitoring

174. The IAs and PMOs will prepare balance sheets, revenue and expenditure statements, total revenue statements, total expenditure statements, detailed revenue statements, detailed expenditure statements, payroll statements, and office expenditure statements monthly and annually. They will also prepare fixed asset statements and basic information at the end of each year. The current reporting system is effective for the existing organizations. At the end of each year, the implementing agency finalizes the financial statements and compares them with the physical data and budget.

C. Procurement Capacity Assessment

175. A complete procurement capacity and risk assessment is presented in Appendix J.

D. Financial Sustainability Analysis

1. Introduction

176. All components are non-revenue generating projects. The financial sustainability analysis has been undertaken in accordance with the ADB's *Financial Management and Analysis of Projects and Financial Due Diligence: A Methodology Note.*

2. Financial Sustainability Analysis of Non-Revenue Generating Road Component

177. Financial performance assessment was conducted on the SPTD and fiscal assessment was carried out for Ankang City Transport Bureau and Shangnan County Government. SPTD will provide subsidy for the trunk roads component from fuel taxes. Ankang and Shangnan fiscal revenue will provide counterpart funding during implementation for all components. SPTD will pay debt service for the Project. O&M funding of the trunk roads will be provided by SPTD through SPHB. Ankang and Shangluo Transport Bureau through Ankang and Shangluo Finance Bureaus will provide O&M funding of rural roads.

178. Cost estimate was reformatted to separating as table following.

Table V-2: Cost Estimate by Financing Source (Unit: $ million)

Item	ADB Loan		SPDOT Subsidy		Local Gov.	
	Ankang	Shangnan	Ankang	Shangnan	Ankang	Shangnan
A. Base Costs						
1 Civil Works						
Trunk Roads Improvement	112.63	32.57	50.02	32.31	16.80	0.00
Rural Roads Improvement	17.48	10.28			3.09	1.81
Road Safety Program	9.63	2.89			0.00	0.00
2 Goods and Equipment					0.00	0.00
3 Land Acquisition and Resettlement	0	0		9.94	14.10	3.82
4 Consultants						
Project Management	0.53	0.22				
Road Safety Capacity Building	0.75	0.31				
Road Safety Education	0.21	0.09				
External Monitors	0.03	0.01			0.14	0.06
Design, Procurement, Supervision					19.01	7.95
Subtotal (A) =Total Base Cost	**141.26**	**46.38**	**50.02**	**42.25**	**53.13**	**13.65**
B. Contingencies						
1. Physicalc					9.29	3.89
2. Pricec					19.55	8.18
Subtotal (B)					**28.84**	**12.07**
C. Financing Charges during Implementation						
1. Interest During Implementation	9.09	2.98				
2. Commitment Charges	0.22	0.07				
Subtotal (C)	**9.31**	**3.06**				
Total (A+B+C)	**150.57**	**49.43**	**50.02**	**42.25**	**81.97**	**25.72**

3. Historical Revenues and Expenditures

Shaanxi Provincial Transport Department

179. As of the end of 2012, there are 4,083 km of expressway, 974 km of Class I highway, 8,377 km of Class II, 14,795 km of Class III and 118,061 km of Class IV. There are 9,500 km of trunk roads. The project length of proposed trunk road is 193 km, accounting for around 2% of current trunk road length. Following chart is flow chart on fuel tax in Shaanxi Province.

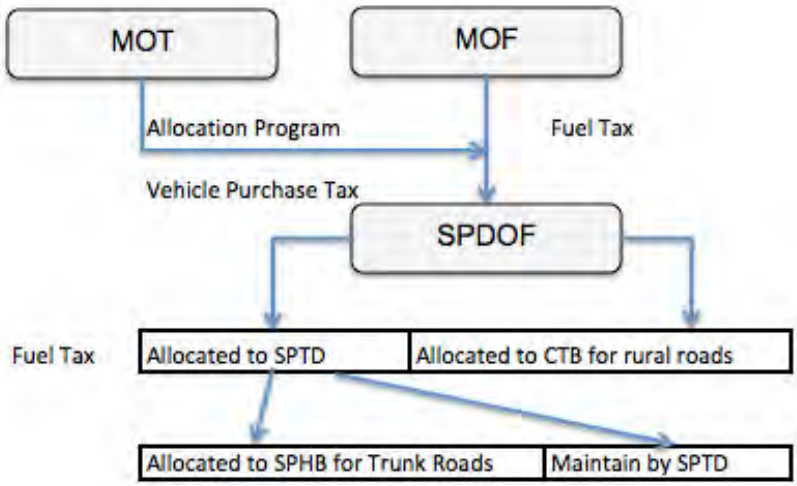


Figure 2: Depiction of Fuel Tax Allocation in Shaanxi Province

180. In 2012, total revenue of SPTD was CNY 95.97 billion. Of this, fuel tax was CNY 4 billion. In 2013, total revenue of SPTD was CNY 98.91 billion and fuel tax was CNY 4.25 billion. This represents a slight increase in revenue while fuel tax to SPTD was almost unchanged. Total expenditure of SPTD was CNY 98.62 billion in 2013 and CNY 95.85 billion in 2012. Of this, expenditure on engineering was CNY 27.53 billion in 2013 and CNY 35.08 billion in 2012.

Table V-3: Historic Revenue and Expenditure (units: CNY billion)

	Item	2011	2012	2013
1	Total Revenue	86.34	95.97	98.91
1.1	Fuel Tax	4.02	4.08	4.25
1.2	Vehicle Purchase Tax	18.02	10.45	10.41
1.3	Toll Income	13.25	15.00	15.90
1.4	Other	0.62	1.57	1.85
1.5	Loan	50.44	64.87	66.50
2	Expenditure	86.32	95.85	98.63
2.1	Expense of Undertaking	5.82	6.42	6.70
2.2	Engineering expenditure	43.51	35.08	27.53
2.3	Repayment	36.89	54.25	64.29
2.4	Other	0.10	0.10	0.10
3	Balance	0.02	0.12	0.29

Source: SPTD

Shangnan County

181. Historical Revenues and Expenditures. The historical financial performance was analyzed to determine whether it can provide the required counterpart funds during the construction period and necessary funds for O&M during the operating period. In addition, the annual average growth rate (AAGR) of revenues and expenditures during 2007-2013 are calculated. The sources of income are from tax (value added tax (VAT), business tax, income tax, resource tax, real property tax etc.) and non-tax revenues and from subsidies and or direct transfers from other levels of government. AAGR of fiscal revenue is 29.1%. Of which, AAGR of revenue from tax is 22.5% and of non-tax revenue is 69.4%. On the other hand, expenditures are categorized into general public services, education, public safety, personnel welfare, environmental protection, agriculture, forestry and water, and transportation. AAGR of transportation expenditure is 4.5%. Transportation expenditure accounting for total expenditure was 3.2% in 2007 and decreasing to 0.8% in 2013.

Table V-4: Historic Revenue and Expenditure (Unit: CNY million)

Item	2007	2008	2009	2010	2011	2012	2013	AAGR
Total Fiscal Revenue	**327**	**459**	**608**	**839**	**1,214**	**1,487**	**1,512**	29.1%
Fiscal Revenues (Local Gov.)	46	81	104	142	198	265	294	36.0%
General Budget Revenue	40	64	90	141	196	264	291	39.3%
a Revenue from taxes	32	50	49	109	93	75	108	22.5%
b Non-tax revenue	8	14	41	31	103	189	183	69.4%
Fund revenue	7	17	14	1	2	2	3	-13.2%
Out-budget Revenues	0	0	0	0	0	0	0	
Share of central government fiscal revenue	281	378	504	697	1,015	1,222	1,218	27.7%
Expenditure	**311**	**447**	**620**	**840**	**1,209**	**1,483**	**1,598**	31.4%
General public service	77	111	122	136	163	230	175	14.6%
Education	100	147	207	286	395	559	452	28.7%
Science & technology	1	2	3	5	7	7	8	39.5%
Culture, sports and media	7	9	13	14	17	21	29	25.3%
Social insurance and employment	12	20	29	91	74	68	81	38.1%
Medical & sanitation	25	39	60	70	89	100	127	30.7%
Environmental protection	0	0	8	27	49	49	86	170.5%
Urban and rural community affairs	6	11	19	10	32	23	36	36.2%
Agriculture, forestry & water	38	54	72	103	173	294	339	43.8%
Transportation	10	8	17	7	11	9	13	4.5%
Industry, commercial finance affairs	7	10	15	18	20	13	14	11.6%
Other	158	245	388	596	1,948	110	240	7.2%

Source: Shangnan County Statistics

Ankang City Transport Bureau

182. Historical Revenues and Expenditures. The historical financial performance was analyzed to determine whether it can provide the required counterpart funds during the construction period and necessary funds for O&M during the operating period. In addition, the annual average growth rate (AAGR) of revenues and expenditures during 2007-2013 are calculated. The sources of income are from tax (value added tax (VAT), business tax, income tax, resource tax, real property tax etc.) and non-tax revenues and from subsidies and or direct transfers from other levels of government. AAGR of fiscal revenue is 32.3%. Of which, AAGR of revenue from tax is 24.1% and of non-tax revenue is 3.4%. On the other hand, expenditures are categorized into general public services, education, public safety, personnel welfare, environmental protection, agriculture, forestry and water, and transportation. AAGR of transportation expenditure is 26.0%. Transportation expenditure accounting for total expenditure was 11.4% in 2008 and decreasing to 1.8% in 2013.

Table V-5: Historic Revenue and Expenditure (Unit: CNY million)

Item	2007	2008	2009	2010	2011	2012	2013	AAGR
Total Fiscal Revenue	**3,490**	**5,817**	**7,854**	**11,025**	**13,015**	**16,228**	**18,721**	32.3%
Fiscal Revenues(Local Gov.)	1,162	749	972	1,323	1,734	2,166	2,534	13.9%
General Budget Revenue	1,162	749	972	1,323	1,734	2,166	2,534	13.9%
a Revenue from taxes	458	602	713	982	1,293	1,363	1,672	24.1%
b Non-tax revenue	705	147	259	341	442	802	862	3.4%
Share of central government fiscal revenue	2,328	5,069	6,882	9,702	11,281	14,062	16,186	38.2%
Expenditure	**3,490**	**5,817**	**7,854**	**11,025**	**13,015**	**16,228**	**18,721**	32.3%
General public service	970	1,236	1,601	2,031	2,588	3,501	4,133	27.3%
Education	961	1,502	1,967	2,187	3,169	4,620	4,870	31.1%

Science & technology	24	31	39	47	57	61	59	16.5%
Culture, sports and media	63	100	125	183	228	217	296	29.4%
Social insurance and employment	210	292	589	1,304	1,017	1,297	1,678	41.4%
Medical & sanitation	276	473	611	974	1,212	1,405	1,648	34.7%
Environmental protection	16	71	419	633	647	636	656	86.0%
Urban and rural community affairs	188	324	324	304	193	297	217	2.4%
Agriculture, forestry & water	335	532	861	1,504	1,672	2,047	2,511	39.9%
Transportation	**85**	**663**	**523**	**419**	**312**	**299**	**341**	**26.0%**
Industry, commercial finance affairs	53	160	273	918	1,275	1,126	1,546	75.4%
Other	310	434	521	522	646	722	767	16.3%

Source: Ankang City statistics.

4. Projections of Revenues and Expenditures

Shaanxi Provincial Transport Department

It is forecast revenue and expenditure of SPTD will keep increasing trend based on Chinese government policy on fuel tax and vehicle purchase tax etc.. During projection of revenue and expenditure of SPTD, growth rate of revenue will be assumed 4.5% in 2014 and decreasing to 3.5% in 2020, and rate of expenditure will be assumed 4.30% in 2014 decreasing to 3.3% in 2020. PRC government just increased fuel tax ratio. It is forecasted that fuel tax will be kept increasing trend for fuel consummation will be increasing. Based on PRC's vehicle industry, unit price of vehicle will be decreasing and quantity of sales will be increasing. It is conservative assumed increasing rate p.a. during 2015-2016 will be 1.80%, and 1.5% during 2017-2019 and 1.0% after 2020. The increasing trend of vehicle purchase tax will be forecasted conservatively 0.0% p.a. during 2015-2016 and 1.2% p.a. 2017-2020, and 0% after 2012. The projection is shown in following table.

Table V-6: Projected Revenue and Expenditure – SPTD (Unit: CNY billion)

	2015	2016	2017	2018	2019	2020
Total Revenue	107.81	112.23	116.71	121.27	125.75	130.15
1.1 Fuel Tax	4.40	4.48	4.55	4.62	4.69	4.74
1.2 Vehicle Purchase Tax	10.41	10.41	10.53	10.66	10.79	10.92
Sum of 1.1 & 1.2	14.81	14.89	15.09	15.28	15.48	15.65
Total Expenditure	107.81	112.23	116.71	121.27	125.75	130.15

Note: Consultants' estimates.

Shangnan County

183. In projecting the revenues funds from land sales have not been considered. The financial forecasts assume that revenue from tax is likely to increase at 30% per annum at 2014 and decreasing to 18% per annum at 2020; annual increasing rate of non-tax revenue will be forecasted as 22% at 2014 and decreasing to 13% at 2020; share of central government fiscal revenue will be 20% at 2014 and decreasing to 8% at 2020. In projecting transportation expenditure, it is assumed that transportation expenditure accounting for total expenditure will keep current levels, namely 0.8%. Transportation expenditure will be calculated based on proportion and projected revenue. The projection is shown below.

Table V-7: Projected Revenue and Expenditure (Unit: CNY million)

	2015	2016	2017	2018	2019	2020
Total Fiscal Revenue	**2,147**	**2,543**	**2,988**	**3,478**	**4,011**	**4,579**
Fiscal Revenues (Local Government)	403	485	580	684	798	916
General Budget Revenue	401	483	578	682	796	914
a Revenue from taxes	125	157	196	240	287	339

b Non-tax revenue	276	326	382	443	509	575
Fund revenue	2	2	2	2	2	2
Out-budget Revenues	0	0	0	0	0	0
Share of central government fiscal revenue	1,745	2,059	2,409	2,794	3,213	3,663
Expenditure	**2,147**	**2,543**	**2,988**	**3,478**	**4,011**	**4,579**
Transportation	17	20	24	28	32	37

Note: Consultants' estimates.

Ankang City

184. In projecting the revenues funds from land sales will not considered. The financial forecasts assume that revenue from tax is likely to increase at 24% per annum at 2014 and decreasing to 16% per annum at 2020; annual increasing rate of non-tax revenue will be forecasted as 3% p.a. during 2014-2020; share of central government fiscal revenue will be 17% at 2014 and decreasing to 10% at 2020. The projection is shown in following table.

Table V-8: Projected Revenue and Expenditure (Unit: CNY million)

	2015	2016	2017	2018	2019	2020
Total Fiscal Revenue	**21,835**	**24,922**	**28,222**	**31,705**	**35,326**	**39,036**
Fiscal Revenues (Local Government)	2,914	3,352	3,849	4,406	5,025	5,704
General Budget Revenue	2,914	3,352	3,849	4,406	5,025	5,704
a Revenue from taxes	2,063	2,475	2,945	3,476	4,066	4,717
b Non-tax revenue	851	877	903	930	958	987
Share of central government fiscal revenue	18,921	21,570	24,374	27,299	30,302	33,332
Expenditure	**21,835**	**24,922**	**28,222**	**31,705**	**35,326**	**39,036**

Note: Consultants' estimates.

5. Repayment and Fiscal Impact and Affordability Assessment

185. **Repayment:** The Consultant had discussed with EA and on maturity-based pricing on sovereign loans. The amortization schedule to be adopted is of annuity at 10% discount rate. The EA requested financing charges during implementation to be capitalized.

186. **Results of the Fiscal Impact and Affordability Assessment.** Assessment of projected annual revenues shows SPTD, Ankang and Shangnan fiscal revenues have the necessary counterpart funds for the Project. The analysis indicates that based on the identified fund sources during project preparation (including new budgets, subsidies and allocations that will be earmarked) all project components are expected to have sufficient funds available for counterpart funds during implementation and O&M costs during operation. Annual counterpart funding ranged from 2.01% in 2017 of Shangnan's projected revenues to 0.76% in 2016 of Ankang's projected fiscal revenue during implementation. Debt service is about 0.6% to 0.62% of projected annual revenues during first six years of operation period while annual O&M is 0.01% to 0.03%. This indicates acceptable fiscal risk since it is expected that fiscal revenues of the municipal and county governments will grow in line with economic development, providing more resource mobility for the two governments to finance the proposed project components. The O&M of the proposed project is assessed that it will not affect SPTD's revenue, Ankang and Shangnan Governments' fiscal sustainability and funds are sufficient to finance other project activities.

187. The contributions of SPTD, Ankang City Government and Shangnan County Government were analyzed in terms of affordability relative to 2016 to 2020's projected revenues and expenditures. Table V-9 shows that counterpart contributions are highest in 2017 where Ankang City Government's CNY 273.09 million will be required to support project investments. Given that this is the year with the highest level of contributions required, it is not expected that the City Finance Bureau and County Finance Bureau would have difficulty making the funds available to

meet counterpart funds. Given that it has adequate time to make provision for the requirements of the counterpart funding with main contributions in 2016 to 2018, the funding of the components is regarded as affordable.

188. The viability of the financing plan as demonstrated by the reliability of proposed counterpart funding sources was also examined. A viable financing plan requires government support for the Project. Assurances of counterpart funding should come in the form of a letter of commitment from Ankang City Finance Bureau and Shangnan County Finance Bureau.

189. The results of the revenue analysis and fiscal analysis are presented in the following tables.

Table V-9: Annual Counterpart Fund as a % of Total Revenue

	2015	2016	2017	2018	2019	Total/Ave.
SPTD						
Annual Contribution (CNY million)	0.00	145.92	216.98	201.78	0.00	564.69
Percent of Total revenue of fuel tax and vehicle purchase tax for SPTD	0.00%	0.98%	1.44%	1.32%	0.00%	0.75%
Shangnan County Government						
Annual Contribution (CNY million)	0.00	40.68	60.49	56.25	0.00	157.41
Percent of Total revenue of SC	0.00%	1.60%	2.02%	1.62%	0.00%	1.05%
Ankang City Government						
Annual Contribution (CNY million)	0.00	129.63	192.76	179.26	0.00	501.64
Percent of Total revenue of AC	0.00%	0.52%	0.68%	0.57%	0.00%	0.35%

Source: Consultants' estimates

Table V-10: Annual O&M as a % of Total Revenue

	2021	2022	2023	2024	2025	2026
SPTD Revenue						
O&M (CNY million)	4.60	4.74	4.88	5.02	5.18	5.33
Percent of Total revenue of fuel tax and vehicle purchase tax of SPTD	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
Shangnan County Government						
O&M (CNY million)	1.66	1.71	1.76	1.81	1.86	1.92
Percent of Total revenue of SC	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
Ankang City Government						
O&M (CNY million)	4.45	4.58	4.72	4.86	5.01	5.16
Percent of Total revenue of AC	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%

Source: Consultants' estimates

O&M cost was considered to increasing 3% p.a. It was assumed that O&M cost of trunk road is 20,000CNY per year per km and is 7,000CNY per year per km for rural road in 2014.

Table V-11: Annual Debt Service as a % of Total Revenue (SPTD)

	2021	2022	2023	2024	2025	2026
Debt Service % of Sum of Fuel Tax and Vehicle Purchase Tax						
Debt Service (CNY million)	93.60	94.42	95.32	97.41	98.63	99.96
Total Debt Service (% of Sum)	0.60%	0.60%	0.60%	0.61%	0.62%	0.62%

Source: Consultants' estimates

VI. WORK PROGRAM AND OUTPUTS

A. Major Outputs and Reporting

190. Some small revisions were made to the original proposal:

- The consultant had proposed a combined National Economic Analyst and Financial Analyst and Management specialist. The proposed expert needed to be replaced, (discussed and agreed with ADB during Inception mission) due to unavailability. A national replacement was appointed to fulfill the Financial Analyst and Management specialist.
- The unallocated National Economic Analyst time and responsibilities was transferred to the International Economic Analyst role.

191. The PPTA consultants submitted the following reports:

(i) Inception report summarizing the status and findings of the PPTA team and any individual consultants hired under the PPTA, a review of the planning documents (feasibility studies, EIA, resettlement plan, etc.), and a detailed work plan and schedule to complete the PPTA final report and related documents, within 4 weeks of the start of the TA initiative; - **Submitted 18th April.**
(ii) Interim report (this report) presenting the sector assessment, preliminary project design and scope, preliminary costing, findings and recommendations for all relevant report sections, due diligence, capacity assessments, and proposed implementation arrangements: **submitted in draft 14th July**, and the final on 30th July.
(iii) Draft final EIA reports (with executive summary), in **August 2014**.
(iv) Draft resettlement plan were submitted by **December 2014**;
(v) Draft final report on the 9th February 2015; and
(vi) Final report was issued in March 2015

192. The fact-finding mission was held from 4th to 13th March 2015.

B. PPTA Team Logistics

193. The Consultants mobilizations are shown in Table VI-1.

Table VI-1: Team Mobilization

International	Position	Contract Input/Actual (mm)
Glen Stringer	Transport Specialist/Team Leader	5.6364/5.6364
Alan Kwok	Environmental Specialist	1.5/1.5
Timothy Yates	Economic Analyst	2.1/2.1
Wanying Wang	Social Development Specialist	2.34/3.34
National		
Dajiang Sun	Social Development Specialist	3.5/3.5
Qian Teng	Financial Analysis and Management Specialist (replaced by Hu Fangfang)	Not mobilized
Qian Teng	Economic Analyst (time allocated to Tim Yates)	Not mobilized
Hu Fangfang (replaces Qian Teng)	Financial Analysis and Management Specialist	2.5/2
Jianguang Jiang	Transport Specialist/Deputy Team	6.27/5.1

	Leader	
Haokun Song	Resettlement Specialist	3/3
Xiaohai Liu	Environmental Specialist	4/4

Appendix A: Project Maps

Figure 1: Ankang City (S102, G316) and Rural Roads

Figure 2: Shangnan City Trunk Road (S224) and Rural Roads

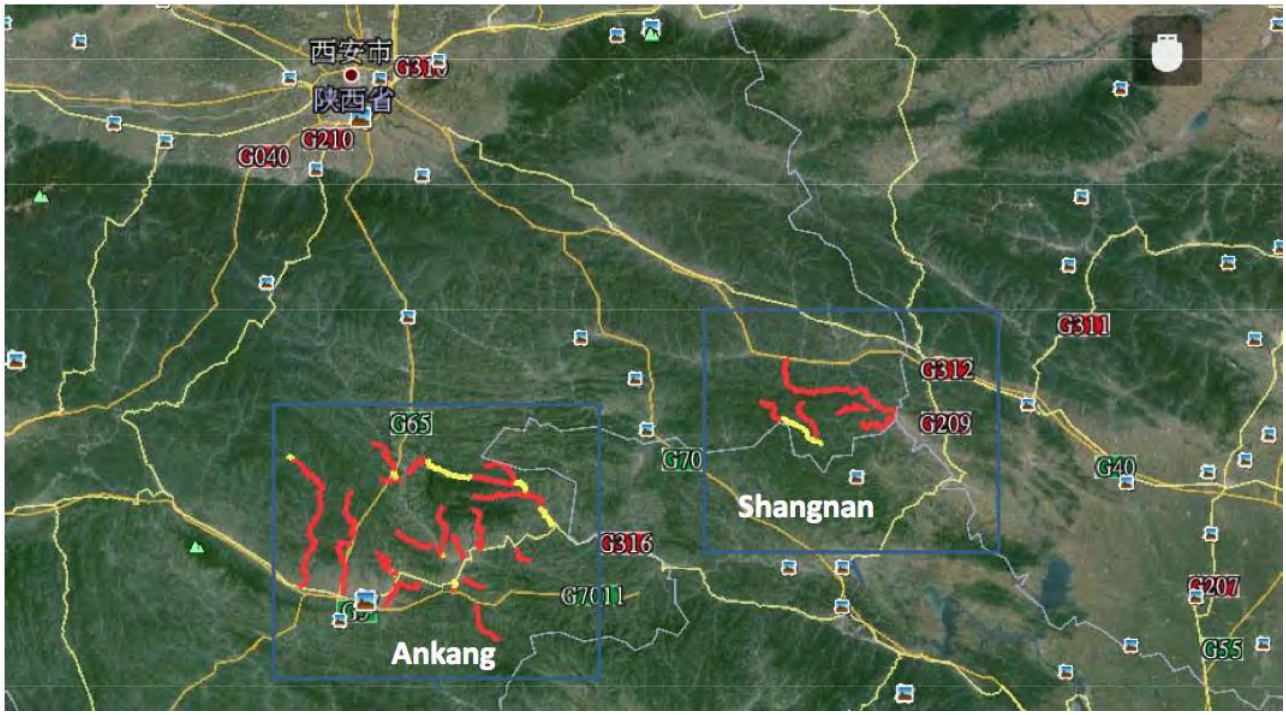


Figure 3: Road Safety Component Roads

APPENDIX B: Road Sector Assessment

I. Sector Overview

1. **Background.** Shaanxi province is located in the north west of China and borders eight other provinces. The geography is varied and is part of the Ordos Desert in the north along the border with Inner Mongolia, the Loess Plateau in the central part of the province, the Qin Mountains (Qinling) running east to west in the south central part, and subtropical climate south of the Qinling. In between the Loess Plateau and the Qinling lies the Wei River Valley.

2. Shaanxi has a total land area of 205,800 square kilometers and a population of 37.53 million [1] (2013 census). With a gross domestic product per capita of CNY 38,564 in 2012 (approximately 92% of the national average), Shaanxi ranks 15th in GDP per capita in P. R. China. The Prefectures of Ankang and Shangluo (in which the Project roads are located) have GDPs per capita of CNY 18,878 and CNY 18,097 respectively, approximately 49% of the Shaanxi average. Shaanxi population is equally distributed between urban and rural areas. The net average income per head in Shaanxi for rural households is CNY 5,763 compared to CNY 20,734 for urban households.

3. Nearly all the population of Shaanxi is ethnic Han Chinese, with pockets of Hui population in the northwestern region (adjacent to Ningxia). The province is also a historical home, along with Gansu Province, of the dialect of the Dungans, of the Hui people, who emigrated from China to Central Asia. The southern part of Shaanxi, known as Guanzhong, where the provincial capital Xi'an is located, is more populated than the northern part.

4. **Transport sector.** The mountainous nature of Shaanxi reduces the potential for inland waterways transport; the prefecture relies heavily on both the road and rail networks. In 2012, provincial highways carried 174.5 billion ton-kilometers of freight and 48.8 billion passenger-kilometers. For rail transport these figures are 144.68 and 40.9 respectively. There are a total of 3.19 million vehicles in Shaanxi (up 16.3% on 2011), comprising passenger vehicles (74%), trucks (14%) and others (12%). Additionally in 2012, there were 2.45 million motorcycles, a decrease of .4% from 2011. Vehicle ownership increased in Ankang and Shangluo by 16% and 9% respectively for the same period.

5. **Road network.** The Shaanxi road network had a total length of 161,411 km (in 2012) and 165,249 km (in 2013) and consists primarily of county and township roads (26%) and village roads (65%). The length of underclass roads in 2013 was 16,257, which represents 10% of total network. The length of unpaved rural roads was 51,620 km, which represents 34.5% of the county, town and village roads. Of the 7,489 km of National road, 4,363 km (58%) are expressways. SPHB statistics indicates approximately 90% of trunk roads are in very good or good condition (based on MQI[2]), compared to only 30% for rural roads. The remaining 70% of rural road condition is equally distributed among fair, poor and bad condition.

Table 1: Road Network Characteristics in Shaanxi (2013)

Administrative level	Total (km) 2012	Total (km) 2013	% of Province network (2013)
National	3,939	7,489	5%
Provincial	5,299	6,096	4%
County	17,577	17,577	11%
Township	23,956	23,973	15%
Village	104,331	107,881	65%
Special	2,200	2,233	1%
Total	**161,411**	**165,249**	100%

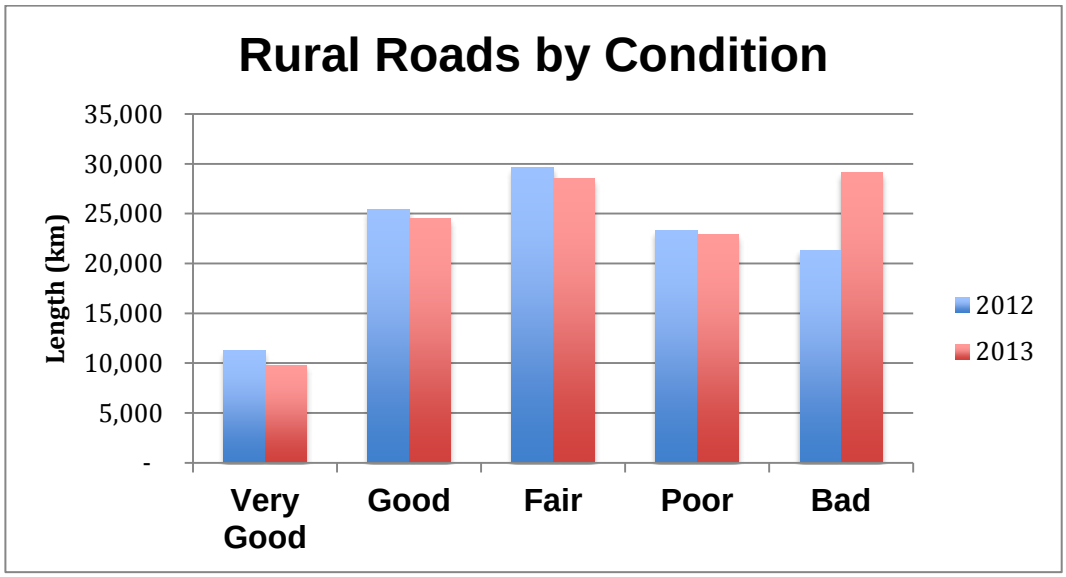
[1] Figures in these paragraphs are 2012 numbers taken from the Shaanxi Statistical Yearbook 2013

[2] Maintenance Quality Index

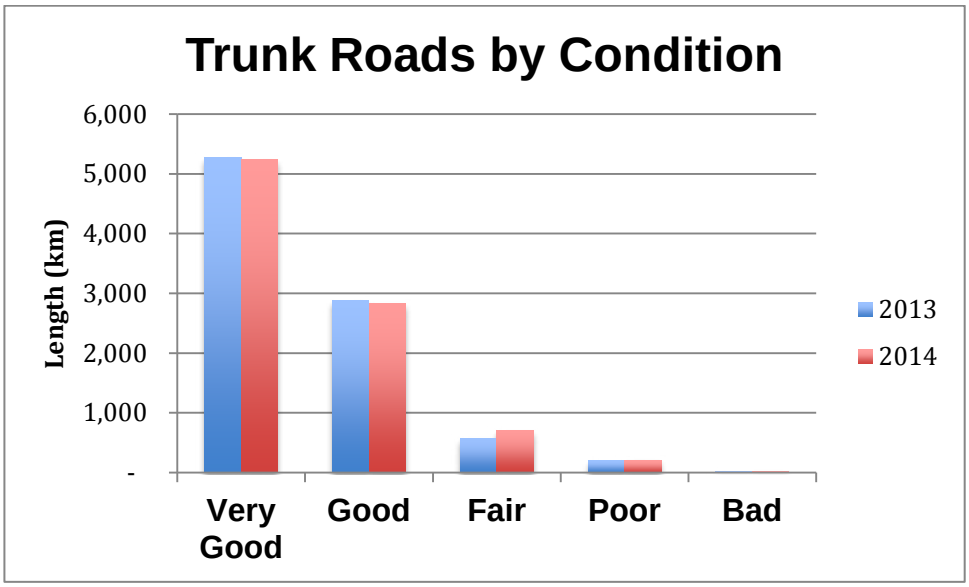
Class	Total (km)	Total (km)	% of Province network (2013)
Expressway	4,083	4,363	3%
Class I	974	1,011	1%
Class II	8,377	8,441	5%
Class III	14,795	14,731	9%
Class IV	118,061	120,445	73%
Under Class	15,000	16,257	10%
Total	**161,411**	**165,249**	100%
Surface	**Total (km)**	**Total (km)**	**% of Province network (2013)**
Asphalt concrete	23,029	23,330	14%
Cement concrete	65,599	69,273	42%
Simple pavement	21,288	21,026	13%
Stone paved / unpaved	51,495	51,620	31%
Total	**161,411**	**165,249**	**100%**

Source: PPTA processing of data from SPTD

6. **Road Condition**. Condition data is recorded annually with trunk and rural roads managed at different organization levels. Data shown in the following tables is based on the MQI values. The EA provided data for 2012 and 2013 with the 2013 total being 5,000 km longer (115,037 km). The data shows a slight deterioration over the two-year period. The data includes County, Township, Village and Special roads. From 2012 to 2013 (according to the above table) an additional 3,600 km was added to the rural road network. The condition spread between counties and districts is constant.



7. The data provided for the trunk roads is for 2013 and 2014 with the length assessed being 42 km longer in 2014 at 9,005 km. There is a marginal drop in condition, with the 89.6% in 2014 being in good or very good condition. The EA indicates that due to budget and equipment limitations, the entire network is not surveyed each year but rather sampling surveys are performed.



8. **Road management.** The Shaanxi Provincial Transport Department (SPTD) is responsible for the management of all transport infrastructures in Shaanxi province including highways, rural roads, public transport, postal services, aviation and railways. SPTD carries out planning, budgeting, and financing construction and maintenance of road projects. Under SPTD's guidance and leadership Shaanxi Provincial Highway Bureau (SPHB), through prefecture-level city and county-level units, is responsible for planning and administering the road subsector, including constructing and maintaining the road network (excluding expressways – however SPHB is responsible for supervision of maintenance on expressways). SPHB is mainly responsible for the management of all national and provincial roads in the province. At the city and county level, the local Transport Bureaus mirror the SPTD, while the local Highway Bureaus manage the road network. The Highway Bureau at the city and county level manages the direct maintenance of rural roads. Refer to Figure 1: SPTD Organizational Structure.

9. The maintenance of the county and township roads is supported by SPHB through a) provision of technical guidelines, b) funding allocations, c) supervision and management of maintenance activities, and d) advice and guidance to local bureaus on funding allocations and maintenance.

10. **Rural roads and access to services and facilities.** Rural roads in Shaanxi have an economic importance in terms of providing rural communities with access to markets (sale of produce and purchase of agricultural inputs), to collection or processing stations for the sale of cash crops, and to towns and cities for (seasonal) employment opportunities. They also provide an important social service in terms of providing access to schools, health facilities and administrative services. Although in Shaanxi some limited services and facilities are located in or around the administrative villages (clinic, processing stations, some primary schools), most services and facilities are located in the townships (markets, hospitals, primary and middle schools, banks, police, etc.). Some services and facilities are only available at the county town (major markets, large hospitals, secondary schools, marriage certificates, border permits, etc.). A lot of rural transport therefore takes place between the villages and the nearest township(s). During the rainy season, however, many rural roads become impassable due to landslides and poor road surfaces, leading to perishable crops being lost and reducing access to socioeconomic services and facilities.

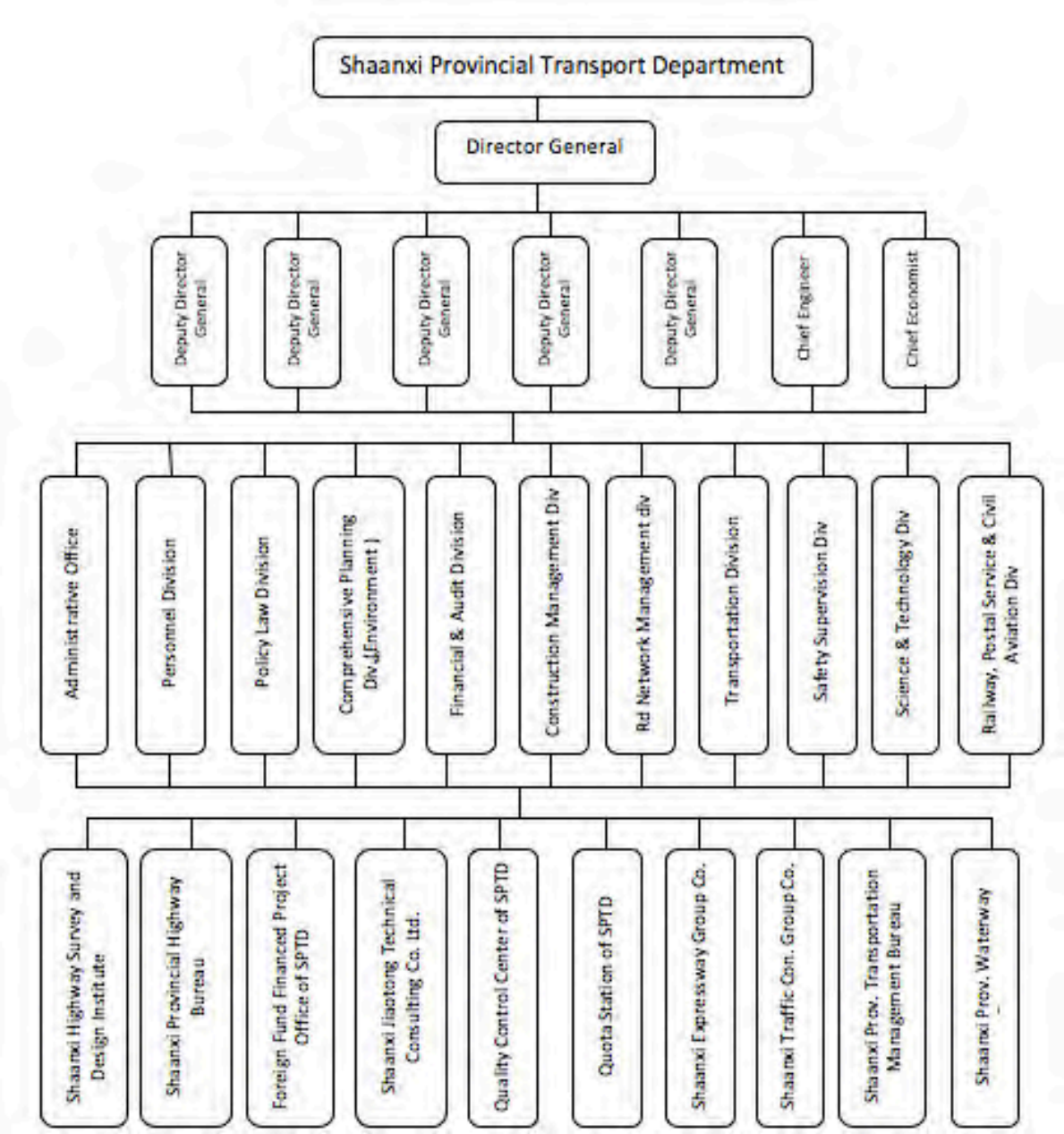


Figure 1: SPTD Organizational Structure

Source: FFPO document

II. Sector Policies

11. **Construction and upgrading.** Transport sector policy is guided by the 12th Five-Year Plan, which will finish at the end of 2015. The 12th Plan takes forward the agenda of sustainable development initiated by the 11th Five Year Plan. Under the 12th Plan, Shaanxi Province aims to have 100% of Counties (city, district) connected with core cities by equal or better than Class II roads, and all administrative villages, where conditions permit, connected by paved roads (asphalt or cement concrete) by the end of 2015. The rural road network is planned to increase to a total of 145,000 km during this period. The development plan targets the proportion of roads equal or better than Class II to be more than 75%, but this currently stands at less than 60%. Also targeted is an increase in expressway length to 5,500 km (currently at 4,363 km).

12. According to the prefecture-level 12th Five-Year Plan, Ankang City aims to invest CNY 5.25 billion in reconstruction of six Class II roads and one Class III road with a total length of 441 km (this includes the Project road G316 Ankang to Xunyang). In addition CNY 9.43 billion will be invested in the reconstruction of 3,319 km of county/township roads (asphalt pavement) and

village roads (asphalt or cement pavement). Under their Plan, Shangluo City targets improving 2,404 km of county/township roads, upgrading 1,473 km of village roads, paving a total length of 7,443 km village roads, and construction of 1,380 km new village roads.

13. The administration levels of the road network are revised every 3 to 5 years. Trunk roads include all national and provincial roads, and some sections of urban roads. Local or rural roads include all county, township and village roads. As a result of the review process, roads can move from between levels. Project trunk road S224 has only recently been upgraded from a County level road to a provincial trunk road.

14. **Maintenance.** A State Council policy (2005) and subsequent policy documents issued by MOT, NDRC and MOF made the traffic bureau at county level responsible for the maintenance of the rural road network with support of the township and village levels, and introduced provincial maintenance subsidies.

15. In 2006 the SPTD issued guidelines stating that counterpart funding from prefecture and county level was required for rural road maintenance. Rural road maintenance costs are divided into two parts: routine maintenance costs financed by city and county governments and other maintenances (including heavy maintenance, medium maintenance, etc.), which are provided by provincial government (through SPTD). SPTD is responsible for determining the integrated annual road maintenance plan and allocating maintenance funds. Current subsidy levels, which are financed from a fuel tax allocation are shown below.

	Unit: CNY per km [(a)]	
Administration Level	**Routine Maintenance** (Financed by city and county Governments)	**Rehabilitation [(b)]** (Allocated by SPTD through SPHB)
County	7,000	15,000
Township	3,500	6,000
Village	1,000	1,000

[a] These are minimum subsidy levels set by the 2005 State Council Policy and not revised since 2008
[b] Rehabilitation includes medium and major maintenance

16. Rehabilitation maintenance for national and provincial roads had traditionally been based on CNY 50,000 per km for National roads, and CNY 30,000 per km for Provincial Roads. This allocation is not strictly adhered to and allocations are performed by the Provincial Finance Department to the Local Finance Bureaus based on available fuel tax allocations, previous maintenance budgets and inflation factors.

17. Routine maintenance of rural roads is the responsibility of county level bodies. Medium and major pavement maintenance is tendered out to professional maintenance organizations, while all other maintenance is carried out through competitive contracting of local residents.

18. **Road Maintenance Budgets**. The following table presents the budgets for road maintenance in Shaanxi province from 2012 to 2014. The budget has doubled in the last 3 years, however the annual allocation to routine maintenance and rehabilitation is almost unchanged. The increased funding is being used for new construction of roads in all administration levels. This is in keeping with development plans, viz: i) the proportion of roads equal or better than Class II to be more than 75% of the network, and ii) and all administrative villages, where conditions permit, connected by paved roads (asphalt or cement concrete) by the end of 2015

Table 2: Annual Maintenance Budgets (CNY million)

	2012							
	National	**Provincial**	**County**	**Township**	**Village**	**Total**	**Total**	**Year on Year increase**
Routine	11,493	13,757	12,069	8,386	9,552	55,257		
Rehabilitation	34,219	63,778	24,656	14,034	9,552	146,239		
New Construction (or	139,561	134,590	298,140	15,957	91,354	679,602	881,098	

Reconstruction)								
	2013							
	National	Provincial	County	Township	Village	Total		
Routine	12,099	13,540	12,303	8,384	10,433	56,759		
Rehabilitation	43,046	55,422	30,677	14,316	10,095	153,556		
New Construction (or Reconstruction)	317,464	224,790	469,496	64,543	212,811	1,289,104	1,499,419	70%
	2014							
	National	Provincial	County	Township	Village	Total		
Routine	12,138	13,554	12,303	8,390	10,788	57,173		
Rehabilitation	54,400	24,298	26,366	14,394	10,788	130,246		
New Construction (or Reconstruction)	413,874	403,407	421,500	92,141	287,751	1,618,673	1,806,092	20%

III. Sector Performance, Problems, and Opportunities

19. **Construction and upgrading.** The paved rural road network (including simple pavement) in Shaanxi has increased by 3,328 km over the last three years, with a further 2,000 km planned for completion in 2014, mainly as a result of upgrading unpaved roads. Around 1,662 km of upgrading and new construction road were completed in 2012, and about 1,570 km of upgrading and new construction road were planned for 2013. By the end of 2015, SPTD plans to build and upgrade an additional 10,000 km of county and township roads with asphalt pavement, and additional 20,000 km of village roads with cement concrete pavement. These plans are on schedule and expected to be achieved.

20. **Maintenance implementation.** The SPHB is responsible for the routine, medium and major maintenance of national and provincial highways. The transport bureaus at the City and county level manage the direct maintenance of rural roads.

21. Under the SPHB, there are 10 City highway bureaus (one for each of the 10 Cities in the province), and 104 Rural Road Management Bureaus (Maintenance Headquarters) at County level. Each sub-highway bureaus manages several Maintenance Units that perform the routine maintenance of national and provincial highways (managing from 10-30 km of road) on a permanent basis. Similarly Road Maintenance Units and Maintenance Centers under the County Bureaus manage the rural roads maintenance. The medium, especially major maintenance works are normally contracted out to the maintenance companies through a bidding process. As well as private companies, there are a number of autonomous state-owned maintenance companies that bid for these contracts.

22. **Maintenance funding.** The provincial maintenance subsidy for 2013 amounted to CNY 2,000 million, which is in line with policies. Counterpart funding is allocated from county and city. The basic maintenance budget for each county is determined from the length, administration level and the relevant subsidies for each road in the county. This budget is usually supplemented from other sources, contributions and donations.

A. Traffic Safety

23. **Management of Traffic Safety[3].** The Shaanxi Provincial Government (SPG) handles top-level management of traffic safety and in June 2013, issued *Shaanxi Provincial Government's Implementation Opinions of State Council's Opinions on Strengthening Road Traffic Safety*

[3] Inception Report, RIOH, IRAP, CHINARAP dated 26th March 2014

Works. In this document the SPG pointed out that a long-term mechanism of traffic safety publicity and education should be established. It also recommended that an educational project on cultivating civilized traffic behavior should be implemented. Meanwhile, in the provincial implementation opinion, the token “making safe development and cherishing life” was used as the main theme for strengthening road traffic safety works. To achieve the goal of reduced fatality rates caused by road traffic, the Opinions document suggested that all works aimed at improving road traffic safety should be consistent with the development of economy, livelihood improvement, and social harmony. It was also noted that to achieve goals such as a complete cooperation mechanism, integral safety treatment, overall operation, safety investment increment, higher service awareness, the improvement of traffic facilities, improved traffic orders and novice project management methods, efforts should be given from the aspects of human, vehicle, road, enterprises, and management.

24. Local municipal governments are responsible for implementing road traffic safety duties. City-level governments issue regional road traffic safety reports in January of each year to the SPG. Relative departments undertake their responsibilities to ensure funds for traffic safety enhancement.

25. **Road Infrastructure Improvement.** The road construction and management department of SPTD is responsible for road infrastructure improvement. Two examples of their activities are: Highway Safety Enhancement Project (HSEP) launched in 2004, and the Terms of Rural Roads Construction and Maintenance (effective from October 1st, 2005). The SPTD also improves the management level such as adopting a tri-management term to make sure that traffic safety facilities are designed, constructed and used with the main works of the roads; checking and treating road hazardous sections; and completing traffic safety rescue mechanism.

26. The HSEP and other road infrastructure improvement projects have all proved to be effective. Many lives have been saved and it is highly accepted by the society. These experiences help create a foundation for future safety work. It is therefore expected that this project will have a huge safety effect and will provide pilot experiences for future projects.

27. **Publicity and education of traffic safety**. Currently, the department of traffic police is responsible for traffic safety education. Local traffic police in Shaanxi province have launched several publicity and educational activities, such as the traffic safety publicity and educational programs being implemented at middle and primary schools. The first national traffic safety day was held on 2 December 2012, and the Shaanxi General Traffic Police Office has designated the week from 2 December to 8 December as the provincial traffic safety week.

28. In 2012, the SPTD, the Department of Public Security, and the Administration of Work Safety co-issued ”Scheme for Shaanxi Passenger Transport Safety Year” to guide the traffic safety works for the whole province. There are also provincial traffic safety activities via the media. For example, the Shaanxi Department of Public Security held a press conference for “122 traffic safety day”, where media representatives were invited to participate to discuss with government about the publicity manners for the traffic safety day, and Dali County has built the first traffic safety publicity theme park in Shaanxi province.

29. **Traffic safety law enforcement**. The traffic police are also responsible for traffic safety law enforcement. During December 2013, the Department of Public Security announced that their primary concern would be aggressive driving behaviors of heavy goods vehicles, traffic violations of coaches (buses), and dangerous goods carriers. The government would continue to improve the traffic safety management for expressways, to increase the number and efficiency of patrols. Specifically, coaches with 9 or more seats and carriers with dangerous goods must be checked, 127 sets of fixed speed detectors would be installed to raise the supervision level, enhance safety education, and multiple countermeasures for eliminating traffic hazards.

30. **Traffic Accidents**. While accident numbers have fallen in recent years, the percentage of fatalities is steadily increasing. In Ankang the incidents mirror the provincial average, where as in Shangluo City, the incidents are much higher than the average and in both cities spiked to very high levels in 2012.

Table 3: Shaanxi Province Accident and Fatality Incidents

	Shaanxi Province				PRC	Ankang City		Shangluo City	
Year	All Crashes	Fatalities	Injuries	% Fatalities	% Fatalities	All Crashes	% Fatalities	All Crashes	% Fatalities
2005	12,011	2,698	8,905	22%	22%				
2006	10,546	2,711	9,995	26%	24%				
2007	9,063	2,270	8,484	25%	25%				
2008	7,205	2,156	6,889	30%	28%				
2009	5,501	2,034	5,404	37%	28%	364	29%	217	59%
2010	6,004	1,944	6,144	32%	30%	387	27%	165	66%
2011	6,362	1,893	6,087	30%	30%	358	28%	277	39%
2012	5,996	1,804	5,505	30%	29%	208	50%	347	59%

Source: Shaanxi Statistical Year Books

B. Project roads crash history

31. Road crash data collected for the project illustrates both the scale of the road safety problem on the project roads and which roads are priorities for safety countermeasures. Table 5 below summarises key road safety data, sorted according to crash costs. The key points are:

- An average of 96 deaths and 1,635 injuries are reported to occur on the roads each year.
- It is estimated that deaths and injuries on the roads cost RMB 517 million (USD 84 million) per year. This represents about 0.3% of GDP in Shaanxi.
- Overall, 21% of the roads (by length) account for about half (46%) of the crash costs.
- The three project trunk roads (G316, S224 and X102) have among the highest crash costs. Other roads with relatively high crash costs include non-trunk road sections of G316, Y338, X316 and X313.
- Death rates and injury rates on all Class III roads exceed the national average (shown in Table 4). For example:
    - the death rate on G316 in Xunyang is 11 times higher than the national average
    - the injury rate on G316 in Xunyang is 24 times higher than the national average
- There is room for improvement on all Class IV roads (Table 4). For example:
    - the death rate on S102 in Xunyang is 134 times higher than the national average
    - the injury rate on S102 in Xunyang is 257 times higher than the national average.

32. An analysis of the data available indicates that the main crash types are: run-off crashes due to sharp curves, unforgiving roadsides such as cliffs, deep drains, and aggressive vertical rock faces (around42%); head-on crashes due to sharp curves and poor sight distance (around 40%); pedestrian crashes (around 9%); and rear-end crashes (around 9%).

33. Head-on, turn on one's side, and rear end crashes are main crash types of the studied road network. As for X201, head-on crashes represent almost 25% of the total crashes. Turn on one's side, and rear end crashes also took a considerable portion of the total crashes.

Table 4: Road casualty rates by road class, China

	Freeway	Class I	Class II	Class III	Class IV	Low class
Length (km）	74113	64430	308743	387967	2469456	703520
Accident rate（per km）	0.131	0.272	0.135	0.074	0.006	0.017
Death rate（person per km）	0.085	0.093	0.053	0.026	0.002	0.005
Injury rate（person per km）	0.185	0.304	0.158	0.088	0.007	0.020

Source: Traffic Accident Annual Report of China (2010).

Table 5: Road Crash Data for Project Roads (2007-2011)

County - road name	Class	Annual crash costs (RMB million)		Average annual casualties				Length (km)	AADT (vpd)
		Total	Per km	Deaths	Deaths per km	Injuries	Injuries per km		
XY-G316 *	3	109	1.2	27	0.29	199	2.1	93	3908
XY-S102 **	4	75	1.1	19	0.27	128	1.8	71	3874
BH-G316	3	56	1.2	14	0.29	103	2.1	48	3930
SN-S224 ***	3	54	0.6	6	0.06	259	2.7	97	731
SN-Y338	4	37	0.5	3	0.04	201	2.6	76	490
SN-X316	4	27	0.7	2	0.05	154	3.9	39	702
SN-X313	4	26	1.1	2	0.07	149	6.4	23	714
HB-G316 *	3	22	1.2	5	0.29	40	2.1	19	3915
XY-X304	4	20	0.2	3	0.04	70	0.8	89	1525
SN-Y206	4	12	0.5	1	0.04	61	2.7	23	578
SN-Y335	4	11	0.5	1	0.05	55	2.6	21	577
SN-Y339	4	8	0.9	1	0.11	38	4.0	10	577
HB-X213	4	8	0.1	2	0.03	7	0.1	79	792
XY-Y304	4	7	0.3	1	0.04	33	1.5	22	1122
XY-Y201	4	6	0.3	1	0.07	12	0.6	21	500
XY-Y302	4	6	0.5	1	0.05	27	2.5	11	508
HB-X210	4	5	0.1	1	0.02	8	0.1	61	743
HB-Y103	4	4	0.1	1	0.02	6	0.2	40	593
XY-Y311	4	4	0.2	1	0.03	11	0.5	21	500
XY-Y303	4	4	0.1	1	0.02	12	0.5	25	255
XY-Y203	4	3	0.1	1	0.02	12	0.5	26	262
XY-Y308	4	3	0.3	1	0.06	10	1.1	9	287
XY-Y206	4	2	0.1	0.4	0.03	6	0.4	16	551
XY-Y313	4	2	0.2	0.4	0.05	6	0.7	9	526
XY-Y301	4	2	0.2	0.2	0.02	8	0.8	11	1052
XY-Y212	4	2	0.1	0.2	0.01	7	0.4	20	254
HB-Y202	4	2	0.2	0.4	0.04	2	0.2	10	587
XY-Y312	4	1	0.1	0.2	0.02	6	0.6	10	254
HB-Y201	4	1	0.1	0.2	0.02	2	0.2	12	587
XY-Y305	4	0	0.1	0.1	0.02	2	0.3	6	310
Total/average		517	0.5	96	0.09	1636	1.6	1015	1442

IV. Road Asset Management[4]

34. **Data collection.** The task of data collection and management of the data appears to be spread between provincial and county level agencies, and also between different agencies at the provincial level depending on the road classification.

35. **Provincial level**: The SPHB perform annual roughness condition surveys on all trunk roads in the province using a 2 laser Network Survey Vehicle (NSV), which also records video to permit post-survey visual rating of cracks and potholes. The SPHB also receive monthly condition data reports from the counties covering defects other than roughness for all asset types.

36. The SPHB maintenance division receives and processes maintenance inspection information for trunk roads. This data originates from the county inspections and relates to defects or items identified for corrective action. The SPHB rural roads division manages data collection for rural roads and receives condition data on an annual basis. No roughness surveys are conducted on rural roads.

[4] Shaanxi Trunk Roads Asset Management Scoping Final Report, ARRB, dated 2013-05-06

37. County level: The counties perform manual condition surveys every month covering pavement, tunnels, bridges and culverts. Pavement defects recorded include all types of cracking, potholes and other surface and subgrade defects. Data are transferred from paper to electronic spreadsheet for simple reporting and are converted into a score or rating. Indices are produced for each indicator and results are forwarded to the SPHB on a 3 monthly basis.

38. **Asset management systems.** Relatively simple asset (pavement) management systems (PMS) are used at both the provincial and county levels. The SPHB have the most comprehensive system.

39. **SPHB PMS Capability**. The current PMS used was been developed in a cooperative effort between SPHB and a local university, beginning in 2009. Testing in a single county occurred during 2010-2011 that identified problems to be rectified. Further efforts in late 2011 have improved the PMS, however SPHB believe it needs further improvement, particularly to permit production of better reports. The software development for the current PMS is outsourced to a software engineering company in Xi'an.

40. Although the SPHB refer to their system as a PMS, none of their identified systems could be described as a true PMS. It does not appear to have any ability to produce aggregated reports or executive level reports. Examples seen were all very detailed level reports at 1 km resolution that is used to store all data. Further processing of the basic PMS report data is undertaken using spreadsheets to produce more meaningful reports and charts. The basic report from the PMS is also given to the provincial maintenance division for further analysis.

41. **County level PMS**: County level agencies have access to a pavement management system, bridge management system and a culvert management system. SPDOT and Chang'an University developed the systems for use by the city and county level administrations. The counties claim to use the systems virtually every day to record data about their assets. A detailed maintenance quality index (MQI) report is the only report produced by their systems and it is used to determine maintenance needs. It is not used for planning purposes.

42. **Rural roads PMS**: Rural roads are not covered by the SPHB asset system. The rural roads division established a database to store annual condition data. Data collection commenced in 2006. The system is believed to be similar to the county level asset register system.

43. All three levels of government are involved with rural road maintenance. The provincial rural roads division is responsible for the overall management of rural roads for the entire province. City level governments are responsible for the counties within their city, while county staff form the main workforce responsible for rural road maintenance.

44. Village committees are responsible for maintenance of village roads. The village committees are under the leadership of the township governments.

45. It is understood that the China Pavement Management System (CPMS) is currently used at a central government level primarily for use on the national expressway network. It is also understood that it is the intention of the central government to roll out the CPMS at a provincial level after the expressway network is completed, in approximately 5 years time. The SPHB has not asked for project assistance with asset management development. In light of these statements, it is not recommended for the project to become involved with current asset management systems and operations.

46. Asset management improvement potential.

- Examine current administrative processes required for rehabilitation and maintenance work planning, approval and budgeting to identify solutions that can lead to more efficient systems, which are able to produce defendable works programs using appropriate analysis and reporting techniques.
- Discussions with provincial level units e.g. SPTD or SPHB, to best determine where any new or upgraded asset management system should be located. Consideration of a new or upgraded provincial level asset management system that includes predictive pavement deterioration, works effects and road user cost modeling capability for economic analysis.

- Improved network reporting capability providing both detailed and summary or executive level reports could be introduced relatively easily to complement existing or new systems.
- Review levels of service, including access standards, for all roads, noting that conditions on rural roads are particularly poor.

V. ADB Sector Experience and Assistance Program

47. ADB has been a key development partner to the PRC's transport sector since 1991. Through its Sustainable Transport Initiative approved in 2010, ADB has established new strategic directions for its transport operations up to 2020. The initiative defines four new focus areas to be scaled up in future ADB operations, i) urban transport, ii) response to climate change, iii) cross-border transport and logistics, and iv) road safety and social sustainability. In line with the initiative, ADB has phased out expressways and begun diversifying its transport assistance into urban transport, inland waterways, and logistics. It also initiated steps to provide assistance to the road subsector for better road asset management and road safety.

48. Under the Country Partnership Strategy 2011-2015, ADB will promote inclusive growth and environmental sustainability by helping develop a more efficient, safe, green, and sustainable transport system. In the road sector, ADB will help (i) develop more effective ways of integrating planning, financing, and execution of road upgrading, rehabilitation, and maintenance, (ii) prepare long-term as well as annual road network rehabilitation and maintenance plans, (iii) develop sustainable financing arrangements, (iv) accelerate sector reforms to promote market-based mechanisms in road maintenance, (v) reduce overloading, and (vi) promote transport efficiency.

Appendix D

附件 D

Preliminary Design Review Comments and Feedback, and Detailed Design Results on Engineering Aspect of Component 1

子项目 1 工程方面初步设计审查意见和反馈

Table of contents/目录

I. INTRODUCTION

1. Based on the Preliminary Design Documents review, ADB "SHAANXI MOUNTAIN ROAD SAFETY DEMONSTRATION PROJECT" PPTA Team provided following comments and recommendations, while the DIs responded with following feedback.

基于初步设计文件的审查，亚行"陕西山区公路安全示范项目"PPTA 技术援助组提出以下审查意见和建议，设计单位也给出了相应的反馈意见。

2. During the site investigations jointly with the DI and relevant local authorities, above mentioned engineering issues were confirmed and discussed. Additional comments and detailed design results are listed follow in.

由设计单位和有关地方当局共同参与的项目现场考察核实并讨论了以上技术问题。考察后的附加意见和施工图设计结果附后。

II. G316 XUNYANG TO ANKANG CLASS II HIGHWAY UPGRADING

A. HORIZONTAL ALIGNMENT DESIGN/平面线形设计

3. To use the right of way of existed roads as much as possible for the highway upgrading projects, the curves with small intersection angles may occur practically, but the current "Design Specification of Highway Alignment" (JTG D20-2006) has the minimum length requirements on the curves with less than 7°intersection angles. The requirements are minimum lengths of 700/△ (angles measured in degree) and 500/△ with the design speeds of 60 km/h and 40 km/h respectively. This Project has quite so many curves with less than 7°intersection angles, among them the lengths cannot meet these minimum lengths requirements are curves of Intersection Point (The Chinese Design Drawings refer to JD) 71, 76, 90, 101 and 160. The design revisions on these curves should be done to follow the Specifications. The design optimizations are advised on other curves in this category, or might cancel the curves if it doesn't cause significant increases on the bills of quantities.

公路改建工程为尽量利用老路，可能有小转角的曲线产生，但现行《公路路线设计规范》（JTG D20-2006）对小于 7°的平曲线有最小长度要求，分别为 60 公里/小时车速时不小于 700/△（转角值以度计），和 40 公里/小时车速时不小于 500/△。本项目有较多小于 7°的平曲线，其最小长度不满足此规范要求有 JD71,JD76,JD90,JD101,和 JD160 等，应修改设计。其它此类小半径曲线宜优化设计，或在工程量增加不大的情况下宜取消。

DI Feedback/设计单位反馈意见：

4. During the optimizations on the detailed design, DI will either cancel horizontal curves with small intersection angles, or increase the lengths of these curves as many as possible, according to the agreeable conditions.

由于旧路为 7.5 米，现在加宽成 8.5 米，旧路仅加宽 1 米，交点的设置考虑了旧路加宽的宽度和旧路构造物的利用，小偏角多设置在桥梁的附近，为了充分利用旧桥，如果取消，会造成中线的偏离，旧桥需要加宽，在施工图优化阶段，我们将根据实际情况，如果没有构造物，尽量取消小偏角或加大小偏角的平曲线长度。

5. C-Shaped curves are strictly limited to be used conditionally under the difficult terrains according the Specification. The Pre-Design has many C-Shaped curves as following. Recommendations are given to have optimizations on these curves and to revise these designs.

C 形曲线，属规范在地形特殊困难时限制使用的。本初步设计有不少 C 形曲线如下所列，建议进行优化，并予以修改设计。

(1) K0+730～K0+900，JD6-JD7，

(2) K4+400～K4+670，JD23-JD24，

(3) K6+580～K6+890，JD37-JD38，

(4) K7+040～K7+540，JD41-JD42-JD43-JD44，

(5) K9+800～K10+040，JD61-JD62，

(6) K11+170～K11+350，JD70-JD71，

(7) K12+620～K12+780，JD79-JD80，

(8) K15+660～K15+830，JD99-JD100，

(9) K17+530～K17+770，JD111-JD112，

(10) K18+320～K18+480，JD115-JD116，

(11) K17+530～K17+770，JD111-JD112，

(12) K18+320～K18+480，JD115-JD116，

(13) K18+510～K18+700，JD117-JD118，

(14) K19+540～K19+770，JD124-JD125，

(15) K20+850～K21+070，JD133-JD134，

(16) K24+330～K24+610，JD149-JD150，

(17) K25+300～K25+850，JD152-JD153，

(18) K26+130～K26+550，JD155-JD156，and

(19) K26+890～K27+440，JD158-JD159-JD160.

DI Feedback/设计单位反馈意见：

6. C-Shaped curves will be optimized on sections with agreeable topographic conditions. On sections with tough terrains, some of C-Shaped curves will be remained, but safety enhancement measures on these sections will be introduced in order to ensure road safety.

根据亚行专家意见，结合现场的实际情况，在地形条件允许，工程量增加不大的情况下， C 形曲线可以优化，但如果地形条件困难，工程量大，优化难度较大时，规范要求 “C 形曲线仅限于地形条件特殊困难，路线严格受限制时方可采用。”所以局部可以设置 C 形曲线，加大安保措施，确保行车安全。

7. The start chainage and the end chainage of this Project are From K0+000 to K34+800.507. There is a broken chainage on the Pre-Design located at K24+026.820, which equals to the broken chainage of K24+275.027, a shortened chainage of 248.207m, thus resulted of the total length of the Project was 34.553km on the Pre-Design. Two more broken chainages occurred on the Revised Pre-Design, there are shortened chainage of 185.586m (K2+214.020 = K2+399.60), and lengthened chainage of 0.94m (K12+109.074 = K12+108.134). Finally, the total length of the Project becomes 34.368km. To avoid the possible mistake, the elimination of these broken chainages on detailed design is advised.

本项目起终点桩号为 K0+000～K34+800.507。由于初步设计有一处断链，位于 K24+026.820,等于断链桩号 K24+275.027，短链 248.207 米。故造成初步设计的实际长度是 34.553 公里。修改的初步设计又增加了 2 处断链,分别是短链 185.586 米（K2+214.020 = K2+399.606）和长链 0.94 米（K12+109.074 = K12+108.134），造成实际长度又变成 34.368 公里。建议施工图设计时设计桩号宜取消断链，以免误会。

DI Feedback/设计单位反馈意见：

8. Due to the detailed survey has been finished, the elimination of broken chainages could cause confusions on the design documents, so DI suggests of keeping these broken chainages since they don't affect the construction works.

由于本项目施工图已测设完毕，如果取消断链，重新排列桩号，则需要重新放线测设，从而造成大量的重复工作和浪费，在不影响施工的前提下，建议不要取消断链。

9. From K1+460 to K1+880, the design solution is a sequence of bridge-high slope (64m highest)-bridge, the recommendation is to revise the design, reduce the height of the slope.

K1+460～K1+880，设计为 桥—高边坡（最高 64 米）—桥 组合方案，宜优化设计降低高边坡。

DI Feedback/设计单位反馈意见：

10. DI will follow PPTA expert's suggestion on detailed design to revise the horizontal alignment, reduce the cutting and lower the slope height.

根据亚行专家意见，在施工图优化阶段，将调整此处的平面线位，减少边坡的开挖，降低边坡高度。

Detailed Design Result/施工图设计结果：

11. On the detailed design, horizontal alignment has been revised by moving the centerline 15m to the left side, thus reduced the cutting.

施工图平面线位调整，路线最大左移 15 米，总体减少了挖方。

12. The high slope (80m highest) from K22+685 to K22+815 located in the expansive soil area, is advised to lower the slope height. Once the delicate existed slope was cut, the existed planted removed, might cause the stability problem in this unique soil area.

K22+685～K22+815 高边坡（最高 80 米），由于其又处于膨胀土路段，破坏原有边坡易造成边坡稳定问题，可以优化设计降低高边坡，尽量减少对原有植被的破坏。

DI Feedback/设计单位反馈意见：

13. DI will follow PPTA expert's suggestion on detailed design to revise the horizontal alignment, reduce the cutting, lower the slope height and lessen the damage of the existing vegetation.

根据亚行专家意见，在施工图优化阶段，将调整此处的平面线位，减少边坡的开挖，降低边坡高度。

Detailed Design Result/施工图设计结果：

14. On the detailed design, horizontal alignment has been revised by moving the centerline to the left side, thus reduced the cutting and lessened the damage of the existing vegetation.

施工图平面线位调整，路线左移，减少了挖方，减少了对原有植被的破坏。

B. VERTICAL ALIGNMENT DESIGN/纵断面设计

15. The vertical curve of R-90000 at K25+000 should be canceled. In fact, it couldn't be done.

K25+000 处 R-90000 的竖曲线应取消，实际上不可能实施。

DI Feedback/设计单位反馈意见：

16. DI will follow PPTA expert's suggestion on detailed design to cancel this vertical curve.

根据亚行专家意见，在施工图优化阶段，取消此处变坡点。

Detailed Design Result/施工图设计结果：

17. On the detailed design this vertical curve has been canceled.

施工图已取消此变坡点。

18. At the bottom of the vertical curve at K32+400, additional culvert should be installed to accommodate the water flow.

K32+400 处的竖曲线底部附近应增加一道涵洞以便排水。

DI Feedback/设计单位反馈意见：

19. DI will follow PPTA expert's suggestion on detailed design to conduct a thorough site investigation, add a culvert if it is necessary.

根据亚行专家意见，施工图优化外业详细调查，如排水不畅，需要补充，根据专家意见，增加一道涵洞。

Detailed Design Result/施工图设计结果：

20. The detailed design adds a 1-2m slab culvert.

施工图增加一道 1-2m 盖板涵。

C. CROSS-SECTION DESIGN/横断面设计

21. The section from K11+797 to K12+003, the Pre-Design solution was an additional half Cross-Section bridge to increase the width of the road. The revised Pre-Design is to maintain existed road of 7.5m in width following the panel review comments, with the transition sections of 20m at both ends connecting with the 8.5m of normal design width. Since this is a short section, 200m in length only, the narrowing and widening cross-section in this short distance might cause safety problem, so additional engineering measures are advised to accommodate the 8.5m of normal design width, or maintain the Pre-Designed half Cross-Section bridge which is a bit far away from the paralleled railway line, much safe and give much more leeway for the road, while install fences on both sides of the new bridge in avoidance of overtaking traffic to protect the existed earth retaining walls. If the option is still maintaining the 7.5m width of existed road, the suggestion is to make the section longer, at least several kilometers, where the transition sections are clearer in sight distance at both ends, and enough traffic warning signs should be installed.

K11+797～K12+003 路段，初步设计为加设半幅 10×20 米桑树沟桥以增加路基宽度，而修改的初步设计根据专家的审查意见改为维持老路的 7.5 米路基，并在两端各设置 20 米的过渡段与 8.5 米路基衔接。由于此路段仅有 200 米，短距离内变窄又变宽，容易造成安全隐患，建议采取工程

措施,将路基宽度维持在标准设计的 8.5 米，或维持加设半幅的桥梁设计（离铁路较远，更安全，更有富余路宽），并保留两侧的桥梁护栏，避免此处超车损坏原挡土墙。若仍需采用 7.5 米的路基总宽，建议路段加长，至少总长在几公里，在两端选择视野距开阔的路段提前变宽，并设计足够警示标志。

DI Feedback/设计单位反馈意见：

22. The Pre-Design has thorough analysis on this situation and the solution has been approved by SPDT. The Pre-Design solution will be remained, but the additional safety measures will be introduced and enough transition lengths for the changing of cross-section width will be ensured.

K11+800～K12+000 段，初步设计阶段已对此段进行了充分论证，增加了纵向桥，为解决此段交通瓶颈，但根据初步设计审查意见及初步设计批复【陕交函【2013】953 号】“鉴于 K11+800～K12+000 临河路段右侧受襄渝铁路影响无法加宽，左侧设置半幅纵向桥加宽方案存在桥梁与路基横向连接问题且工程规模大，原则同意此路段维持旧路宽度 7.5 米的设计方案，做好路基宽度过渡和交通安全设施”。施工图设计阶段依据初设批复，此路段维持现状，同时结合亚行专家意见，加大安保工程，同时做好路基宽度的过渡。

D. SIGHTSEEING PLATFORM/绿化景点

23. The Pre-Design has 7 Sightseeing Platforms along the Hanjiang River, among them, two are going to utilize the existed facilities and the land, and five out of seven will be newly built. Without the median divider in this Class II highway, the vehicles and passengers on the mountain side lane need to cross the road, causing the traffic weavings thus potential safety issues would occur. Sufficient safety measures should be considered, or might cancel some of them with short intervals.

本项目沿汉江设计了 7 处观景台，其中 2 处利用原有设施，5 处新建。由于二级路没有中央分隔带，这些路段山体一侧的车辆和乘客，要横跨公路，造成车辆、乘客交织，容易造成安全遗患，应采取足够的安全保障措施，或将相距较近的酌情取消。

DI Feedback/设计单位反馈意见：

24. DI will follow PPTA expert’s suggestion to avoid the potential safety problems on these locations, change the theme from Sightseeing Platforms to landscaping greeneries only, and install with No-Parking Traffic Signs on these sections.

根据亚行专家意见，为了减少安全隐患，保证道路的通畅，7 处观景平台改为绿化景点，严禁车辆停靠。

Detailed Design Result/施工图设计结果：

25. Landscaping greeneries have been reduced to 4 places on the detailed design.

施工图最终确定绿化景点为 4 处。

E. ADDITIONAL COMMENTS UPON THE FIELD SURVEY/考察后的附加意见

26. During the field survey, PPTA experts discussed the practice of pavement recycling in Shaanxi province with the DI and the local authorities, encourage the DI to consider pavement recycling options on the detailed design.

现场考察期间，PPTA 专家和设计单位和地方当局讨论了路面再生利用情况，鼓励设计单位在施工图设计时考虑路面再生利用方案。

III. S102 XUNYANG TO XIAOHE CLASS II HIGHWAY UPGRADING

A. HORIZONTAL ALIGNMENT DESIGN/平面线形设计

27. This upgrading project is going to use the existed alignment before K17+369, which was upgraded in 1999. This approach is suitable under current condition, but there is a curve with the radius of 82m at K14, that is smaller than the minimum radius 0f 125m for the design speed 60 km/h stipulated on the current Specification. So, further research on the alignment improvement around this curve area is advised.

本项目改建在 K17+369 之前完全利用 1999 年改建的原有线位，在现况条件下是合理的，但存在一处 K14 附近的半径仅 82 米（小于规范规定 60 公里/小时的极限最小半径 125 米）的平曲线，应研究分析是否可以改善此处的线形。

DI Feedback/设计单位反馈意见：

28. DI will take PPTA expert's suggestions into consideration on detailed design, further analyze the possible options.

K14 附近的半径仅 82 米的平曲线，在初步设计阶段经反复论证，如果采用 125 米的满足规范的极限最小半径，需要开挖山体，同时拆迁 3 户 3 层楼房和山顶的移动塔及电塔，经造价比较和施工难度论证后，与旬阳县交通运输局沟通，结合咨询公司专家意见，建议维持旧路 82 米的平曲线半径，如果需要调整，我们将结合亚行专家意见，在施工图优化阶段，将进一步做方案比较。

29. From K28+770 to K29+040, there are two tight curves with the radius of 125m and 94m respectively, and at K30+160 (JD81) there is a small curve with 80m radius, the alignment improvements for these curves are also advised.

K28+770～K29+040 两处小半径曲线分别为 125 米和 94 米，K30+160(JD81)小半径曲线 80 米，宜优化改善。

DI Feedback/设计单位反馈意见：

30. Due to the difficult topographic conditions in these sections, Pre-Design solutions of maintaining existing alignments in these sections have been approved by SPDT. So DI suggests the horizontal alignments would not be changed.

根据初步设计的批复（陕交函【2013】954 号），大岭水库段（K27+600～K30+200）2.6 公里，一侧为库区，一侧为陡峭松散的山体，路基加宽困难，原则上不得采用开挖山体拓宽路基的方案，路基维持原有旧路，采用 7.5 米宽度，K28+770～K29+040 两处小半径曲线分别为 125 米和 94 米，K30+160(JD81)小半径曲线 80 米，满足现有旧路状况，所以建议维持旧路指标。

31. C-Shaped curves are strictly limited to be used conditionally under the difficult terrains according the Specification. The Pre-Design has many C-Shaped curves as following. Recommendations are given to have optimizations on these curves and to revise these designs.

C 形曲线，属规范在地形特殊困难时限制使用的。本初步设计有不少 C 形曲线如下所列，建议进行优化，并予以修改设计。

(1) K19+800～K20+220， JD52-JD53，

(2) K31+220～K31+740， JD84-JD85，and

(3) K48+400～K48+690， JD136-JD137.

DI Feedback/设计单位反馈意见：

32. C-Shaped curves will be optimized on sections with agreeable topographic conditions. On sections with tough terrains, such as from K40+900～K49+300, some C-Shaped curves will be remained, but safety enhancement measures on these sections will be introduced in order to ensure road safety.

根据亚行专家意见，结合现场的实际情况，在地形条件允许，工程量增加不大的情况下， C 形曲线可以优化为卵形曲线，但如果地形条件困难，工程量巨大，优化难度较大时，根据初步设计批复（陕交函【2013】954 号），范家庄至两河关段（K40+900～K49+300）8.4 公里，一侧临河，一侧为陡峭松散的山体，路基加宽困难，原则上不得采用开挖山体拓宽路基的方案，路基维持原有旧路，采用 8.5 米宽度，规范要求 “C 形曲线仅限于地形条件特殊困难，路线严格受限制时方可采用。”所以局部可以设置 C 形曲线，加大安保措施，确保行车安全。

33. The start chainage and the end chainage of this Project are From K0+000 to K60+500. There are three broken chainages on the Pre-Design, thus resulted of the total length of the Project is 60.488km. To avoid the possible mistake, the elimination of these broken chainages on detailed design is advised.

本项目终点桩号为 K60+500,由于初步设计有 3 处断链，造成实际长度 60.488 公里。建议施工图设计时设计桩号宜取消断链，以免误会。

DI Feedback/设计单位反馈意见：

34. Due to the detailed survey has been finished, the elimination of broken chainages could cause confusions on the design documents, so DI suggests of keeping these broken chainages since they don’t affect the construction works.

由于本项目施工图已测设完毕，如果取消断链，重新排列桩号，则需要重新放线测设，从而造成大量的重复工作和浪费，在不影响施工的前提下，建议不要取消断链。

B. PAVEMENT STRUCTURE/路面结构

35. According to the traffic forecast on the FSRs, the traffic volumes are predicted at the amount of 12008 AADT in 2030 of G316 Xunyang to Ankang Class II Highway, and 7927 AADT in 2033 of S102 Xunyang to Xiaohe Class II Highway respectively. While the designed pavement structures are: 4cm asphalt concrete (AC-16) + 5cm asphalt concrete (AC-20) + 20cm cement treated crushed stone + 20cm cement treated sand gravel for G316 Xunyang to Ankang Class II Highway, 49cm in total thickness, and 4cm asphalt concrete (AC-16) + 5cm asphalt concrete (AC-20) + 32cm cement treated crushed stone + 18cm cement treated sand gravel, 59cm in total thickness for S102 Xunyang to Xiaohe Class II Highway respectively. That means with much less traffic volume predicted for the S102 Xunyang to Xiaohe Class II Highway than G316 Xunyang to Ankang Class II Highway, the pavement structure designed for this Project is much thicker, a bit unrealistic.

根据《工可》交通量预测，国道 316 旬阳至安康二级公路改建：2030 年：12008 辆/日。预测 2030 年小客车占 37%、中货 9%、大货 22%。省道 102 旬阳至小河二级公路改建：2033 年：7927 辆/日。预测 2033 年客车占 41.4%、货车 58.6%。两项目设计的路面结构为：国道 316 旬阳至安康二级公路改建：4(AC-16)+5(AC-20)+20(水稳碎石)+20(水稳砂砾)=49cm。省道 102 旬阳

至小河二级公路改建：4(AC-16)+5(AC-20)+32(水稳碎石)+18(水稳砂砾)=59cm。也就是说，本项目的预测交通量比国道 316 旬阳至安康项目小得多，路面结构确较厚，不是很合理。

DI Feedback/设计单位反馈意见：

36. Pre-Design pavement structures are: 4cm asphalt concrete (AC-13) + 5cm asphalt concrete (AC-16) + 32cm cement treated crushed stone + 20cm cement treated sand gravel, 61cm in total thickness for S102 Xunyang to Xiaohe Class II Highway. During the panel review of the Pre-Design, the pavement structures have been optimized as 4cm asphalt concrete (AC-16) + 5cm asphalt concrete (AC-20) + 22cm cement treated crushed stone + 20cm cement treated sand gravel, 51cm in total thickness. Finally, SPDT approved pavement structures are: 4cm asphalt concrete (AC-16) + 5cm asphalt concrete (AC-20) + 20cm cement treated crushed stone + 20cm cement treated sand gravel, 49cm in total thickness, which the detailed design will apply.

省道 102 旬阳至小河二级公路工程，初步设计路面结构层为：4(AC-13)+5(AC-16)+32(水稳碎石)+20(水稳砂砾)=61cm，初步设计评审阶段，按专家意见对路面结构层进行了优化调整,调整后结构层为：4(AC-16)+5(AC-20)+22(水稳碎石)+20(水稳砂砾)=51cm，初步设计批复（陕交函【2013】954 号）路面结构层为：4(AC-16)+5(AC-20)+20(水稳碎石)+20(水稳砂砾)=49cm，施工图阶段按初设批复执行。

C. ADDITIONAL COMMENTS UPON THE FIELD SURVEY/考察后的附加意见

37. The site investigation finds out that the small curve with the radius of 82m at K14 causes the sharp turning and insufficient sight distance. It is possible to enlarge the curve according to the topographic condition. So the improvement on the horizontal alignments around this curve is advised for the detailed design.

现场考察观察到 K14 的小半径曲线造成明显急转弯和视距不足。地形考察认为加大此处的平曲线半径是有可能的。建议设计单位在施工图设计时考虑改善此处的平曲线线形。

Detailed Design Result/施工图设计结果：

38. The proposed change will need to demolish a high tension tower and deep cutting of expansive soil, so the detailed design retain the existing alignment.

若将其半径改至 125 米则将拆除高压电塔一处，且改线处为膨胀土深挖方，中桩最大挖深为 25 米，工程量巨大，与建设单位沟通后，该处沿旧路布线。

39. Due to unstable slope From K28+770 to K29+040, two tight curves with the radii of 125m and 94m respectively in this section may remain, but the improvement could be made at K30+260 where there is a small curve with 80m radius, at least to improve the sight distance.

K28+770～K29+040 两处半径 125 米和 94 米现场观察有滑塌，边坡不稳定，可以维持原线位不动。但 K30+160 半径 80 米的曲线，有可能加以改善，建议研究处理，至少应改善此处的视距。

Detailed Design Result/施工图设计结果：

40. There are houses on the left side of K30+160, the proposed change will need to demolish the houses and deep cutting, so the detailed design retain the existing alignment.

K30+160 处路线左侧有房屋，且该段为大岭水库段地质灾害较多，若改善该处线形，会增加拆迁，并且会开挖左侧山体，不易处理，维持旧路。

41. Some sections the existing alignments are good, but the realignments on the Pre-Design will encroach upon Xunhe River channel, such as From K44+400 to K44+700, K50+400 to K51+800 and K58+000 to K59+200. The advices given for the detailed design are less encroachment on the riverbed or no encroachment at all by using the existing road alignments.

有些路段原有线位的线形还是可以的，初步设计的改线线位将占压旬河河道，如路段 K44+400-K44+700，K50+400-K51+800 和 K58+000-K59+200。建议在施工图阶段予以研究优化，尽量少占压河道，或利用老路线形不占河道为宜。

Detailed Design Result/施工图设计结果：

42. The alignment from K44+400 to K44+700 has been improved by using the existing road to avoid the encroachment of the river channel; from K58+000 to K59+200 is going to reuse the existing road too to avoid the encroachment of the river channel.

K44+400-K44+700 已改善线形，靠近山体，不占用河道；K58+000-K59+200 已改用老路，不占用河道。

43. There are some at-grade intersections with small intersection angles in the vicinities close to tunnels that are going to be newly built according to the Pre-Design. They will cause safety problems. The advices are to cancel those unnecessary at-grade intersections very close to the tunnel ends or merge them.

改线后的隧道口附近与老路相交的小转角平交口应注意安全设计，没必要的平交尽量取消或合并。

44. From K59+787 to K59+811, there is a landslide area close to the tunnel to be built. The Pre-Design treatment for the slope protection is five anti-slide pilings in single row. The strengthening treatments such as unloading the loose soil above the slope and/or multi-row pilings are advised to protect the tunnel and the slope.

K59+787～K59+811 滑坡，初步设计采用单排 5 根抗滑桩处理。由于处于隧道口，建议应加大处理力度，如卸载、采用多排桩等措施。

Detailed Design Result/施工图设计结果：

45. According to the detailed survey results, the soil here is stable, so the protection work here will be the earth retaining wall.

根据详测结果，此处残留土方现状稳定，设计中考虑采用挡墙进行防护。

IV. S224 SHANGNAN TO WEIJIATAI CLASS II HIGHWAY UPGRADING

A. HORIZONTAL ALIGNMENT DESIGN/平面线形设计

46. To use the right of way of existed roads as much as possible for the highway upgrading projects, the curves with small intersection angles may occur practically, but the current “Design Specification of Highway Alignment” (JTG D20-2006) has the minimum length requirements on the curves with less than 7°intersection angles. The requirements are minimum lengths of 700/△ (angles measured in degree) and 500/△ with the design speeds of 60 km/h and 40 km/h respectively. This Project the design speed from K0+000～K9+500is 60km/h, other sections the design speed is 40 km/h. This Project has some curves with less than 7°intersection angles, among them there is one curve with less than 7° intersection angle at intersection point 8 (near K5+800) that cannot meet the minimum length requirement. The design revision on this curve should be done to follow the Specifications. The design optimizations are advised on other curves in this category, or might cancel the curves if they don’t cause significant increases on the bills of quantities.

公路改建工程为尽量利用老路，可能有小转角的曲线产生，但规范对小于 7° 的平曲线有最小长度要求，分别为 60 公里/小时车速时不小于 700/△（转角值以度计），和 40 公里/小时车速时不小于 500/△。本项目 K0+000～K9+500 设计车速为 60 公里/小时，其余路段为 40 公里/小时。本项目有一些小于 7° 的平曲线，其中最小长度不满足此规范要求有 JD8(K5+800 附近)，建议修改，其它此类小半径曲线宜优化设计，或在工程量增加不大的情况下宜取消。

DI Feedback/设计单位反馈意见：

47. The curve of JD8 has been changed to the radius of 1529.898, 143.938m in length, which meets the minimum length requirement stipulated on the Specifications. Other curves in this category have been canceled if they don't cause significant increases on the bills of quantities.

答复：JD8 初步设计中曲线半径 1500 米，偏角 5° ，长度 127.149 米，不满足 60 公里/小时车速时不小于 700/△的要求。此次设计中半径已优化修改为 1529.898 米，长度 143.938 米，满足规范要求。其他小偏角曲线位于 40 公里/小时车速的路段，曲线长度均满足不小于 500/△的规范要求。部分小偏角曲线在本次设计修改中，在工程量增加不大的情况下已取消设置。

48. C-Shaped curves are strictly limited to be used conditionally under the difficult terrains according the Specification. The Pre-Design has many C-Shaped curves as following. Recommendations are given to have optimizations on these curves and to revise these designs.

C 形曲线，属规范在地形特殊困难时限制使用的。本初步设计有不少 C 形曲线如下所列，建议进行优化，并予以修改设计。

(1) K18+210～K18+450, JD65-JD66，

(2) K19+690～K19+950, JD73-JD74，

(3) K22+220～K22+480, JD89-JD90，

(4) K23+340～K23+570, JD98-JD99，

(5) K25+960～K26+060, JD114-JD115，

(6) K28+140～K28+430, JD125-JD126，

(7) K29+080～K29+520, JD130-JD131，

(8) K30+620～K31+050, JD135-JD136，

(9) K36+990～K37+380, JD169-JD170-JD171，

(10) K40+630～K40+890, JD189-JD190,

(11) K41+490～K41+800, JD194-JD195,

(12) K42+070～K42+330, JD198-JD199,

(13) K44+060～K44+490, JD208-JD209-JD210，

(14) K44+550～K44+790, JD211-JD212,

(15) K45+000～K45+260, JD214-JD215,

(16) K46+200～K46+250, JD222-JD223,

(17) K46+470～K46+820, JD224-JD225-JD226，

(18) K46+940～K47+160, JD228-JD229,

(19) K48+290～K48+600, JD236-JD237,

(20) K51+020～K51+300, JD251-JD252,

(21) K52+850～K53+110, JD264-JD265, and

(22) K53+790～K54+020, JD269-JD270.

DI Feedback/设计单位反馈意见：

49. Based on the agreeable topographic conditions, most of these C-Shaped curves have been optimized to be a single curve, or a compound curve. However, there are 4 places the C-Shaped curves would be remained due to difficult conditions, such as (1) and (22) are to avoid the big amount of resettlements, (2) is to avoid the deep cutting, and (16) is due to the big increase of the bills of quantities.

答复：本次设计根据地形条件，在不过大增加工程量的前提下，对初步设计线形进行了优化。上述曲线中(3)、 (4) 、(5) 、(6)、 (7)、 (15) 、(20) 、(21)八 处 C 形曲线，已合并修改为单圆曲线，(8) (10) (11) (12) (13) (14) (18) (19) 八处 C 形曲线，已优化线形为卵形曲线，（9）处 JD170-JD171 已合并为单圆曲线，和 JD169 优化为卵形曲线。（17）处 JD225-JD226 已合并为单圆曲线，和 JD224 优化为卵形曲线。上述曲线中有四处由于地形条件和工程量大小限制，C 形曲线不宜取消，其中(1)、 (22)两处位于过村镇段，C 形曲线若合并，会导致拆迁量大，(2)处 C 形曲线受地形限制，右侧山体较高，合并后开挖山体工程量大。(16)处 C 形曲线受地形限制，左侧山体太高，右侧沟深 15 米，山高沟深合并后工程量太大。

50. The Specifications allow hairpin curves on Class III and Class IV highways. Usually, hairpin curves are avoided on above Class II highways. This Project has 3 hairpin curves on the sections between K10～K10+150, K20+380～K20+500 and K21+290～K21+430 with around 30m radius, which is equivalent to the minimum radius for 30 km/h design speed. Among them, the gradients on former two curves reached 7%, which cannot meet the 3.5% minimum required on the hairpin curves. So, the alignments in these sections are better to be revised to avoid hairpin curves as possible.

规范规定三、四级路可采用回头曲线。通常二级以上公路原则上应避免设置回头曲线。本项目在 K10～K10+150 路段、K20+380～K20+500 和 K21+290～K21+430 设置了三处约 30 米极限半径的回头曲线，相当于设计时速为 30 公里/小时的极限半径，而前 2 处纵坡达到约 7%，不满足规范规定的回头曲线 3.5%的极限纵坡要求，宜优化调整这些路段的平面线性，尽量避免设置回头曲线。

DI Feedback/设计单位反馈意见：

51. Due to the difficult topographic conditions, these three hairpin curves are unavoidable. The improvement will be made to ensure the gradients below 3%.

答复：受地形条件限制，本项目 K8+200 以后路段设计速度 40km/h，越岭段为争取设置隧道的平纵向有利位置，克服高差，无法避免使用回头曲线进行展线，本次修改做好平纵组合设计，并保证回头曲线段纵坡不大于 3%，满足规范要求。

Detailed Design Result/施工图设计结果：

52. The radii of the hairpin curves from K20+380 to K20+500 and from K21+290 to K21+430 have been enlarged to 40m.

K20+380～K20+500 和 K21+290～K21+430 段回头曲线半径已增大到 40m。

53. From K45+300 to K45+400 (JD216), the Pre-Designed radius of 30m only meets the minimum radius requirement for 30 km/h design speed stipulated on the Specifications. The

minimum radius for the design speed of 40 km/h is 60m. So, the recommendation is to build a short tunnel or to cut through the hill. In this way, the curve radius on both side get improved as well.

K45+300～K45+400 (JD216) 附近的 30 米的半径仅满足规范规定的 30 公里/小时设计车速的极限半径，40 公里/小时设计车速的极限半径应为 60 米，建议此处采用短隧道通过，同时，两侧的曲线半径也会得到改善。

DI Feedback/设计单位反馈意见：

54. The comment accepted. The DI will revise the design to have a tunnel here and improve the horizontal alignments as well.

答复：此处山体岩体完整性及稳定性良好，适合做短隧道通过，此次设计采纳建议，调整线形通过设置短隧道穿过山体，同时改善前后平面线形。

55. The Pre-Design has other curves with radii in less than the minimum of 60m. They are K32+265(JD143)R=44, K41+509(JD194)R=47, K44+806(JD212)R=40, K49+722(JD243)R=47, K51+838-K51+943-K52+045(JD256,257,258) three curves of about R=40, and K52+621(JD263)R=43. The design improvements on these curves are advised.

本项目初步设计小于极限最小半径 60 米的还有 K32+265(JD143)R=44，K41+509(JD194)R=47，K44+806(JD212)R=40，K49+722(JD243)R=47，K51+838-K51+943-K52+045(JD256,257,258)三处 R 大约均为 40，和 K52+621(JD263)R=43 等处，宜尽量改善这些曲线的设计。

DI Feedback/设计单位反馈意见：

56. The Pre-Design has 13 curves with radii in less than the minimum of 60m, 8 of them have been revised to the radii of above 60m. Due to the difficult topographic conditions, 5 of them will be remained with radii of less than 60m although they will get slight improvements.

答复：全线小于极限半径 60 米的，初步设计中有 13 处，分别为(1) K20+053.560 处 R=57.71839、(2) K20+658.297 处 R=41.25541、(3) K21+243.718 处 R=39.50973、(4) K32+265.003 处 R=44.15398、(5) K41+509.546 处 R=47.25606、(6) K44+806.074 处 R=40、(7) K45+511.677 处 R=30、(8) K45+481.819 处 R=43.45572、(9) K49+722.142 处 R=47.18887、(10) K51+838.333 处 R=41.44313、(11) K51+943.171 处 R=40、(12) K52+045.369 处 R=40.35618、(13) K52+785.641 处 R=43.43625。

本次设计根据地形条件，在不过多增加工程量的前提下，对上述曲线的平面线形进行优化改善。其中(1)、(3)、(4)、(6)、(7)、(8)、(9)、(12)八处曲线半径都已得到优化，满足规范极限半径 60 米的要求。部分曲线由于地形条件限制，通过优化无法达到规范极限半径 60 米的要求。其中(2)处曲线偏角大、相邻曲线距离短、山体高，曲线半径受地形条件限制无法达到半径 60 米。(5)处曲线内侧山体过高，相邻曲线距离短，本次设计将曲线半径增大到 50.721，受地形条件限制无法达到半径 60 米。(10) (11)处为 W 形弯道，沟道两侧山体高大，沟道狭窄，受地形条件限制无法满足规范 60 米。(13)处曲线偏角大、相邻曲线距离短、山高沟窄，曲线半径受地形条件限制无法达到半径 60 米，本次改善线形 R 增大到 52.445。

B. CROSS-SECTION DESIGN/横断面设计

57. There are continuously 7% maximum gradients on sections from K8+600 to K10+890, and from K24+147 to K26+470. In case of necessity, the additional climbing lane uphill and emergency parking lane downhill should be considered.

K8+600～K10+890 双庙岭 1 号隧道连续极限 7%的纵坡，K24+147 白蛇沟隧道～K26+470 连续极限 7%的纵坡，应研究分析是否设置爬坡车道和避险车道。

DI Feedback/设计单位反馈意见：

58. Due to the heavy mountain conditions, it is difficult to have additional climbing lane or emergency parking lane on this highway. But for the road safety, the traffic safety measures will be strengthened.

答复：受地形条件限制，该路段山高沟窄，不具备设置爬坡车道及避险车道的条件，为保证行车安全，本次加强交通安全设施的设计。

Detailed Design Result/施工图设计结果：

59. The emergency lay-by has been designed from K9+270 to K9+382.120, and the additional climbing lane has been designed from K24+652.936 to K25+330.415.

在 K9+270～K9+382.120 段右侧设置了紧急停车带。在 K24+652.936～K25+330.415 段左侧设置了爬坡车道。

C. PAVEMENT STRUCTURE/路面结构

60. According to the “Pavement Structure Drawing”, pavement structures in the sections from K0～K39+600 is 4cm asphalt concrete + 5cm asphalt concrete + 20cm cement treated crushed stone + 20cm cement treated sand gravel, 49cm in total thickness, and from K39+600～K54+483 is 3cm asphalt concrete + 4cm asphalt concrete + 20cm cement treated crushed stone + 20cm cement treated sand gravel, 47cm in total thickness. But the general design description only mentioned one structure, the former one. It needs to be clarified.

根据《路面结构设计图（一）》， K0～K39+600 路段区间路面结构为：新建路面 4+5+20+20=49 厘米，旧路补强为 4+5+20=29 厘米；而 K39+600～K54+483 路段区间路面结构为：3+4+20+20=47 厘米，旧路补强为 3+4+20=27 厘米。设计总说明中只有一种路面结构，请澄清。（根据《工可》的交通量预测结果，2036 年从马蹄店至魏家台三段预测交通量相差不大，从 8884～8190 递减，重车比例也相差不大，宜采用同一路面结构厚度）

DI Feedback/设计单位反馈意见：

61. Based on the approval paper given by SPTD, the pavement structures and the bills of quantities have been revised accordingly.

答复：根据交通厅关于初步设计的批复，应结合路段交通量情况，进一步分段研究确定路面结构层设计。故初步设计修改中按照批复要求，对路面结构图和相应工程量进行了修改。

D. ADDITIONAL COMMENTS UPON THE FIELD SURVEY/考察后的附加意见

62. In Qingshan Town around K16+300, the existing street is 14.5m in width, while the upgrading design width is 12m. So within this township area, outside the 12m design width, additional pedestrian lane pavement is advised.

在青山镇（桩号 K16+300）附近，老路的街道宽度是 14.5 米，新改建设计的路面宽度只有 12 米，因此建议在青山镇街道范围内，在设计宽度之外剩余的街道路面铺筑人行道。

63. The site investigation reveals that it is possible to improve the hairpin curve alignment from K20+200 to K20+700, so the improvement on the detailed design is suggested.

通过现场考察认为，K20+200-K20+700 处的回头曲线有可能加以改善，建议在施工图阶段优化此处的平面线形。

Detailed Design Result/施工图设计结果：

64. The curve radius has been enlarged to 40m.

该段回头曲线半径已增大到 40m。

65. The field survey discussed the possible improvement on the hairpin curve alignment from K21+200 to K21+600 by realigning the route to the opposite side of the creek. The detailed design will analyze this option.

通过现场考察认为，K21+200-K21+600 处的回头曲线有可能在河沟对面侧布设线形加以改善，建议在施工图阶段优化此处的平面线形。

Detailed Design Result/施工图设计结果：

66. The curve radius has been enlarged to 40m.

该段回头曲线半径已增大到 40m。

67. Some sections in difficult terrains, for instance the section from K52+680 to K53+500, could apply the narrow cross-section in total width of 8.5m in order to avoid the encroachment on the river channels.

某些困难路段，如 K52+680-K53+500 路段的弯道改建，可以采用较窄的 8.5 米的路基宽度，以少占用河道为宜。

68. From k54+483 to the Shaan'e Border, the existing road pavement conditions are poor. To have overall benefit and completed function, this remaining section should better have upgrading or rehabilitation plans correspondently.

K54+483-陕鄂界，现场考察发现路面状况较差。为发挥整条道路的总体功能效益，此剩余路段宜有相应的改建或大修计划。

69. The observation reveals that there are traverse cracks in regular sequence on the newly built pavement of the road linking with this road section in Hubei Province. So the detailed design and construction should pay attention on the avoidance of this kind pavement damage on this road upgrading.

通过观察此路连接的湖北段改建后的路面状况，发现有规则的横向裂缝多，故建议本路段的施工图设计和施工应注意避免类似的路面损坏产生。

Appendix E

附件九

Engineering Summary of Component 2

子项目 E 工程概况

Table of contents/目录

I. INTRODUCTION/序言

1. Based on the review of Detailed Design Documents, ADB “SHAANXI MOUNTAIN ROAD SAFETY DEMONSTRATION PROJECT” PPTA Team summarizes the following engineering features.

基于施工图设计文件的审查，亚行“陕西山区公路安全示范项目”PPTA 技术援助组概括了以下工程概况。

2. Component 2 includes 8 rural roads. Among them, four roads located in Xunyang County, Ankang City, three roads located in Hanbin District, Ankang City; and one road located in Shangnan County, Shangluo City. The total length of the Component 2 Rural Roads will be 139.656km after the upgrading. The following map shows rural road No.1 to No.7 in Ankang City.

子项目 2 包括 8 条农村公路。其中，位于安康市旬阳县 4 条路，汉滨区 3 条路；商洛市商南县 1 条。子项目 2 农村公路改建后总长为 139.656 公里。下图显示安康市的序列 1 到 7 的农村公路。

亚行贷款陕西山区道路安全示范项目示意图

3. General Information of Rural Road Subcomponent is described as following table:

农村公路子项目基本信息一览表如下：

General Information of Rural Road Subcomponent

No.	County or District	Project Name	Project Discription	Detailed Design Length (Km)		Current Conditions			Detailed Design			Detailed Design Budget (10000CNY)	Detailed Design Unit Cost (10000CNY)
				Class Ⅳ	Under Class	Class	Total Width	Pavement Type	Total Width	Pavement Width	Pavement Type		
		Sum		**94.414**	**45.242**							**23535**	**169**
Ⅰ	**Ankang City**			**49.102**	**45.242**							**15761**	
1	Xunyang County	Shuxiao Road Shangma to Xiaohe Section	The Project is a part of X304 Shuhe Town (very close to G316 National Highway) to Xiaohe Town (very close to G065 Expressway) County Road Started at Shangma Village and ended at Xiaohe Town linking with S102 Provincial Road. The section from Shuhe to Shangma has been upgraded and this section is the remaining section.	38.405		Class Ⅳ	4.5-5.5	Asphalt (Partial Cement)	6.5(5.5 from K68+125 to K69+760 and from K78+030 to K79+070)	6(5 from K68+125 to K69+760 and from K78+030 to K79+070)	From K52 to K76+646, 20cm cement concrete+20cm cement stabilized crushed stone+16cm sand gravel; From K76+646 to K90+404, 22cm cement concrete+18cm cement stabilized crushed stone+18cm sand gravel	9177	239
2	Xunyang County	Lijiaba to Baiguo Road	A 7.879Km village road linking between Baiguo Village and the Village Road of Lijiaba to Lvhe Town, including 5.540Km Main Road and 2.339Km Feeder Road From Xiangjiana to Xiefangliang		7.879	Under Class	2.5-4.0	K0—K4+256 Macadam,K4+256—K4+840 Unpaved,K4+840—K5+54 Macadam,Feeder Road K0—K1+660 Macadam,K1+660—K2+336 Unpaved	5(4 from K4+500 to K4+648.7 of main road, from K0+341.4 to K0+453.7 of feeder road)	4.5(3.5 from K4+500 to K4+648.7 of main road, from K0+341.4 to K0+453.7 of feeder road)	18cm cement concrete+18cm aggregate crushed stone	620	79
3	Xunyang County	Beigou to Luojia Road	A 7.253Km village road linking Beigou Village and Luojia Village of Xiaohe Town to X304 Shuxiao County Road, including 6.551Km Main Road and 0.702Km Lijiayazi Feeder Road		7.253	Under Class	3.0-4.0	K0—K5+468 Macadam,K5+468—K6+552 Cement,Feeder Road Macadam	5	4.5	18cm cement concrete+18cm aggregate crushed stone	556	77
4	Xunyang County	Yangpo to Liangheguan Road	A village road linking 5 villages of Yangpo, Qipan, Zhangjiagou, Shuangni and Liangheguan in Xiaohe Town to S102		16.618	Under Class	2.0-5.0	Unpaved	5	4.5	18cm cement concrete+18cm aggregate crushed stone	1235	74
5	Hanbin District	Yanba to Dongqiao Road	A village road linking Yanba Town to S207 Ankang to langao Provincial Highway started at Yanba Town and ended at Dongzigou Bridge in Yinghe Town connected with S207	10.697		Under Class	4.0-6.0	K0—K5+635 Cement,K5+635—K10+697 Macadam	6.5(6 from K6+285 to K6+735 and form K7+300 to K8+335)	6(5.5 from K6+285 to K6+735 and from K7+300 to K8+335)	20cm cement concrete+18cm cement stabilized crushed stone+18cm sand gravel	3003	281
6	Hanbin District	Zaobao to Youshengcun Road	A village road linking Youshengcun to Zaobao Village Road		4.157	Under Class	3.5-4.5	Unpaved	5	4.5	18cm Cement Concrete Slab+16cm Sand Gravel	361	87
7	Hanbin District	Zaobao to Wujiashan Road	A 9.335km village road linking Wujiashan to the Zaobao Village Road, including 4.319km Main Road and 5.016km Tianzhuang Feeder Road		9.335	Under Class	3.5-4.5	Unpaved	5	4.5	18cm Cement Concrete Slab+16cm Sand Gravel	809	87
Ⅱ	**Shangluo City**			**45.312**								**7774**	
8	Shangnan County	Xianghe to Shuigou Road	A village road linking Xianghe Town (linked with S224 Shangnan to Yunxian Provincial Highway) to Shuigou Town started at Xianghe Town and ended at Balipo of Shuigou Town	**45.312**		Class Ⅳ	5.5	K0—K6+300 Asphalt，K6+600—K15+660 Cement，K15+660—K24+850 Asphalt，K24+850—K45+390 Macadam	6.5(5.5 from K6+690 to K16+690)	6(5 from K6+690 to K16+690)	20cm Cement Concrete Slab (24cm From K34+200 to K35+200)+18cm Cement Stabilized Sand Gravel+15cm Sand Gravel	7774	172

4. The following chapters are the engineering summaries of above listed roads from No.1 to No.8.

以下章节是上表所列的第 1 到第 8 条公路的工程概况。

II. NO.1 SHANGMA TO XIAOHE ROAD/1 号上码至小河公路

A. Project Current Situation/项目现况

5. No.1 Shangma to Xiaohe Road is part of X304 Shuxiao Highway. Shuxiao Highway is around 90km in total length, start point linked with G316, end point linked with S102. This project east side starts at K52+000 of X304 Shuxiao Highway, Shangma Village, Hongjun Town, west side ends at K153+776 of S102 Provincial Highway. The upgrading project will be 38.405km in total length, in overall direction from east to west, located in heavy mountainous areas.

旬阳县蜀小公路上码至小河段公路改建工程属 X304 蜀小公路的重要组成部分。蜀小公路全长约 90 公里，起点接 G316，终点接 S102。本项目起点接 X304 原蜀小路 K52+000，东端起点位于红军镇上码村，翻过蔡家岭，途径铁厂村、张良村、新田湾村、康家坪社区、龙王潭村、张家沟村、膀子村，西端止于小河镇街道，与 102 省道 K153+776 处相接。路线全长 38.405 公里。拟改建路段位于旬阳县红军镇和小河镇境内，总体为东西走向，全线位于山岭重丘区。

6. The east section of Shuxiao Highway, which the east side of this project linked with, is under construction, and will be upgraded to Class III highway with 7.5m width of subgrade and 6.9m width of cement concrete pavement. The S102 section linked with the west side of this project, is at design stage, planned to be upgraded to Class II highway with 10m width of subgrade and 9.4m width of asphalt concrete pavement

与本项目东端起点相接的蜀小公路东段正在按照路基宽度 7.5 米、水泥混凝土路面宽度 6.9 米的三级公路实施改建。与本项目西端终点相接的 S102 改建处于勘察设计阶段，计划按路基宽度 10 米，沥青混凝土路面宽度 9.4 米的二级路标准改建。

7. The existing road alignment conditions are as follows:

原有公路路线现况如下：

- From K52+000 to K55+500, the existing road is a valley line along the Zhutong River, the alignments are basically met the Class IV standard. There are 5 sections in gradients of above 8%. The minimum radius is 30m.

  K52+000～K55+500 旧路为沿溪线，沿竹筒河而上，旧路平纵面线形指标基本上满足四级公路技术标准，局部路段坡陡弯急，纵坡大于 8%的路段有五处，最小平曲线半径为 30 米。

- From K55+500 to K59+200 the existing road is a ridge crossing line, crossing over the Caijialin Ridge, in Class IV standard. The uphill section is 2.3km in length with 8 hairpin curves in minimum radius of 6.3m and maximum gradient of 11.7% (the maximum gradient is 12.1% in the whole uphill section). The downhill section is 0.45km in length with 1 hairpin curve in radius of 13.5m and gradient of 4.5%. The minimum radius is 16m and the maximum gradient is 16.2% outside the hairpin curve in the whole downhill section. There are several sections in insufficient sight distances.

K55+500～K59+200 为蔡家岭段，为越岭线，该路段旧路等级为四级公路，分为上岭段和下岭段。上岭段旧路长度约 2.3 公里，共设置有八处回头曲线，且回头曲线路段均未设置缓坡。回头半径分别为 14.6m、6.3m、7.6m、9.3m、7.1m、12m、7.5m、7.3m，回头纵坡分别为 11.7%、6.1%、10.2%、10.7%、7.3%、9.6%、8.8%、9.2%；最大纵坡为 12.1%/110m，平均纵坡为 7.96%。其中有一段连续 1375 米无缓坡，平均纵坡 9.2%。下岭段旧路长度 0.45 公里，共设置一处回头曲线，且回头处纵坡不满足本次改建要求，回头曲线半径为 13.5m，回头处纵坡为 4.5%，该段平曲线最小半径为 16m，连续 500m 无缓坡，最小纵坡 3.1%/100m，最大纵坡 16.2%/50m，平均纵坡为 8.5%。上下岭段平纵面线形组合较差，多处路段不能满足行车视距要求。

- From K59+200 to K89+770, the existing road is a valley line along the Gongguan River, the alignments are basically met the Class IV standard. There are partial sections in small radii and insufficient sigh distances.

K59+200～K89+770 现有旧路为沿溪线，路线基本沿公馆河北岸布线，旧路平面线形指标基本满足四级公路技术标准，局部路段半径较小，视距不良。

- From K89+770 to K90+40 it is the street road in Xiaohe Town with a cluster of buildings in both sides. The existing road is in poor alignment with minimum radius of 15m and maximum gradient of 9.25%.

K89+770～K90+405 段为小河街道，两侧房屋密集，旧路平面线形较差，半径较小，最小半径仅为 15 米，多处坡陡急弯，暗弯较多，纵坡较大，最大纵坡 9.25%。

8. The existing road subgrade and pavement conditions are as follows:

原有公路路基路面现况如下：

- From K52+000 to K76+646, Shangma Village to Kangjiaping Community, the subgrade is 4.5 to 5.5m, pavement 4.0 to 5.0m, 0.25m curb stones in both sides. It is in asphalt pavement with the exceptional 319m cement pavement from K53+859 to K54+178. It was built in 2006 with asphalt pavement structure of 3cm bituminous surface treatment + 18cm cement stabilized gravel base course, or cement pavement structure of 20cm cement concrete slab + 16cm cement stabilized gravel base course. There are so many reflection cracks in the asphalt pavement, potholes in some sections, and uneven subgrade subsidence partially. The cement concrete slabs observed some peelings, surface angularities, and spallings.

K52+000～K76+646 段为上码村至康家坪社区段，路基宽度 4.5～5.5m，路面宽度 4.0～5.0m，两侧 2×0.25m 路边石。除 K53+859～K54+178 段长 319m 为水泥路外，其余旧路均为沥青混凝土路面。该段旧路改建于 2006 年，其中旧水泥路面宽 5.0m，板块尺寸为 2.5×5.5m，路面结构为 20cm 水泥面板+16cm 水稳砂砾，水泥路面面层脱落，骨料

外露，个别板块破碎，平整度较好；沥青路面结构面层为 3cm 沥青表处+18cm 水稳砂砾基层，旧沥青路面反射裂缝较多，个别路段坑槽较多，局部路段出现路基不均匀沉降。

- From K76+646 to K89+760 the existing road was built in 2005 with 4.5 to 5.5m subgrade widths, 4.0 to 5.0 pavement widths and 0.25cm curb stones in both sides. From K76+707 to K77+025 it is Kangjiaping Community street, 6.0m in width of cement concrete pavement with the structure of 20cm cement concrete slab + 18cm cement stabilized gravel base course; the cement concrete pavement is in good conditions in general with only a few of spallings. Other sections are the asphalt pavement with the structure of 3cm bituminous surface treatment + 18cm cement stabilized gravel base course. Due to the heavy load trucks transporting around Hongshiyan Quarry nearby Kangjiaping Community, the existing road was heavily damaged. So many peelings and potholes on the pavement and so much subgrade subsidence.

K76+646～K89+760 段旧路改建于 2005 年，旧沥青路段路基宽度 4.5～5.5m，路面宽度 4.0～5.0m，两侧 2×0.25m 路边石。K76+707～K77+025 段为康家坪社区街道水泥混凝土路面，路面宽度 6.0m，板块尺寸为 4.0×3.0m。旧水泥路面结构为 20cm 水泥面板+18cm 水稳砂砾，整体使用性能较好，个别板块破碎。其余路段为沥青混凝土路面，旧沥青路面结构为：面层为 3cm 沥青表处+18cm 水稳砂砾，由于康家坪社区附近红石岩砂场重车较多，该段旧路整体破损严重，多数面层脱落，坑槽较多，受重车碾压，路基发生不均匀沉降较多。

- From K89+760 to K90+404.953 it is Xiaohe Town Street, built in 1999, cement concrete pavement in widths of 5.5 to 6.0m. The existing road section is in good conditions in general with only a few of spallings.

K89+760～K90+404.953 段为小河镇街道，修建于 1999 年，水泥混凝土路面。路面宽度 5.5～6.0m，K89+760～K89+990 段两块板，板块尺寸为 2.6×6.0m，K89+990～K90+089 段单块板，板块尺寸为 5.5×7.5m，K90+089～K90+404.953 段两块板，板块尺寸为 3.0×6.0m。该段旧路平整度较好，个别板块出现碎裂现象，两侧排水系统完善，整体使用效果较好。

9. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There are 3 bridges in this project, among them, K89+828.09 Xiaohe Large Bridge, 7+2×1.0m in width and 6×20m spans will be reused without any repair; K76+891.6 Xiaoling Medium Bridge, 7.5m+2×0.25m in width and 1×20m span will be reused after repair; K66+347 Zhangliangcun Small Bridge, 6.5m+2×0.5m in width and 1×8m span will be reused after repair.

拟改建项目旧路共设有桥梁 3 座，其中 K89+828.09 小河大桥 1 座，净 7+2×1.0m（人行道护栏），6×20 预应力砼空心板，完全利用；K76+891.6 小岭中桥 1 座，净 7.5m+2×0.25m（护栏），1×20 空腹式石拱桥，修复利用；K66+347 张良村小桥 1 座，净 6.5m+2×0.5m（防撞护栏），1×8 钢筋混凝土空心板，修复利用。

- There are 75 culverts in the existing road; most of them are stone slab culverts in small sizes. There are many damages on both ends of the culverts; so many of them the water flows are blocked.

拟建项目原有涵洞共 75 道，以石板涵为主，进出口损坏较多，且孔径偏小，堵塞现象较为严重。

B. Upgrading Program/改建方案

- The upgrading standard applies for Class IV Highway with Design Speed of 20km/h. In general, the subgrade width will be 6.5m, pavement 6m, 25cm curbs on both sides. From K68+125 to K69+760 and from K78+030 to K79+070 in difficult terrains, apply for 5.5m subgrade and 5m pavement.

本项目按设计速度 20Km/h 的四级公路技术标准改建，一般路段路基宽度 6.5 米，路面宽度 6 米，两侧各 25cm 路边石；K68+125～K69+760 和 K78+030～K79+070 特殊路段，采用路基宽度为 5.5 米，路面宽度 5 米，两侧各 25cm 路边石。

10. The pavement will be cement concrete. From K52 to K76+646, the structure will be 20cm cement concrete slab + 20cm cement stabilized crushed stones + 16cm sand gravel. From K52 to K76+646. There are heavy load trucks transporting around the quarry, the structure will be 22cm cement concrete slab + 18cm cement stabilized crushed stones + 18cm sand gravel.

全线采用水泥混凝土路面，K52—K76+646 路段采用水泥砼面板 20cm + 水泥稳定碎石 20cm + 16cm 天然沙砾，K76+646—K90+405 路段由于康家坪社区附近红石岩砂场重车较多，采用水泥砼面板 22cm + 18cm 水泥稳定碎石 + 18cm 天然沙砾。

11. The upgrading project will reuse existing roadbed of 32.987Km, amounted for 85.9%. The major alignment arrangements are as follows:

项目为旧路改建工程，全线利用现有旧路进行加宽改建，利用旧路 32.987Km，旧路利用率为 85.9%。利用和废弃原有公路的情况如下：

- From K54+420 to K54+510, K60+317 to K60+365, K64+970 to K65+030, K68+980 to K69+030, K70+540 to K77+620, K74+161 to K74+245, K77+280to K77+331 and K80+160～K80+240, 0.543Km in total length, the curves are going to be improved;

以下段落在工程量增加不大的情况下，对原有旧路存在的连续弯或急弯进行了截弯取直，增加交点间距： K54+420～K54+510、K60+317～K60+365、K64+970～K65+030、K68+980～K69+030、K70+540～K77+620、K74+161～K74+245 、K77+280～K77+331 和 K80+160～K80+240 段共计 0.543Km；

- From K54+960 to K59+200, 4.240Km in length, crossing over Caijialing Ridge, due to the existing road alignment don't meet Class IV standards and located in the landslide area, will be realigned; and

路线翻越蔡家岭时，由于旧路平纵面指标不满足四级公路要求，局部处于滑坡路段及尾矿堆积处，本次进行展线降坡、避开不良路段，改走新线，改线范围为 K54+960～K59+200，共计 4.240Km；

- From K89+770 to K90+405, 0.635Km in length of Xiaohe Street, will be reused after minor repair.

小河街道为修复利用段（K89+770～K90+405），共计 0.635Km。

C. Upgrading Scale of Works/改建工程规模

12. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.1 Shangma to Xiaohe Road

1 号上码至小河公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	38.405	
Earth Volume/土方	$1000m^3$	98.924	
Rock Volume/石方	$1000m^3$	164.449	
Drainage/路基排水	$1000m^3$	14.485	Most of M7.5 Mortar Rubble/主要是浆砌片石
Protection/防护	$1000m^3$	22.556+12.803	M7.5 Mortar Rubble+C15 Cement Concrete 浆砌片石+混凝土
Pavement/路面	$1000m^2$	232.466	
Large and Medium Bridge 大中桥梁	m/No.座	155/2	Reused/利用
Small Bridge 小桥	m/No.座	53.28/3	Reuse 1 and Newly build 2 利用 1 座，新建 2 座
Culvert/涵洞	No.道	127	Reuse 8 and Newly build 119 利用 8 道，新建 119 道

III. NO.2 LIJIABA TO BAIGUO ROAD/2 号力加坝至白果公路

A. Project Current Situation/项目现况

13. No.2 Lijiaba to Baiguo Road is located at west Xunyang County, Ankang City, south of Hanjiang River, in heavy mountainous terrain. The project starts at Cian Bridge, Lijiaba of Duanjiahe Town, ends at Taoyuan Village, Baiguoshu, the main road is 5.540km in length. For the villager's transport convenience around these heavy mountainous areas, the program includes a 2.339km feeder road from Xiangjiana at K2+755 of main road, to Xiefangliang. The project is 7.879km in total length.

旬阳县段家河镇力加坝至白果公路改建工程位于安康市旬阳县西部汉江以南，为山岭重丘区沿溪线。拟建项目起于段家河镇力加坝慈安桥桥头，沿烂木沟河向南，经黄家桥村，上跨十天高速庙沟村隧道，终点止于白果树桃园村，路线长度 5.540 公里；为方便歇房梁、大树垭、李家庄、白果树等深山区群众的出行，本次设计在向家那(主线 K2+755 处)设置一条支线，由东北沿烂木沟河支流向西南，终点止于歇房梁，路线长度 2.339 公里。本项目总里程长 7.879 公里。

14. The existing Lijiaba to Baiguo Road is a macadam road with 2.5-4.0m width of subgrade and 2.0-3.0m macadam pavement.

力加坝至白果旧路为砂石路面，路基宽 2.5～4.0 米，路面宽 2.0～3.0 米。

15. The existing road alignment conditions are as follows:

原有公路路线现况如下：

- The existing main road is a valley line in relatively good horizontal alignment; the upgrading program will be one side widening. The average gradient of the existing road is 5.6% with 309m altitude difference between the start point and the end point. There are 4 big gradient sections, K3+000 to K3+115, K3+700 to K3+795, K4+225 to K4+390, and K5+052 to K5+134, in maximum gradient of 15.8%.

  主线旧路为沿溪线，右侧临山左侧临河，旧路平面线形指标较好，基本能满足外延级公路平面指标要求，本次采用单侧加宽，以挖方为主，尽量少占河道，局部挖方工程量较大时，采用临河侧设置防护，减少挖余方数量；旧路纵面较为平缓，起点低终点高，高程差值 309 米，平均纵坡 5.6%；旧路纵面 K3+000～K3+115、K3+700～K3+795、K4+225～K4+390、K5+052～K5+134 四段纵面超标，最大纵坡 15.8%，本次对四段纵面进行适当优化。

- The existing feeder road is also a valley line, but in relatively poor horizontal alignment; the upgrading program will be one side widening including some realignment sections. There are 2 big gradient sections, K0+000 to K0+470 and K0+890 to K1+038, in maximum gradient of 16.4%.

  支线旧路为沿溪(山腰)线，一侧临山一侧临深沟，旧路平面线形指标较差，无法满足外延级公路平面指标要求，本次采用单侧加宽，局部路段截弯取直。旧路纵面 K0+000～K0+470、K0+890 ～ K1+038 两段纵面超标，最大纵坡 16.4% ，本次对两段纵面进行适当优化。

16. The existing road subgrade and pavement conditions are as follows:

原有公路路基路面现况如下：

- The existing main road from K0+000 to K4+256 is a macadam road, 2.5 to 3.5m in total width, partial section the width is 4m after widened in 2009 to serve as the haulage road of Shitian Expressway construction. From K4+256 to K4+840 it is an earth road, 2.5 to 3.5m in total width. From K4+840 to K5+540 it was a temporary

road inside the waste bank of Shitian Expressway construction, a macadam road 3.0m in total width.

旧路 K0+000～K4+256 段为砂石路，原有路基宽度 2.5～3.5 米，2009 年十天高速将该段作为施工便道对局部路段进行拓宽，路基局部宽度达到 4.0 米。该段路基多为临河路基，右侧临山左侧临河，全段无排水设施，临河侧设有部分路肩墙，但结构破坏较为严重，道路纵坡较为平缓，积水严重，在车辆长期碾压下路基出现车辙，局部沉陷；K4+256～K4+840 段旧路为土路，路基宽度为 2.5～3.5，其中 K4+476～K4+529 段现有道路位于十天高速庙沟村隧道进口上方挖方平台，路基宽度严重不足，且右侧下临隧道顶挖方平台截水沟，左侧紧靠锚杆框架格子梁护坡，拓宽空间不足；K4+840～K5+540 段旧路为十天高速弃土场内便道，砂石道路，路基宽度为 3.0 米。

- The existing feeder road from K0+000 to K1+660 is a macadam road, widened to 3.0m in total width in 2012. From K1+660 to K2+336 it was an earth road, built in 1992, 1.5 to 2.0m in total width.

支路 K0+000～K1+660 段为砂石道路，于 2012 年加宽至 3.0 米，无任何排水及防护设施；其中 K0+341.4～K0+453.7 段左侧沟深坎陡，右侧临高挡墙，且顶部有房屋，路基宽度不足且拓宽困难；K1+660～K2+336 段为土路，路基修建于 1992 年，路基宽 1.5～2.0 米，路基局部出现坍塌、沉陷等病害。

17. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There are 7 culverts in the existing main road, 5 of them will be reused.

道路主线旧有涵洞 7 道，其中圆管涵 6 道，石盖板涵 1 道。本次设计利用 5 道，拆除新建 1 道，废除 1 道。

- There are 3 culverts in the existing feeder road, and will be demolished and replaced by new culverts.

支路旧有涵洞 3 道，其中混凝土管涵 2 道，石盖板涵 1 道，全部拆除新建。

- There is no any bridge in the existing roads.

本项目没有桥梁。

B. Upgrading Program/改建方案

18. The upgrading standard applies for Underclass Highway with Design Speed of 15km/h. In general, the subgrade width will be 5m, pavement 4.5m, 25cm curbs on both sides. From main road K4+500 to K4+648.7 and feeder road K0+341.4 to K0+453.7, where the widening is difficult, applies for 4m subgrade and 3.5m pavement.

本项目按设计速度 15Km/h 的山岭重丘区外延级公路技术标准改建，路基宽度 5.0 米，两侧各 0.25m 路边石，采用水泥混凝土路面。局部加宽困难路段(主线 K4+500～K4+648.7、支线 K0+341.4～K0+453.7)，路基宽度采用 4.0 米，路面采用 3.5 米。

19. According to “Shaanxi Provincial Rural Road Technical Standard”, the design program includes passing bays. There will be 8 passing bays in the main road, and 2 in feeder road.

根据《陕西省农村公路技术标准》（陕交发[2005]143 号）相关规定，本次设计增加错车道设计。主线共设错车道 8 处，支线 2 处。

20. The pavement will be cement concrete. The structure will be 18cm cement concrete slab + 18cm aggregate crushed stones, 36cm in total thickness.

路面结构组成为：18cm 水泥混凝土面板 + 18cm 级配碎石基层，路面总厚度 36cm。全线路肩均采用 C20 混凝土加固处理。

21. Major alignment improvements are as follows:

主要线形改善如下：

- The main road alignment will be basically alone the existing road, roadbed widening will be just on one side, partial sections the horizontal alignments will be improved; the vertical alignments from K3+000 to K3+115, K3+700 to K3+795, K4+225to K4+390 and K5+052 to K5+134, four sections aren’t meet the standard, the maximum gradient is 15.8%, will be improved;

设计主线全线基本沿既有旧路布设，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当优化线形；旧路纵面K3+000～K3+115、K3+700～K3+795、K4+225～K4+390、K5+052～K5+134四段纵面超标，最大纵坡15.8%，本次对四段纵面进行适当优化；

- The feeder road alignment will be basically alone the existing road as well, roadbed widening will be just on one side, partial sections the horizontal alignments will be improved; the vertical alignments from K0+000 to K0+470 and from K0+890 to K1+038 aren’t meet the standard, the maximum gradient is 16.4%, will be improved.

支线平面设计基本沿既有旧路布设，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当优化线形；旧路纵面K0+000～K0+470、K0+890～K1+038 两段纵面超标，最大纵坡16.4%，本次对两段纵面进行适当优化。

C. Upgrading Scale of Works/改建工程规模

22. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.2 Lijiaba to Baiguo Road

2 号力加坝至白果公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	7.879	
Earth Volume/土方	1000m^3	4.11	
Rock Volume/石方	1000m^3	9.21	
Drainage/路基排水	1000m^3	0.506	C15 Cement Concrete/C15 混凝土
Protection/防护	1000m^3	0.3	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	35.199	
Bridge/桥梁	m/No.座	-	No Bridge/无桥梁
Culvert/涵洞	No.道	16	Newly Build 7/新建 7 道

IV. NO.3 BEIGOU TO LUOJIA ROAD/3 号北沟至落驾公路

A. Project Current Situation/项目现况

23. No.3 Beigou to Luojia Road is located at north of Xunyang County, Ankang City. The project starts at Beigou Village, Laobeigou, ends at Luojia, the main road is 6.551km in length. In the project area, there is a Temple at the mountain top, west of Lijiayazi, where villagers give prayers. So for the local villager's convenience, the program includes a 0.702km feeder road from Lijiayazi to the Temple. In total, the project is 7.253km in length.

旬阳县小河镇北沟至落驾公路改建工程位于安康市旬阳县北部。拟建项目南起老公馆北沟村，沿催家山南山坡展线爬坡翻越李家垭子，在蹄子沟展线下坡，经寨垭子，然后在桦树砭继续展线下坡，沿落驾河支流向北，终点止于落驾，路线长度 6.551 公里；项目区内李家垭子西侧山顶有一寺庙，该寺庙是当地群众许愿求福的重要场所，为方便当地群众出行，本次另在李家垭子至山顶寺庙间设置一条支线，路线长度 0.702 公里；本项目总里程长 7.253 公里。

24. The existing Beigou to Luojia Road is a macadam road with 3.0-4.0m width of subgrade and 2.0-3.0m macadam pavement.

北沟至落驾旧路为砂石路面，路基宽 3.0～4.0 米，路面宽 2.0～3.0 米。

25. The existing road alignment conditions are as follows:

原有公路路线现况如下：

- Most sections of the existing road are ridge-crossing lines. There are 12 hairpin curves with the minimum radius of 4m.

旧路多为越岭线，平面因山就势，蜿蜒曲折，无线形指标，纵面呈“人”字形，起终点低，中部高，局部纵面起伏变化频繁。旧路局部平面曲线半径小于 4 米，回头曲线半径大多小于 6 米，且纵坡较大，全线回头曲线 12 处。

- From the start point to Lijiayazi, it is a continuously climbing line, with 110m of altitude difference, 10% average gradient, and 16.5% of maximum gradient.

旧路起点至李家垭子段为连续爬坡路段，起终点高程差值 110 米，旧路平均纵坡 10%，局部最大纵坡 16.5%；

- After crossing Lijiayazi Ridge, there is a continuously descending line, 300m in length, with 80m of altitude difference, 13.2% average gradient, and 14.8% of maximum gradient.

旧路翻越李家垭子后，在蹄子沟展线下坡，起终点高程差值 80 米，平均纵坡 13.2%，最大纵坡 14.8%，超限连续坡长 300 米；

- The descending section from Zhaiyazi to Huashubian, the altitude difference is 218m, with 15.4% average gradient, and 22.2% of maximum gradient.

旧路在寨垭子至桦树砭下坡段，起终点高程差值 218 米，平均纵坡 15.4%，最大纵坡 22.2%。

- From Huashubian to the end point of the existing main road, it is in relatively good horizontal alignment, although the vertical alignment is undulant.

桦树砭至终点段约 1 公里为沿溪线，平、纵面指标相对较好，平面线形指标基本能满足通村路标准要求，纵面起伏变化较为频繁。

- The existing feeder road is a climbing line, with the average gradient of 13.7%, and the maximum of 15.6%.

支路旧路长 514 米，为连续上坡道路，起终点高差 71 米，平均纵坡 13.7%，最大纵坡 15.6%，超限连续坡长 340 米。

26. The existing road subgrade and pavement conditions are as follows:

原有公路路基路面现况如下：

- From the start point to Huashubian, it is a macadam road, with the subgrade width of 3.0 to 4.0, the pavement of 2.0 to 3.0m.

旧路起点至桦树砭为越岭线，砂石道路，路基宽度 3.0～4.0 米，路面宽 2.0～3.0 米，该段路基多为半填半挖路基形式，一侧临山一侧临沟，临山侧多数路段无排水设施，临沟侧均未设置支挡防护，道路局部纵坡平缓路段积水严重，在车辆多次碾压下路基出现车辙沉陷；

- From Huashubian to the end point, it is in cement concrete pavement, with 4.0m width of subgrade, and 3.5m pavement.

桦树砭至终点段为沿溪线，长度约 1 公里，水泥混凝土路面，路基宽度 4.0 米，路面宽度 3.5 米，路面状况较差，局部路面断板严重，多数板块存在裂缝、露骨等病害，临山侧未设置边沟，临河侧局部设有干砌挡墙，局部路段因排水不畅，路基出现沉陷，局部面板边部受雨水冲刷出现悬空；

- The feeder road is a macadam road, with subgrade width of 2.5 to 3.5m, and pavement of 2.0 to 2.5m.

支路为连续上坡道路，砂石路面，路基宽 2.5～3.5 米，路面宽 2.0～2.5 米，旧路状况同主线砂石路。

27. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There is only a small stone arch bridge in the existing main road, 1 span of 5m, 4.2+2×0.6m width, will be reused. There is no bridge in the feeder road.

主线既有桥梁 1 座，为 1-5.0 米石拱桥，重力式台，桥梁净宽 4.2 米+2×0.6 米，两侧设不锈钢钢管栏杆，高度 0.8 米，将予以利用。支线无桥梁设置；

- There are 9 culverts in the existing main road, no any culvert in the feeder road.

道路主线旧有涵洞 9 道，其中圆管涵 7 道，石拱涵 2 道。本次设计利用 8 道，其余 1 道因道路改线废弃。支路全段无旧涵。

B. Upgrading Program/改建方案

28. The upgrading standard applies for Underclass Highway with Design Speed of 15km/h. The subgrade width will be 5m, pavement 4.5m, 25cm curbs on both sides.

本项目按设计速度 15Km/h 的山岭重丘区外延级公路技术标准改建，路基宽度 5.0 米，两侧各 0.25m 路边石。

29. The pavement will be cement concrete. The structure will be 18cm cement concrete slab + 18cm aggregate crushed stones, 36cm in total thickness.

全线采用水泥混凝土路面，路面结构组成为：18cm 水泥混凝土面板 + 18cm 级配碎石基层，路面总厚度 36cm。全线路肩均采用 C20 混凝土加固处理。

30. The major upgrading programs are as follows:

主要改建方案如下：

- From K0+000 to K1+150, the alignment will be basically alone the existing road, roadbed widening will be just on one side, partial sections the horizontal alignments will be improved;

K0+000～K1+150(起点～李家垭子)段设计路线基本沿既有旧路布设，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当调整；

- From K1+150 to K1+850, due to the gradients on the existing road are much higher than the standard allowed, the new alignments have been designed;

K1+150～K1+850(李家垭子～蹄子沟)段因旧路纵坡严重超标，本次对该段采用重新展线降坡方案设计，旧路基本废弃无利用；

- From K1+850 to K2+650, the alignment will be basically alone the existing road, roadbed widening will be just on one side, partial sections the horizontal alignments will be improved;

K1+850～K2+650(蹄子沟～寨垭子)段设计路线基本沿既有旧路布设，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当调整，该段纵坡较缓；

- From K2+650 to K5+250, due to the gradients on the existing road are much higher than the standard allowed, the new alignments have been designed;

K2+650～K5+250(寨垭子～桦树砭)段旧路纵坡严重超标，本次对该段采用重新展现降坡方案设计，旧路全部废弃无利用；

- From K5+250 to K6+552, the alignment will be basically alone the existing road, roadbed widening will be just on one side, the elevations passing through villages will be retained; and

K5+250～K6+552(桦树砭～终点)段设计路线基本沿既有旧路布设，采用单侧加宽，纵面设计以补强为主，局部过村镇路段保持既有标高不变；

- The Feeder Road from K0+000 to K0+702, the alignment will be basically alone the existing road; roadbed widening will be just on one side, the horizontal alignments of partial sections will be improved.

支线 K0+000～K0+702 段设计路线基本沿既有旧路布设，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当调整。

C. Upgrading Scale of Works/改建工程规模

31. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.3 Beigou to Luojia Road

3 号北沟至落驾公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	7.253	
Earth Volume/土方	1000m^3	11.474	
Rock Volume/石方	1000m^3	3.001	
Drainage/路基排水	1000m^3	0.564	C15 Cement Concrete/C15 混凝土
Protection/防护	1000m^3	0.126	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	32.648	
Bridge/桥梁	m/No.座	7/1	Reused/利用
Culvert/涵洞	No.道	13	Newly Build 5/新建 5 道

V. NO.4 YANGPO TO LIANGHEGUAN ROAD/4 号阳坡至两河关公路

A. Project Current Situation/项目现况

32. No.4 Yangpo to Liangheguan Road is located at northwest of Xunyang County, Ankang City. The project start point is linked with Maopingjie to Yanpozai Village Road, end point is linked with Shuangnicun Village Road. The project is 16.618km in total length.

旬阳县小河镇阳坡至两河关公路改建工程位于安康市旬阳县西北。拟建项目西接现有由茅坪街通往阳坡寨的通村公路，向东经天池梁、庙垭子、曹家岭、洞沟，终点止于双泥村与现有通村公路，路线全长 16.618 公里。

33. The existing Yangpo to Liangheguan Road is an unpaved road with 2.0-5.0m width of subgrade. The existing road was built in 2008 and has some missing links. There is no existing road fromK8+400 to K10+900 and from K12520 to K13+700.

阳坡至两河关旧路为土路，路基宽 2.0～5.0 米，旧路修建于 2008 年，未贯通。其中 K8+400～K10+900 和 K12+520～K13+700 没有现有道路。

34. The existing road alignment conditions are as follows:

原有公路路线现况如下：

- From K0+000 to K2+580, the existing road is along the Maoping Valley, the horizontal alignment is in relatively good conditions, although some sections will be short-cut.

旧路 K0+000～K2+580 沿茅坪沟布线，路线平面因山就势，蜿蜒曲折，平面指标基本能满足外延级技术标准，局部路段需对旧路弯道进行截弯取直；

- From K2+580 to K8+400, the ridge-crossing line, is in poor conditions. There are 18 hairpin curves with the minimum radius of 3.9m.

K2+580～K8+400 段为越岭段，旧路平面指标较差，回头曲线均不能满足外延级技术标准，旧路回头曲线平曲线最小半径 3.9 米，该段回头曲线共 18 处；

- It is a missing link from K8+400 to K10+900 need a new road section.

K8+400～K10+900 段为新线；

- From K10+950 to K12+520, the existing road is along the Caojia Valley, the horizontal alignment is in relatively good conditions.

K10+950～K12+520 段，旧路沿曹家岭布线，随弯就弯，路线平面指标基本满足外延级技术标准；

- It is a missing link from K12+520 to K13+700 too; a new road section will be added.

K12+520～K13+700 段为新线；

- From K13+700 to the end point, connecting mountain dwellers, the horizontal alignment is in relatively good conditions.

K13+700～项目终点，旧路因山就势，串珠式连接山区居民，旧路平面指标基本满足外延级技术标准。

35. The existing road subgrade and pavement conditions are as follows:

原有公路路基路面现况如下：

- The existing road width from K0+000 to K8+400 is 3.5 to 5.0m;

K0+000～K8+400 段路基宽度 3.5～5.0 米；

- The existing road width from K10+950 to K12+520 is 2.0 to 4.0m;

K10+950～K12+520 段路基宽度 2.0～4.0 米；

- The existing road width from K13+700 to the end is 3.0 to 4.5m;

K13+700～项目终点段路基宽度 3.0～4.5 米；

- The existing road sections are all earth roads.

旧路均为土路，旧路平面、纵面指标相对较差，旧路无边沟，涵洞较少；

36. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There is no any bridge in the existing road;

  全线无桥梁；

- There are 4 culverts in the existing road, badly damaged and in small sizes, need to be replaced by new culverts.

  旧路原有涵洞共 4 道，均为圆管涵，由于跨径较小，破损严重，故拆除新建。

B. Upgrading Program/改建方案

37. The upgrading standard applies for Underclass Highway with Design Speed of 15km/h. The subgrade width will be 5m, pavement 4.5m, 25cm curbs on both sides.

本项目按设计速度 15Km/h 的山岭重丘区外延级公路技术标准改建，路基宽度 5.0 米，两侧各 0.25m 路边石。

38. The pavement will be cement concrete. The structure will be 18cm cement concrete slab + 18cm aggregate crushed stones, 36cm in total thickness.

全线采用水泥混凝土路面，路面结构组成为：18cm 水泥混凝土面板 + 18cm 级配碎石基层，路面总厚度 36cm。全线路肩均采用 C20 混凝土加固处理。

39. The road alignment will be basically alone the existing road, roadbed widening will be just on one side, partial sections the horizontal alignments will be improved; the vertical alignments from K2+580 to K2+892, K3+320 to K3+416, K3+864 to K3+987 and K4+127 to K5+342, four sections aren't meet the standard with the maximum gradient of 18.63%, will be improved by changing the horizontal alignments.

主线沿既有旧路布设段，采用单侧加宽，局部平面指标不满足规范要求的路段进行适当优化线形；旧路纵面 K2+580～K2+892、K3+320～K3+416、K3+864～K3+987、K4+127～K5+342 四段纵面超标，最大纵坡 18.63%，本次对四段平面优化调整使纵断面指标满足技术标准要求。

C. Upgrading Scale of Works/改建工程规模

40. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.4 Yangpo to Liangheguan Road

4 号阳坡至两河关公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	16.618	
Earth Volume/土方	1000m^3	17.02	
Rock Volume/石方	1000m^3	6.29	
Drainage/路基排水	1000m^3	1.24	C15 Cement Concrete/C15 混凝土
Protection/防护	1000m^3	1.206	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	67.43	
Bridge/桥梁	m/No.座	-	No Bridge/无桥梁
Culvert/涵洞	No.道	4	Newly Build/新建

VI. NO.5 YANBA TO DONGQIAO ROAD/5 号晏坝至洞桥公路

A. Project Current Situation/项目现况

41. No.5 Yanba to Dongqiao Road is located in Hanbin District, Ankang City, start point at Yanba Town, linked with Jihe to Yanba Highway, end point at Dongqiao Village, linked with S207 at K34+200. The upgrading project will be 10.697 in total length.

安康市汉滨区宴坝至洞桥四级公路起点位于晏坝镇（接吉河至晏坝公路），经黑虎村、唐台村、桂坪村，终点至瀛湖镇洞桥村与 S207 K34+200 形成 T 型交叉，路线全长 10.697 公里。

42. The existing road is an underclass road. From K0+000 to K5+000, the horizontal and vertical alignments are basically met Class IV standards, cement concrete pavement in 3.5m width, built in 2010. From K5+500 to K10+697, the horizontal and vertical alignments are in poor conditions with the maximum gradient of 12% and the minimum radius of 7m.

旧路为等外公路，其中 K0+000～K5+500 段为沿溪线，平、纵面基本满足四级公路标准，水泥混凝土路面，宽度 3.5 米修建于 2010 年。K5+500～K10+697.486 段为山腰线，平、纵面相对较差，最大纵坡 12%，最小半径 7 米。

43. The project is linked with S207 and Jihe to Yanba Highway. S207 at the end point is a Class II highway with 10m width of subgrade and 9.2m width of asphalt concrete pavement. Jihe to Yanba at the start point is a Class IV highway with 6.5m width of subgrade and 6.0m width of cement concrete pavement.

与拟建项目有联系的公路主要有 S207、吉河至晏坝公路。路线终点处的 S207 公路等级为二级，路基宽度 10.0m，路面宽度 9.2m，两侧为 2×0.4m 的路边石，路面为沥青凝土路面；路线起点接吉河至晏坝公路，该段公路等级为四级，路基宽度 6.5m，路面宽度 6.0m，路面为水泥凝土路面。

44. The existing road alignment conditions are as follows:

原有公路路线现况如下：

- From K0+000 to K0+905, it is located in planned Shaannan immigration resettlement area, Yanba downtown center. It is urbanized with clustered buildings along the roadsides.

  K0+000～K0+905 段为晏坝镇中心社区陕南移民搬迁安置规划区域，旧路两侧房屋密集街道化严重。

- From K0+905 to K5+500, the valley line, the horizontal and vertical alignments are basically met with Class IV standards. From K1+320 to K1+940, the road is severely damaged, the subgrade strength isn't enough, and half of the subgrade is in danger of sliding. The section from K2+440 to K2+620 is close the river on one side, facing clustered buildings on the other side. The section from K5+320 to K5+500 is across over the Yanji River without a bridge, impassable during the flood seasons.

  K0+905～K5+500 段旧路为沿溪线,除个别交点(JD27R=9m、JD39R=7m)半径不满足四级公路设计标准外，其余均满足四级公路平、纵面要求。K1+320～K1+940 段旧路损坏严重，路基强度不足，半幅有滑塌趋势；K2+440～K2+620 段旧路一侧临河另一侧房屋密集；K5+320～K5+500 段公路跨越堰吉河，无桥梁，汛期无法通行。

- From 5+500～K10+697, the hill-side line, most sections the horizontal and vertical alignments are not met with Class IV standard. The ridge line sections are in small radii, very poor sight distance conditions. The maximum gradient on the section from K5+830 to K6+165 is 10%, K6+355 to K6+655, 12%.

  5+500～K10+697 该段为山腰线，路线随弯就势，平、纵面指标多数路段不满足四级公路技术标准。套山脊展线路段平面半径偏小，视距极差存在严重的安全隐患，如：JD37(R=9 米)、JD91(R=7 米)、JD113(R=10 米)、JD117(R=9 米)均为暗弯。套沟展线路段纵坡较大如：K5+830～K6+165 段最大纵坡 10%，连续坡长 335 米，K6+355～K6+655 段最大纵坡 12%，连续坡长 300 米。

45. The existing road subgrade and pavement conditions are as follows:

原有公路路基路面现况如下：

- From K0+000 to K0+585, it is located in the development zone in Yanba Town, a city road, built in 2011 with 6m carriageways and 2×2m sidewalks. It is in cement concrete pavement, 20cm cement concrete slab + 15cm crushed mountain rocks, without any defect. This section will be reused without any change.

  K0+000～K0+585 该段位于晏坝镇开发区，属于城市道路，建于 2011 年 9 月，行车道宽度为 6 米，两侧 2×2 米人行道，水泥混凝土路面，路面结构为 20cm 水泥混凝土路面

+15cm 开山石渣，路面无病害，平整度较好；该段以地下排水管道为主，本次设计该段完全利用。

- The section from K0+900 to K5+635 was built in 2010, 4.0m of subgrade, 3.0m of cement concrete pavement, and 2×0.5m earth shoulders. The pavement structure is 18cm cement concrete slab + 15cm crushed mountain rocks. There are many longitudinal cracks and transverse cracks, partial section have corner cracks and hollowed slabs.

K0+900～K5+635 该段改建于 2010 年 10 月，路基宽度 4.0m，路面宽度 3.0m，两侧为 2×0.5m 土路肩，水泥混凝土路面，路面结构为 18cm 水泥混凝土路面+15cm 开山石渣；面板尺寸为 3.0×4.0m；此段路面平整度较好，既有面板大面积出现纵、横向裂缝，局部路段板角出现裂缝或者面板掏空现象，本次设计完全拟合旧路，对既有面板进行稳固断裂，充当路面底基层；该段挡土墙以干砌为主，部分路段已经裂缝、倾斜现象，局部设置有 M7.5 浆砌块片石挡墙；该段旧路排水以土质边沟，且淤塞现象严重。

- The section from K5+635 to K10+697.486 is a macadam road with 5-6m in total widths. There are potholes and rutting, partial sections have subsidence.

K5+635～K10+697.486 该段路基宽度为 5.0～6.0m，砂石路面，路面平整度较差，坑槽车辙现象严重，部分路段沉陷现象；该段为山腰线，一侧靠山，一侧沟，临沟一侧挡墙多为干砌，且大部分出现鼓包现象，个别路段已经倒塌；旧路靠山体一侧基本为土质边沟，且淤塞现象严重，排水不畅。

46. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There is 1 bridge on the existing road. K1+396 Tangtaicun Small bridge, 1×10m reinforced concrete slab bridge, was built in 2008. The design program is to demolish it and build a new one.

旧路沿线设置桥梁 1 座，唐台村小桥(K1+396)，旧桥为 1×10 米钢筋砼现浇板桥，宽度为 6.1=净 5.7+2×0.2，下部为扩大基础，修建于 2008 年，桥梁净空 1.6 米，泄洪能力不足，与规划河堤位置冲突，故本次定为拆除新建。

- The existing road is across over Yanji River at K5+522 without a bridge, impassable during the flood seasons.

旧路在 K5+522.325 跨越堰吉河时无桥梁等构造物，汛期涨水无法通行。

- There are 9 existing culvers.

旧路原有涵洞 9 道，以石盖板涵和圆管涵为主，因涵洞孔径普遍较小，个别涵洞进口淤塞，结构损坏。

B. Upgrading Program/改建方案

47. The upgrading standard applies for Class IV Highway with Design Speed of 20km/h. The typical subgrade width will be 6.5m, pavement 6m, 25cm curbs on both sides. From K6+285 to K6+735 and form K7+300 to K8+335, the subgrade width will be 5.5m, pavement 5m, 25cm curbs on both sides.

本项目按设计速度 20Km/h 的四级公路技术标准设计，一般路段路基宽度 6.5 米，各部分组成分别为 2×3m(车行道)+2×0.25m（路边石）。桩号 K6+285～K6+735 和 K7+300～K8+335 两段采用路基宽度 5.5 米，路面宽 5 米，2×0.25m 路边石。

48. The pavement will be cement concrete. The structure will be 20cm cement concrete slab + 18cm cement stabilized crushed stones + 18cm sand gravel.

全线采用水泥混凝土路面，路面结构采用 20cm 水泥砼面板+18cm 水泥稳定基层+18cm 天然沙砾垫层。

49. From K0+000 to K0+630, it is an urban road section with 6m pavement, will be retained without any change.

原有旧路等级为等外公路，K0+000～K0+630 段水泥混凝土路面，该段为市政道路，路面宽度 6.0 米，两侧路缘石，临河一侧 3 米绿化带，排水由雨水篦子收集经地下管线排入河道，本次设计完全利用；

50. From K0+630 to K5+500, the existing cement concrete pavement is 3.5m, will be widened by using existing roadbed of 3.705km, other section will be in new alignments.

K0+630～K5+500 段路基宽度 4.5 米，水泥混凝土路面宽度 3.5 米，路基、路面宽度较窄，且路面损坏严重，本次设计除 K0+630～K0+905、K1+320～K1+960 段于规划河堤并线，K2+470～K2+620、K2+820～K2+860、K3+600～K3+660 段截弯取直，K5+320～K5+500 段泽址建桥为新线外，其余路段均为旧路加宽改建，加宽利用段长 3.705 公里，处理方式为将该段旧水泥混凝土路面进行断裂稳固当做底基层利用。

51. From K5+500 to K10+697.486, it is an earth road, will be widened by using existing roadbed of 4.887km, other section will be in new alignments.

K5+500～K10+697.486 段无路面铺装，该段旧路平纵面相对较差，不满足四级公路技术标准，其中 K6+570～K6+670、K7+420～K7+500、K8+870～K8+920、K9+420～K9+460、K9+730～K9+770 段截弯取直或另走新线，其余路段利用旧路路基加宽，利用旧路路基加宽长度 4.887 公里。

52. In total, 80.3% of existing roadbed will be reused.

全线总共旧路利用率为 80.3%。

C. Upgrading Scale of Works/改建工程规模

53. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.5 Yanba to Dongqiao Road

5 号宴坝至洞桥公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	10.697	
Earth Volume/土方	1000m^3	91.193	
Rock Volume/石方	1000m^3	84.780	
Drainage/路基排水	1000m^3	0.274	Most of M7.5 Mortar Rubble/主要是浆砌片石
Protection/防护	1000m^3	6.484	Most of M7.5 Mortar Rubble/主要是浆砌片石
Pavement/路面	1000m^2	62.225	
Bridge/桥梁	m/No.座	49.38/2	Newly build/新建
Culvert/涵洞	No.道	42	Newly build/新建

VII. NO.6 ZAOBAO TO YOUSHENGCUN ROAD/6 号早包至优胜村公路

A. Project Current Situation/项目现况

54. No.6 Zaobao to Youshengcun Road is located in Hanbin District, Ankang City. The project start point is linked with Zaobao Road at K13+020; ends at Youshengcun Village. The project is 4.157km in total length.

汉滨区早包至优胜村公路改建工程，路线起点 K0+000 位于高举村接早包路 K13+020 处，路线沿现有村道盘山而上，路线终点 K4+156.675 位于优胜村，路线全长 4.157Km。

55. The existing Zaobao to Youshengcun Road is an unpaved bumping road with 3.5-4.5m width of subgrade. The existing road was built in 1990s. The alignments are in poor conditions with the maximum gradient of 12%. There is no bridge and culvert on the existing road.

本项目旧路修建于上世纪 90 年代。其中 K2+560～K2+560 段旧路平面线形指标较差，且受地形所限，改线难度大。部分路段纵断面指标较差，最大纵坡 12%，平均纵坡 5.6%。旧路为土路，坑洼不平，路基宽度 3.5m～4.5m。旧路无桥梁，无涵洞。

B. Upgrading Program/改建方案

56. The upgrading standard applies for Underclass Highway with Design Speed of 15km/h or 10km/h in difficult terrain. The subgrade width will be 5.0m, pavement 4.5m, 25cm earth shoulders on both sides.

本项目全线采用外延公路标准，设计速度 15Km/h，特殊困难路段 10Km/h。路基宽度为 5.0m，路面宽度为 4.5m，两侧各为 25cm 土路肩。

57. The pavement will be cement concrete. The structure will be 18cm cement concrete slab + 16cm sand gravel, 34cm in total thickness.

全段采用普通水泥混凝土路面，路面结构组成为：18cm 水泥混凝土面层+16cm 天然砂砾基层，总厚度 34cm。

58. The Majority of the existing horizontal and vertical alignments will be retained after the upgrading with the minimum radius of 11m and the maximum gradient of 12%.

改建的路线平纵面基本维持现有的平纵线形，最小半径曲线 11m，最大纵坡为 12.0%。

C. Upgrading Scale of Works/改建工程规模

59. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.6 Zaobao to Youshengcun Road

6 号早包至优胜村公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	4.157	
Fill/填方	1000m^3	3.272	Compacted Volume/压实方
Cut/挖方	1000m^3	9.117	Natural Volume/自然方
Drainage/路基排水	1000m^3	0.679	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	18.705	
Bridge/桥梁	m/No.座	-	No Bridge/无桥梁
Culvert/涵洞	No.道	4	All newly built/新建

VIII. NO.7 ZAOBAO TO WUJIASHAN ROAD/7 号早包至吴家山公路

A. Project Current Situation/项目现况

60. No.7 Zaobao to Wujiashan Road is located in Hanbin District, Ankang City. The project start point is in Gaoju Village linked with Zaobao Road at K12+360; ends at Wujiashan. The main road is 4.319km in length. The Tianzhuang Feeder Road is linked with the main road at K1+525, 5.016km in length. The project is 9.335km in total length.

汉滨区早包至吴家山公路改建工程，路线起点 K0+000 位于高举村接早包路 K12+360 处，路线沿现有村道盘山而上，路线终点 K4+318.737 位于吴家山，主线长度 4.319Km；田庄支线起点接主线 K1+525 处，路线沿现有村道沿沟而上，在 K3+700 处翻越垭口盘山而下至田庄终点 K5+016.138，支线长度 5.016Km；路线全长 9.335Km。

61. The existing Zaobao to Wujiashan Road is an unpaved bumping road with 3.5-4.5m width of subgrade. The existing road was built in 1990s.

本项目旧路修建于上世纪 90 年代。旧路为土路，坑洼不平，路基宽度 3.5m～4.5m。

62. The main road alignments are in poor conditions with the maximum gradient of 12%. There are 7 hairpin curves with radii from 5 to 9m. There is no bridge and has only 2 culverts on the existing road.

主路线形指标较差，最大纵坡 12%，平均纵坡 5.76%。其中 K0+000～K0+425、K1+105～K1+200、K3+670～K4+318 段旧路平面线形指标较差，JD29、JD30、JD48 旧路曲线半径分别为 6m、7m、8.5m；路线共设置 7 处回头曲线，回头曲线半径 5～9m；不满足规范要求。旧路无桥梁；旧涵 2 道，原有 1 道结构完好，排水顺畅，可完全利用；另 1 道孔径过小，堵塞严重，无法满足排洪要求，需拆除重建。

63. The Tianzhuan Feeder Road alignments are in poor conditions. There are continuous 0.955Km climbing section in average gradient of 6.01% and continuous 1.311Km descending section in average gradient of 6.11% on the existing road. There are 4 hairpin curves with radii from 5 to 8m. There is no bridge and has 1 culverts on the existing road.

支线 K3+920～K4+590 段旧路平面线形指标较差。路线共设置 4 处回头曲线，回头曲线半径 5～8m；不满足规范要求。纵断面指标较差，K2+750～K3+705 段连续上坡，路线长度 0.955Km，平均纵坡 6.01%，最大纵坡 7.56%；K3+705～K5+016.138 段连续下坡，路线长度 1.311Km，平均纵坡 6.11%，最大纵坡 8.45%。旧路无桥梁，原有旧涵 1 道，因孔径过小，堵塞严重，无法满足排洪要求，需拆除重建。

B. Upgrading Program/改建方案

64. The upgrading standard applies for Underclass Highway with Design Speed of 15km/h or 10km/h in difficult terrain. The subgrade width will be 5.0m, pavement 4.5m, 25cm earth shoulders on both sides.

本项目全线采用外延公路标准，设计速度 15Km/h，特殊困难路段 10Km/h。路基宽度为 5.0m，路面宽度为 4.5m，两侧各为 25cm 土路肩。

65. The pavement will be cement concrete. The structure will be 18cm cement concrete slab + 16cm sand gravel, 34cm in total thickness.

全段采用普通水泥混凝土路面，路面结构组成为：18cm 水泥混凝土面层+16cm 天然砂砾基层，总厚度 34cm。

66. The Majority of the existing horizontal and vertical alignments will be retained after the upgrading. The major horizontal alignment adjustment will be enlargements of 11 hairpin curves from currently 5-9m to 10-11m and other 3 curves from currently 6, 7 and 8.5m to 10m, thus all the horizontal radii will be above 10m; the vertical alignment will be no major change with the maximum gradient of 12%.

改建的路线平纵面绝大多数维持现有的平纵线形。路线平面调整主要是将 11 处回头曲线半径从现在的 5～9m 调整到 10～11m，平面指标经调整后均大于半径 10m；路线纵断面基本维持原路纵段，最大纵坡为 12%。

C. Upgrading Scale of Works/改建工程规模

67. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.7 Zaobao to Wujiashan Road

7 号早包至吴家山公路主要工程数量表

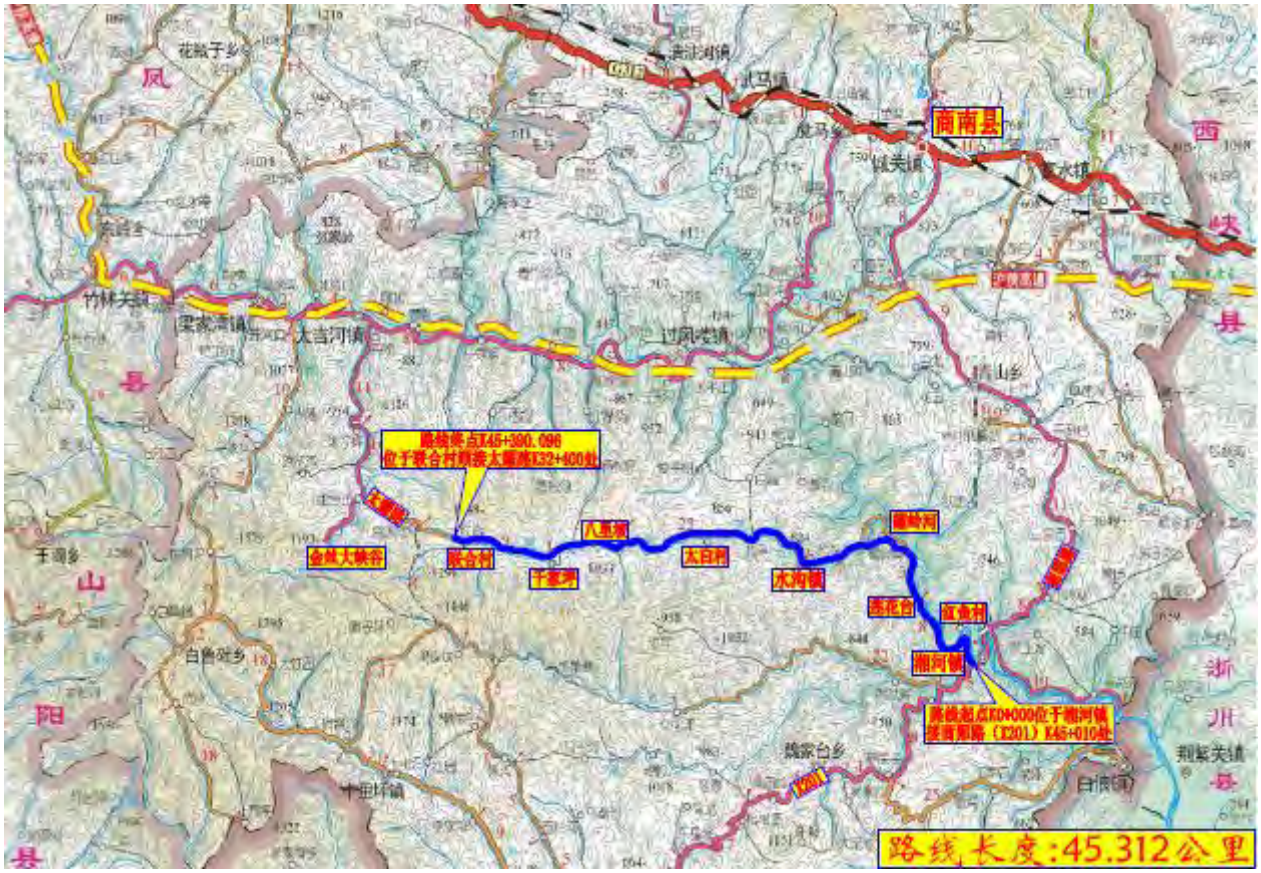
Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	9.335	
Fill/填方	1000m^3	8.135	Compacted Volume/压实方
Cut/挖方	1000m^3	23.383	Natural Volume/自然方
Drainage/路基排水	1000m^3	1.174	M7.5 Mortar Rubble/浆砌片石
Protection/防护	1000m^3	0.098	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	42.007	
Bridge/桥梁	m/No.座	-	No Bridge/无桥梁
Culvert/涵洞	No.道	10	1 reused without any repair/其中完全利用 1 道

IX. NO.8 XIANGHE TO SHUIGOU ROAD/8 号湘河至水沟公路

A. Project Current Situation/项目现况

68. No. 8 Xianghe to Shuigou is located in Shangnan County, Shangluo City. The start point linked with S224 at K45+100, end point linked with Taiyao Highway at K32+400, Lianhe Village. The upgrading project will be 45.312km in total length. The following is the location map of No.8 rural road.

商南县湘河镇至水沟镇四级公路改建工程，路线起点 K0+000 位于湘河镇接商郧路（S224）K45+010 处，路线沿丹江西岸布线，经过红鱼村、莲花台村，从 K6+690 开始盘山而上，经过耀岭河村，在 K11+840 处越过垭口，路线盘山而下在 K15+720 处到沟底，路线沿耀岭河北岸向上，经过水沟村、太白村、八里坡村、千家坪村，路线终点 K45+390.096 位于联合村顺接太耀路 K32+400 处，路线全长 45.312Km。路线在 K20+140 处设置断链，K20+361.522=K20+440，短链长度 78.478m。下图是 8 号农村公路的地理位置图。



69. The existing road was built in 1990s, and rehabilitated in 2007.

本项目旧路修建于上世纪 90 年代，于 2007 年进行了旧路改造。

70. The existing road conditions are as follows:

原有公路现况如下：

- From K0+000 to K6+300 it is a valley line with relatively good horizontal and vertical alignments that basically meet with the Class IV standards. There are 15 intersection angles less than 7°. The gradient at the bridge end from K0+100 to K0+200 is 7.1% exceeded the standard. The existing road is in asphalt pavement, 5.5m in total width, 4.5m pavement, and 50cm curb stones in both sides. The pavement structure is 4cm AC + 18cm cement stabilized gravel. The existing road subgrade is in good conditions in general, partial sections have subsidence and potholes. The pavement from K5+600 to K5+800 was severely fretted due to the Lianhuatai Village construction. The drainage system is incomplete; side ditches are earth ditched and many blocked. The protection facilities are good; existing retaining walls are in good conditions.

K0+000～K6+300 段为沿溪线，路线平面指标较好，基本满足四级公路标准要求。旧路 JD9、JD11、JD12、JD18、JD19、JD20、JD23、JD29、JD55、JD58、JD61、JD68、JD69、JD70、JD74 共 15 处路线转角小于 7°，反向曲线 JD42、JD43 旧路平曲线长度不足 40m。路线纵断面指标较好，基本满足四级公路标准要求。K0+100～K0+200 段桥头纵坡为 7.1%，纵坡超标。旧路无标线，安全设施缺少，除路线起点三处指路标志外，仅有三处标志，且破旧不堪；无护栏。旧路为沥青混凝土路面，路基宽度

5.5m，路面宽度 4.5m，两侧各 50cm 的路边石，旧路结构层为 4cm 中粒式沥青混凝土+18cm 水泥稳定砂砾；旧路路基基本完好，局部路段路基有沉陷、坑槽等病害，病害面积约 1617m3，占该段路面面积的 5.7%；旧路在 K5+600~K5+800 段由于湘河镇莲花台村的建设，路面磨损较为严重；旧路路基排水设施不完善，边沟为土边沟，且堵塞严重；旧路防护设施完善，原有挡墙基本完好。

- From K6+300 to K15+660 it is a ridge crossing line, partial sections the horizontal alignments are poor, cannot meet Class IV standard. There are 6 intersection angles less than 7°, 13 hairpin curves with the minimum radius of 8m. Partial sections are in poor vertical alignment conditions that cannot meet with Class IV standard. The uphill section from K6+690 to K11+835, 5.145Km in length, the average gradient is 5.1%. The downhill section from K11+835 to K15+720, 3.885Km in length, the average gradient is 5.5%. The existing road subgrade is in good conditions in general, partial sections have subsidence. The existing road is in cement concrete pavement, 5.5m in total width, 4.5m pavement, and 50cm curb stones in both sides. The pavement structure is 18cm cement concrete slab + 18cm aggregate crushed stones. The pavement from K6+300 to K6+820 was severely fretted, from K11+368 to K14+500 slab peelings. The drainage system is incomplete; side ditches are earth ditched and many blocked. The protection facilities are good; existing retaining walls are in good conditions.

K6+300～K15+660 段为越岭线，部分路段平面指标较差，不满足四级公路标准。旧路 JD77、JD78、JD79、JD105、JD108、JD132 共 6 处路线转角小于 7°，反向曲线 JD81、JD82、JD83 旧路平曲线长度不足 40m。K8+240 至 K8+500 段旧路平曲线长度不足 40m，且线形不连续，视距不良，路侧险要，该段路线共设置 13 处回头曲线，12 处回头曲线半径 8～14m，1 处 18.75m。部分路段纵断面指标较差，不满足四级公路标准。上坡段 K6+690～K11+835，长度 5.145Km，平均纵坡 5.1%；下坡段 K11+835～K15+720，长度 3.885Km，平均纵坡 5.5%。旧路无标线，安全设施缺少，仅有两处标志，且破旧不堪；混凝土护墩 2240m，示警桩 454m，无护栏。旧路为水泥混凝土路面，路基宽度 5.5m，路面宽度 4.5m，两侧各 50cm 的路边石，面板尺寸为 4.5（长）×4.5m（宽），旧路结构层为，18cm 水泥混凝土+18cm 级配碎石；旧路路基基本完好，局部路段路基有沉陷，沉陷面积约 2722.5 ㎡，占该段路面面积的 6.5%，部分水泥混凝土面板断裂，共计 225 块，断板率约 9.92%；旧路在 K6+300~K6+820 段路面磨损较为严重，K11+368~K14+500 段旧路回头曲线位置面板脱落；旧路路基排水设施不完善，边沟为土边沟，且堵塞严重；旧路防护设施完善，原有挡墙基本完好。

- From K15+660 to K45+390.098, the valley line, is in relatively good horizontal alignment conditions basically meet with Class IV standard. There are 13 intersection angles less than 7°. The vertical alignments are also in relatively good conditions basically meet with Class IV standard. Sections from K18+250 to K18+425, K23+370 to K23+590, and K32+385 to K32+695 are in adverse grade. The section from K38+620 to K38+720 the gradient is 11.4%.

K15+660～K45+390.098 段为沿溪线，路线平面指标较好，满足四级公路标准要求。多处平曲线间直线段长度小于 15m。旧路 JD195、JD210、JD232、JD272、JD279、JD294、JD305、JD312、JD318、JD321、JD341、JD417、JD421 共 13 处路线转角小于 7°。路线纵断面指标较好，基本满足四级公路标准要求。K18+250～K18+425 段、K23+370～K23+590 段、K32+385～K32+695 段旧路存在反坡。K38+620～K38+720 段旧路纵坡为 11.4%，坡长 100m。旧路无标线，安全设施缺少，无标志，仅 K19+550～K20+325 左侧设置 SB-2a 型混凝土护栏 685m。

- From K15+660 to K24+850 the existing road is 5.5m in total width, 4.5m asphalt pavement with the structure of 4cm AC + 18cm cement stabilized gravel, and 50cm

curb stones in both sides. The existing road subgrade is in good conditions in general, partial sections have subsidence and potholes. The pavement from K19+500 to K20+405 was severely fretted due to the Shuigou Town construction. The drainage system is incomplete; side ditches are earth ditched and many blocked. The protection facilities are good; existing retaining walls are in good conditions.

K15+660～K24+850 段旧路为沥青混凝土路面，路基宽度 5.5m，路面宽度 4.5m，两侧各 50cm 的路边石，旧路结构层为，4cm 中粒式沥青混凝土+18cm 水泥稳定砂砾；旧路路基基本完好，局部路段路基有沉陷、坑槽等病害，病害面积面积约 3071.5m3，占该段路面面积的 2.3%，旧路在 K19+500~K20+405 段由于水沟镇的建设，路面磨损较为严重；旧路路基排水设施不完善，边沟为土边沟，且堵塞严重；旧路防护设施完善，原有挡墙基本完好。

- From K24+850 to K45+390.098 the existing road is a macadam pavement. The subgrade is basically in good conditions, but the pavement is bumped. The drainage system is incomplete; side ditches are earth ditched and many blocked. The protection facilities are good; existing retaining walls are in good conditions.

K24+850～K45+390.098 段旧路为砂石路面，旧路路基基本完好，但路面坑洼不平；旧路路基排水设施不完善，边沟为土边沟，且堵塞严重；旧路防护设施完善，原有挡墙基本完好。

71. The existing bridges and culverts conditions are as follows:

原有公路桥梁、涵洞现况如下：

- There are 3 bridges in the project, all hollow slab bridges. Among them, only K0+040 Lengshuihe Medium Bridge has some damages need repair before reuse it, other 2 bridges will be reused without any repair work.

全线共有桥梁 3 座，均为空心板桥。其中 K0+040.0 冷水河中桥，护栏有部分破损，需修复，其余 2 座桥梁上、下部结构均完好，可完全利用。

- There are 116 existing culverts. 70 of them will be reused without any change, 16 reused after dredged, 11 are going to be lengthened, 17 will be demolished and rebuilt with big-sized ones, and newly built 35.

旧涵 116 道（55 道盖板涵，56 道圆管涵，5 道拱涵），有 70 道（34 道盖板涵，33 道圆管涵，3 道拱涵）结构完好，排水顺畅，可完全利用；有 18 道（6 道盖板涵，11 道圆管涵，1 道拱涵）孔内部分堵塞，需清淤利用；有 11 道（9 道盖板涵，1 道圆管涵，1 道拱涵）涵长不足，需接长利用；有 17 道（6 道盖板涵，11 道圆管涵）孔径过小，进口堵塞严重，无法满足排洪要求，需拆除重建；新建涵洞 35 道（18 道盖板涵，17 道圆管涵）。

B. Upgrading Program/改建方案

72. The upgrading standard applies for Class IV Highway with Design Speed of 20km/h. The typical subgrade width will be 6.5m, pavement 6m, 25cm curbs on both sides. The subgrade width from K6+690 to K16+690 will be 5.5m, pavement 5m, 25cm curbs on both sides.

本项目全线采用四级公路标准，设计速度20Km/h，路基宽度为一般路段6.5m，路面宽度为6.0m，两侧各0.25m宽C20石混凝土路边石加固。K6+690~K16+690段路基宽度为5.5m，路面宽度5.0m，两侧各0.25m宽C20混凝土路边石加固。

73. The pavement will be cement concrete. In general, the structure will be 20cm cement concrete slab + 18cm cement stabilized sand gravel + 15cm sand gravel, 53cm in total thickness. From K32+400 to K35+200. There are heavy load mining trucks around, the structure will be 24cm cement concrete slab + 18cm cement stabilized sand gravel + 15cm sand gravel, 57cm in total thickness.

全段采用普通水泥混凝土路面，一般新建路段采用水泥砼面板 20cm + 水泥稳定沙砾 18cm + 15cm 天然沙砾，总厚度 53cm；K34+200~K35+200 有矿区车辆通过，采用水泥砼面板 24cm + 18cm 水泥稳定碎石 + 18cm 天然沙砾，总厚度 57cm。

74. The Majority of the existing horizontal and vertical alignments will be retained after the upgrading. The major horizontal alignment adjustment will be enlargements of 12 hairpin curves from currently 8-14m to 15-16m, thus all the horizontal radii will meet the minimum of 15m stipulated on the Specification; the Major vertical alignment adjustment will be the change of the gradient on the Section K38+620-K38+720 from currently 11.4% to 6.57%, thus all the gradients will meet the maximum of 8.52% stipulated on the Specification.

改建的路线平纵面绝大多数维持现有的平纵线形。路线平面调整主要是将 12 处回头曲线半径从现在的 8～14m 调整到 15～16m，平面指标经调整后均满足极限半径 15m 的规范要求；路线纵断面主要是将 K38+620～K38+720 纵坡从现在的 11.4%，调整为 6.57%，调整坡长 170m，纵面指标经调整后，最大纵坡为 8.52%，最小凸形竖曲线半径为 700m/2 个，最小凹型竖曲线半径为 700m/1 个，均满足规范要求。

C. Upgrading Scale of Works/改建工程规模

75. The Major Scale of Works are listed on the following table:

Major Scale of Works of No.8 Xianghe to Shuigou Road

8 号湘河至水沟公路主要工程数量表

Item/项目	Unit/单位	Volume/数量	Remark/备注
Length/路线长度	Km	45.312	
Fill/填方	1000m^3	44.940	Compacted Volume/压实方
Cut/挖方	1000m^3	226.854	Natural Volume/自然方
Drainage/路基排水	1000m^3	18.853	M7.5 Mortar Rubble/浆砌片石
Protection/防护	1000m^3	35.639	M7.5 Mortar Rubble/浆砌片石
Pavement/路面	1000m^2	286.459	Not including at-grade intersection and bridge deck/不包括平交及桥梁部分
Bridge/桥梁	m/No.座	116.6/3	2 reused without any repair, 1 reused after repair/完全利用 2 座，修复利用 1 座
Culvert/涵洞	No.道	151	70 reused without any repair/其中完全利用 70 道

Appendix F: Rural Road Design Submission

Rural Road Subcomponent Cost Estimate Analysis and Engineering Recommendation

农村公路子项目施工图预算分析和工程建议

A. Cost Estimate Analysis/施工图预算分析

There are three roads designed by Zhongyu Company, i.e. No. 6 Zaobao to Youshengcun Road, No.7 Zaobao to Wujiashang Road, and No.8 Xianghe to Shuigou Road. The relatively high cost parts among these three roads are as follows:

由中宇公司设计的 3 条公路，分别是序号 6、7 和 8 号农村公路，也即早包至优胜村公路、早包至吴家山公路和湘河至水沟公路。其预算费用相对较高的部分有：

1. Safety Facility Cost: Of Zaobao to Youshengcun Road and Zaobao to Wujiashang Road they are accounted for 10.36% and 12.72%. On other comparable roads, they are only amounted for 1.24% to 3.54%.

   安全设施费用：早包至优胜村公路、早包至吴家山公路分别占 10.36%、12.72%。其它相应公路的安全设施费用仅占 1.24%至 3.54%之间。

2. Pavement Cost: Of Zaobao to Youshengcun Road and Zaobao to Wujiashang Road they are accounted for 39.01% and 45.07%, relatively higher. The reason is that, there are 3 layers of pavement structures applied by the detailed designs, i.e. 18cm cement concrete + 18cm cement stabilized crushed stones + 15cm sand gravel, more than 1 layer compared with 18cm cement concrete + 18cm aggregated crushed stones on other comparable roads.

   路面费用：早包至优胜村公路、早包至吴家山公路分别占 39.01%、45.07%。其原因是早包至优胜村公路和早包至吴家山公路采用了 3 层的路面铺装，也即 18cm 水泥砼+18cm 水泥稳定+15cm 天然沙砾，比其它可比较公路的 18cm 水泥砼+18cm 级配碎石增加了 1 层。

No.2 Lijiaba to Baiguo Road and No.3 Beigou to Luojia Road, the subgrade costs are relatively higher, accounted for 43.98% and 47.97%. The reason is that, the current highest gradients on these two roads are relatively higher, 16% and 22% respectively. The vertical alignment improvements cause high cutting or filling, or many new road sections, for instance, there are around half of Beigou to Luojia Road re-aligned on the detailed design.

序号 2 和 3 号公路，也即力加坝至白果公路和北沟至落驾公路，其预算费用中路基费用相对较高，分别占 43.98%和 47.97%。其原因是此 2 条公路原纵坡较大，其旧路最大纵坡分别是 16%和 22%，调整纵坡带来高填挖或新建路段较长。其中北沟至落驾公路有约一半的路段长度是新建线位。

B. Main Reason Upon High Cost and Engineering Recommendation/总体上造成造价偏高的主要原因和工程建议

1. Apply Flexible Subgrade Widths/灵活采用路基宽度

The stipulations on the Specifications are: 2-lane Class IV highways can accommodate the traffic volume of less than AADT 2000, single lane Class IV highways can accommodate the traffic volume of less than AADT 400.

《规范》规定：四级公路为主要供汽车行驶的双车道或单车道公路，双车道四级公路应能适应将各种车辆折合成小客车的年平均日交通量 2000 辆以下，单车道四级公路应能适应将各种车辆折合成小客车的年平均日交通量 400 辆以下。

According to the traffic surveys and the projections, No.1 Shuhe to Xiaohe Road, current traffic

volume of 430-531 pcu, and No.8 Xianghe to Shuigou Road, current traffic volume of 603-729 pcu, can apply for 2-lane Class IV highways. Other roads, current traffic volumes are ranged from 32 to 174 pcu, and less than 400 pcu during the projection periods, can apply for single lane Class IV highways or underclass highways.
故根据本项目的交通量现况调查数据和未来预测分析，序号 1 和 8 号公路，也即蜀河至小河（上码至小河段）公路（现状交通量为 12 小时观测 430—531 pcu）和湘河至水沟公路（现状交通量为 12 小时观测 603—729 pcu）可采用双车道四级公路，其它公路（现状交通量为 32—174 pcu，预测期内也不会超过 400 pcu）均可采用单车道四级公路或等外公路。

On the detailed designs of Rural Road Component, No.1 Shuhe to Xiaohe Road, current traffic volume of 430-531 pcu, and No.8 Xianghe to Shuigou Road, current traffic volume of 603-729 pcu, applied for 2-lane Class IV highways with 6.5m in total width and 6m pavement width are adequate in conformity with the specifications. While No.5 Yanba to Dongqiao Road, also applied for 2-lane Class IV highway with 6.5m in total width and 6m pavement width on the detailed design, is above the standard, could apply for single lane Class IV highway instead. Other roads are all adequately applied for underclass highways on the detailed designs, but the subgrade widths should be flexible. If the total widths are not enough for two lanes after the curve widening, and the total widths are not enough for two lanes on insufficient sight distance sections, the total widths can be widened to accommodate 2 carriageways. Other sections can retain the existing road widths and adequately newly build some necessary passing bays.
农村公路子项目施工图设计中，序号 1 和 8 号公路，也即蜀河至小河（上码至小河段）公路（现状交通量为 12 小时观测 430—531 pcu）和湘河至水沟公路（现状交通量为 12 小时观测 603—729 pcu）采用的是双车道四级公路，路基宽度 6.5 米，路面宽 6 米，为标准规定值，是合适的。而序号 5 的晏坝至洞桥公路，施工图设计也采用的是双车道四级公路，路基宽度 6.5 米，路面宽 6 米，标准掌握偏高，可采用单车道四级公路。其它公路的施工图设计都采用了等外公路，是合适的，但路基路面宽度可根据原路基宽度灵活取用，也即在弯道加宽后总宽、视距不足路段的总宽不够双车道的错车宽度时，可加宽到双车道宽度，其它路段可保留原有的路基宽度并在适当的位置增加适量的交汇车道即可。

2. Select Pavement Type Rationally/合理选用路面类型

All rural roads are applied for cement concrete pavements on the detailed designs. Because the cement concrete pavement requires a minimum slab thickness, so the costs are relatively higher. Since all rural roads are low class highways, they can apply for bituminous surface treatment pavement, bituminous macadam pavement or thin bituminous concrete pavement, the base courses can be differentiated according to the traffic volumes, thus reduce the costs.
所有的农村公路子项目施工图设计均采用的是水泥混凝土路面。因为水泥混凝土路面的面板有最低厚度要求，故使得路面造价偏高。由于所有的农村公路子项目都属于低等级公路，故可采用沥青表面处置、沥青碎石或较薄的沥青混凝土等路面面层，基层也可根据不同的交通量采用不同的厚度，由此降低路面造价。

3. Avoid new bridge works/避免新增桥梁

No.5 Yanba to Dongqiao road, its bridge and culvert costs accounted for 6.30%, obviously higher than other roads. The reason is to newly build 2 small bridges. Among them, Tangtaicun small bridge at K1+396, the existing bridge was built in 2008, the detailed design program is to demolish the existing bridge and build a new one nearby. Is it considerable to reuse the existing

bridge in order to reduce the cost? While the proposed new Guipingcun small bridge across Yanji River at K5+522, considering with multi-span culvers or a ford pavement instead (submersible pavement is allowed in low class highways), will save the investment.
序号 5 的晏坝至洞桥公路，其桥涵费用占 6.30%，比例明显高于其它公路，其原因是新建 2 座小桥。其中唐台村小桥（K1+396），现有桥梁建于 2008 年，设计方案是拆除重建，是否可考虑利用以降低造价？而在 K5+522 跨堰吉河，新修建桂坪村小桥，可否考虑多孔涵洞，或采用低等级公路允许的过水路面通过以减少投资?

4. Reduce culvert installations/减少涵洞设置
   Almost on all rural road detailed designs, there are 3-4 culvers per km. There are few reusable culverts on the existing rural roads; most of them are going to be newly installed, so it is a big increase on the amounts of the culverts on the detailed design programs. Except No.1 and No.8, other roads have small traffic volumes. The recommendation is to cancel these new culverts with the exception of those culverts situated on the bottoms of the vertical curves. Since the hill slope surface water can flow over pavement vertically without affecting traffic flow in such a low traffic volume, besides, if they were cement concrete pavements, they are not easily being damaged by run-off water.
   几乎所有的农村公路子项目施工图设计，设置的涵洞均在每公里 3—4 道。由于原有可利用的涵洞较少，这些涵洞多数是新建涵洞，因此造成施工图设计涵洞增加太多。除了序号 1 和 8 两条公路外，其它公路交通量都很小，建议除在竖曲线底部附近可以增设涵洞外，其它涵洞均可考虑取消。因为雨天山坡水可从路面纵向通过，由于交通量小，并不影响交通，且如果是水泥混凝土路面的话，路面也不容易被地表水损坏。

SHAANXI MOUNTAIN ROAD SAFETY DEMONSTRATION PROJECT
陕西山区公路安全示范项目
PPTA Team
PPTA 技援组
2014/6/16

Appendix G

PPTA 8440 - Traffic Forecasts

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I. TRAFFIC FORECASTS

A. INTRODUCTION

1. This appendix describes the traffic forecasts adopted for:

- three trunk roads (S102, G316 and S224)
- eight rural roads

B. TRAFFIC FORECASTS FOR TRUNK ROAD EVALUATIONS

1. Introduction and data sources

2. This section describes historic traffic data, the results of any relevant OD surveys and hourly traffic data. 2014 is adopted as the base year for traffic.

3. Historic traffic data are reported in the FSRs and various DI submissions and comprise a mixture of project counts and historic data collected as part of routine provincial counts. Traffic is reported as AADTs, converted to PCU/day using the recommended Chinese PCU factors.

4. Most traffic data available to the consultants are based on one-day 24h counts, expanded to estimates of AADT using seasonality and day of week adjustment factors. The adjustment factors are believed to be derived from long term automatic traffic count data (generally collected on tolled highways). Although the adjustment factors are sound, this procedure does not eliminate the large sampling error inherent in a one-day count. Therefore, where cross checks with other sources suggest that an AADT may be in error, adjustments are made.

2. Vehicle classification

5. Official traffic counts (and therefore the FSRs) use a standard vehicle classification, shown below with the official passenger car unit (PCU) rating for each vehicle. Trucks carrying containers are often counted separately, and may be rigid or articulated vehicles, but are here included with truck-trailer combinations. HDM-4, the program used for economic evaluation, uses a slightly different measure, namely passenger car space equivalents (PCSEs), whose recommended values for a two or four lane road are also shown in the table. PCSEs are used in congestion calculations in HDM-4.

Table 1: Motorized vehicle classification used in traffic counts

Class	PCU[a]	PCSE[b]	Ref in tables	Description
Light passenger vehicle	1.0	1.0	L	Cars and small buses with a maximum of 19 seats. 2 axles; <6m
Heavy passenger vehicle	1.5	1.5	H	Buses with >19 seats (axle configuration 12)
Light goods	1.0	1.3	L	Light goods vehicles with two axles and rated load <2t (typical axle configuration 12)
Medium goods	1.5	1.5	M	Medium goods vehicles (rigid) with two axles and rated loads 2-7t (typical axle configuration 1.2). 6-12m
Heavy goods	2.0	1.8	H	Heavy goods vehicle with three or four axles (rigid) and rated loads 7-20t (typical axle configuration 11-22)

Class	PCU[a]	PCSE[b]	Ref in tables	Description
Truck-trailer combination	3.0	2.2	T	Truck semi-trailer combination with typical axle configuration 1.2-222. Class includes trucks carrying containers and very heavy goods vehicles
Agricultural tractor	3.0	-	-	Treated as LGVs in traffic tabulations
Motorcycle	1.0	0.5	MC	Includes motor-tricycles

Sources: (a) PRC standards, 2010, (b) table B1-1 of volume 4 of HDM-4 v2 documentation

3. Historic and base year traffic on project roads

a. S102 Xunyang to Xiaohe

6. The project section of the S102 is a two-lane road of local and regional significance, connecting the urban center of Xunyang at its southern end to smaller settlements en route and to the BaoMao (G65) expressway at its northern end. One minor road, the X304, joins the S102 at Xiaohe town center.

7. Records are available at six stations, listed in the table below. Three are on the S102 itself and give a good spread along the project road.

8. The automatic traffic count (ATC) station at Qingni is at the northern outskirts of Xunyang urban center. Its records form a useful time series but may be biased by strong growth in short urban and suburban trips. Traffic recorded here is broadly representative of the relatively urbanized 12km section north of the S102/G316 junction.

Table 2: S102 traffic count locations

Name	Type	Available record	Location
On S102, from south to north			
Qingni	ATC Project	2005-13 (ATC), 2014 (project)	Approx 9km N of S102/G316 junction; northern suburbs of Xunyang urban area
Ganxi	Project	2011, 2012, 2014	Approx 16km N of S102/G316 junction
Xiaohe	Project	2011, 2012, 2014	Approx 58km N of S102/G316 junction, just south of X304/S102 junction
Other sites			
BaoMao exit ramp	Toll	2012, 2014	Measures traffic joining/leaving the G65 BaoMao expressway
Mojiaping	Project	2012, 2014	X304

Sources: FSRs, FSR updates

Table 3: S102 traffic, 2005-14

Year	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
Qingni – S102												
2005	0	298	282	241	350	277	16	1,464	1,464	580	884	2,460
2006	0	321	140	162	156	145	0	924	924	461	463	1,386

Year	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
2007	0	307	135	147	145	135	0	869	869	442	427	1,297
2008	650	1,485	131	129	137	78	95	2,705	2,055	1,616	439	3,280
2009	1,467	1,769	103	319	206	167	86	4,117	2,650	1,872	778	4,863
2010	974	2,493	113	484	315	231	170	4,780	3,806	2,606	1,200	5,966
2011	772	2,708	192	375	357	208	193	4,805	4,033	2,900	1,133	6,075
2012	427	2,989	236	259	241	102	161	4,415	3,988	3,225	763	5,337
2013	993	2,592	229	310	343	297	154	4,918	3,925	2,821	1,104	6,267
2014	941	3,023	114	197	172	613	66	5,126	4,185	3,137	1,048	6,693
Ganxi – S102												
2011	0	408	70	386	239	135	3	1,241	1,241	478	763	1,673
2012	64	461	97	546	340	163	22	1,693	1,629	558	1,071	2,309
2014	849	1,543	42	120	85	169	6	2,814	1,965	1,585	380	3,282
Xiaohe – S102												
2011	0	385	63	372	217	105	2	1,143	1,143	448	696	1,499
2012	47	501	115	565	372	200	27	1,827	1,780	616	1,164	2,560
2014	565	1331	105	91	189	25	2	2,308	1,743	1,436	307	2,634
BaoMao – G65 expressway access												
2012	0	337	31	198	41	50	99	756	756	368	388	1,193
Mojiaping – X304												
2012	84	124	8	76	31	5	8	336	252	132	120	427

Source: FSR and updates; project counts; Shaanxi traffic yearbook 2013
Note: (a) excludes motor-cycles

9. Analysis of daily traffic. Traffic on the S102 must have been affected by the opening of the Shaanxi sections of the BaoMao expressway in April 2012 (shortly before the FSR project counts and OD survey in May 2012). The effect may not have been great, however, as BaoMao is especially attractive to traffic between Ankang and Xi'an rather than those making trips between Xunyang and Xi'an, who continue to use the S102. (There is a regular coach service between Xunyang and Xi'an that uses the project road, noted during a field visit). This is confirmed by the FSR's OD matrix, which shows 85 percent of all trips with ends in zones between Xunyang south and Xiaohe.

10. Fleet composition is similar at Ganxi and Xiaohe; both stations record approximately 65 percent goods traffic (as veh/day goods ÷ AADT excluding motor-cycles). At Qingni, as expected close to urban Xunyang, goods traffic drops to approximately 25 percent.

11. Project counts in 2014 present a consistent picture of traffic along the project road – see the figure below. The southern end of the project road is heavily urbanized. There is also a cement plant approximately 12km from the S102/G316 junction. Accordingly, passenger traffic at Qingni is double that at Ganxi and Xiaohe while goods traffic is three times as great. There is no significant difference between traffic observed at Xiaohe and Ganxi. A moving observer count (MOC) on 9 April 2014 gave an estimated 2,300 veh/day (excluding motor-cycles) for the entire project road, compared with 2,200 veh/day derived from DI traffic count data above. (The MOC took place late morning; the 1h:24h expansion factor implied by hourly traffic data was 12.5).

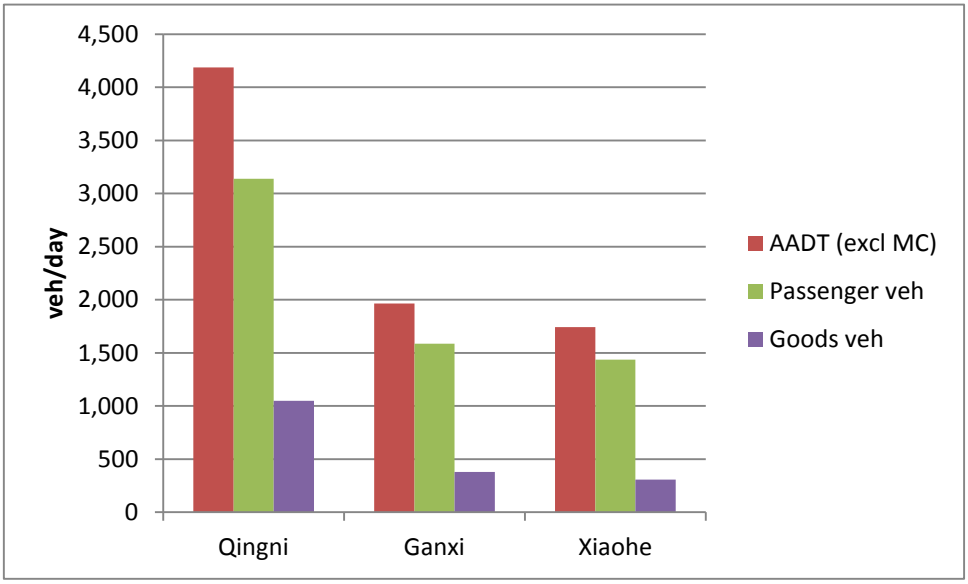


Figure 1: S102 AADT estimates, 2014

12. It is concluded that the available data are representative of project road conditions.

13. Estimate of base year traffic. For evaluation purposes the project road is divided into two sections using both traffic and proposed intervention as criteria for subdivision: section A, from the S102/G316 junction to km17.4 on the project road, and section B, from km17.4 to the end point at km60.5. Traffic on section A is taken as the average traffic at Qingni and Ganxi; traffic on B is the average of Ganxi and Xiaohe.

Table 4: S102 project road base year traffic

Section	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
A	895	2,283	78	159	129	391	36	3,970	3,075	2,361	714	4,970
B	707	1,437	74	106	137	97	4	2,561	1,854	1,511	344	2,870
A+B	761	1,680	75	121	135	182	13	2,967	2,206	1,755	451	3,480
Fleet %	26%	57%	2%	4%	5%	6%	0.4%	100%				

14. Hourly traffic flows are available for the three counts requested by the PPTA team in April 2014. The patterns at the project road three sites are similar:

- very little night-time traffic was observed. Between 21h00 and 05h00 3 percent of the daily total were observed at Xiaohe and Ganxi, 5 percent at Qingni. 12h to 24h expansion factors are 1.1 at Xiaohe and Ganxi and 1.2 at Qingni (all vehicle classes; there was no systematic variation between classes)
- a highly diffused morning peak between 08h00 and 12h00
- afternoon peaks between 16h00 and 17h00 at Qingni and Ganxi; no clear afternoon peak at Xiaohe

15. Figure 2 shows the average distribution of hourly flows at the three sites. (The values shown are simple averages of the raw two-way observations at the three sites).

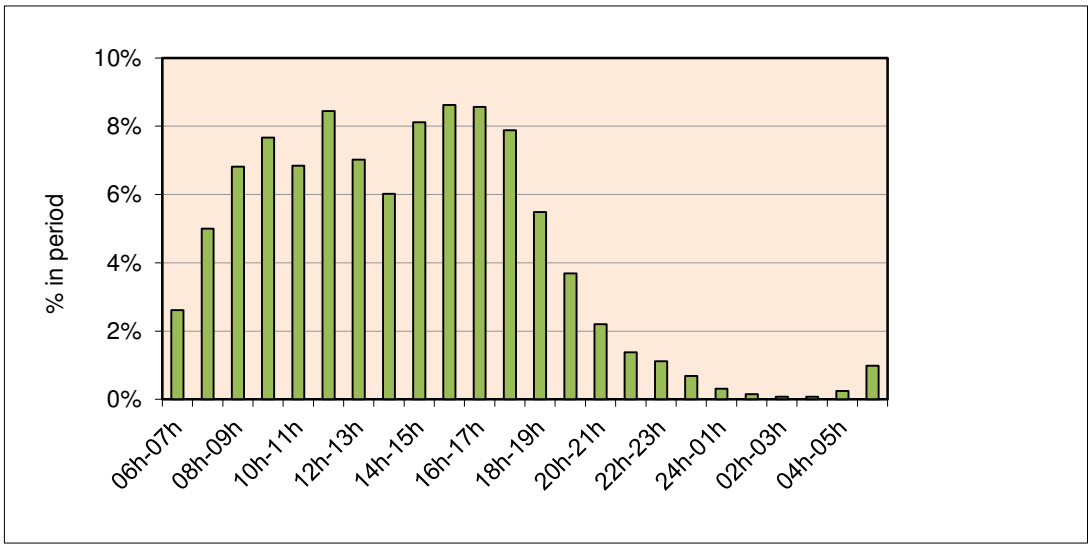


Figure 2: Hourly traffic, S102

b. G316 Xunyang to Ankang

16. The project section of the G316 is a two-lane road that follows the Han River between Ankang urban center at its western end and Xunyang urban center in the east. Its role as the principal route between these urban centers has largely been usurped by the G7011 (Shitian) expressway, opened in 2012. The western (Ankang) end of the road is highly urbanized. This section of the G316 is not joined by any roads of any significance.

17. Only one time series of traffic counts is located on the project road, at Guanmiao (a former toll station, closed in 2012. A weigh station now operates at the same site).

18. The FSR makes extensive use of the Jiaojiagou record. This is despite the fact that Jiaojiagou is east of the start of the project road and that traffic at this site is considerably greater than that carried by the project road. This is because the section immediately east of the project road carries traffic from south of the Han river to Xunyang. (Prior to November 2011 this cross-river traffic used a vehicle ferry; from November 2011 it uses a new bridge at Luhe. From late 2012 traffic using the Luhe bridge is augmented by traffic joining or leaving the newly opened G7011 (Shitian) expressway).

19. Although the volume of traffic at Jiaojiagou is unrepresentative, its growth rate should be indicative of the growth of traffic in the Ankang-Xunyang corridor.

20. The FSR OD survey and Jiaojiagou traffic counts were carried out shortly before the Shaanxi sections of the G7011 were opened.

Table 5: G316 traffic count locations

Name	Type	Available record	Location
On project road, from east to west			
Luhe	Project station	2012, 2014x2	0.8km west of start point; 2nd 2014 count = corroborative count at km1860+200
Longyuang	Project station	2014x2	19km west of start point; 2nd 2014 count = corroborative count at km1877+200
Guanmiao	Former toll	2004-11, 2012, 2014x2	Former toll station (now weigh station) approx.35km west of start point; 2nd 2014 count = corroborative count at km1893+100
Other sites			

Name	Type	Available record	Location
Jiaojiagou	Regular	2004-12, 2014	East of project start point and east of western Shitian connector
Luhe	Toll	2012, 2014	Measures traffic joining/leaving the Shitian expressway,

Sources:FSRs, FSR updates

Table 6: G316 traffic, 2005-14

Year	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
Jiaojiagou												
2004	0	1,029	193	165	229	237	0	1,853	1,853	1,222	631	2538
2005	0	524	143	310	457	372	0	1,806	1,806	667	1,139	3200
2006	0	895	248	319	372	442	0	2,276	2,276	1,143	1,133	3470
2007	0	509	71	181	137	136	0	1,034	1,034	580	454	1410
2008	258	894	42	208	210	308	181	2,101	1,843	936	907	3386
2009	251	1,445	135	222	326	336	257	2,972	2,721	1,580	1,141	4768
2010	742	1,286	102	196	380	470	258	3,434	2,692	1,388	1,304	5434
2011	546	1,344	70	181	244	390	202	2,977	2,431	1,414	1,017	4525
2012	598	1,947	148	183	161	229	141	3,407	2,809	2,095	714	4445
2014	1,307	2,459	227	220	149	404	207	4,973	3,666	2,686	980	6,971
Luhe												
2014	432	609	0	4	18	508	0	1,571	1,139	609	530	2,596
2014[b]	374	715	0	144	15	21	168	1437	1063	715	348	1,991
Longquan												
2014	258	599	0	46	131	1,772	0	2,806	2,548	599	1,949	6,416
2014[b]	142	783	1	586	14	74	427	2,027	1,885	784	1,101	2,711
Guanmiao												
2004	-	259	-	123	98	10	22	-	526	292	234	703
2005	-	392	-	155	143	14	27	-	747	440	307	976
2006	-	425	-	168	153	16	30	-	811	477	334	1067
2007	-	448	-	188	165	18	33	-	873	504	369	1156
2008	-	450	-	190	157	21	37	-	881	503	378	1192
2009	-	575	-	221	193	28	48	-	1,130	640	490	1621
2010	-	665	-	233	259	14	43	-	1,279	752	527	1759
2011	-	631	-	200	353	7	49	-	1,311	750	561	1864
2012	572	430	141	317	416	195	47	2,118	1,546	571	975	2,949
2014	751	1,231	18	1,678	264	975	0	4,917	4,166	1,249	2,917	7,008
2014[b]	1,012	2,462	120	2027	44	127	672	6,464	5,452	2,582	2,870	8,816

Source: FSR and updates; project counts
Note: (a) excludes motor-cycles
(b) corroborative count May 2014. Figures shown are raw 12h counts x 1.1 for all vehicles except large passenger vehicles, heavy goods and truck-trailers (all x 1.0)

21. Base year traffic. The two sets of 2014 counts (one by the DI in April and a corroborative count commissioned by the PPTA consultants in May) are, given the sampling errors inherent in one day counts, consistent, at least in total AADT terms. The principal issue is the high absolute numbers of heavy goods vehicles, both rigid and articulated, at the Longquan and Guanmiao sites. From observation these are construction vehicles; their use of the project road is likely to be short term, although of course it is certain that some construction-related traffic will persist. Accordingly, heavy goods traffic at these sites is drastically reduced before estimating base year traffic, as described below.

22. The following adjustments are made:

- at Luhe, base year traffic based on corroborative count only for heavy goods and the average of the two 2014 data sets for other vehicle classes
- at Longquan, heavy goods vehicles reduced from 501 to 250 per day. Base year traffic based on average of two 2014 data sets for passenger vehicles and light goods. For medium and heavy goods, adjusted corroborative counts used
- at Guanmiao, heavy goods vehicles reduced from 799 to 300 per day. Base year traffic based on average of two 2014 data sets for passenger vehicles and light goods. For medium and heavy goods, adjusted corroborative counts used

23. Figure 3 shows adjusted 2014 traffic at the three sites. The comparatively high traffic at Guanmiao is striking, but is confirmed by both sets of traffic counts in 2014.

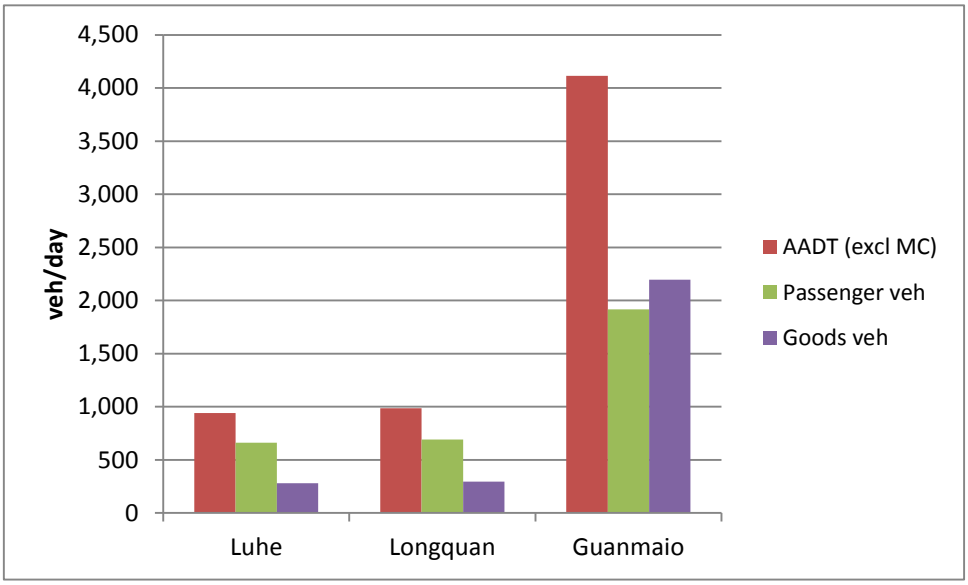


Figure 3: G316 traffic in 2014

24. For evaluation purposes the road is divided into three sections:

Table 7: G316: sections for evaluation

Section	km[a]	Traffic
A (subject to realignment)	17.5	Average of adjusted Luhe and adjusted Longquan
B (subject to realignment)	7.0	Average of adjusted Luhe and adjusted Longquan
C (reconstruction, little or no realignment)	9.9	Average of adjusted Longquan and adjusted Guanmiao
Total	34.4	

Note: (a) project road km

25. Table 8 shows estimates of base year traffic.

Table 8: G316 project road base year traffic

Section	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
A	302	677	0	52	16	31	189	1,267	965	677	288	1,391
B	302	677	0	52	16	31	189	1,267	965	677	288	1,391
C	541	1,269	35	942	29	45	230	3,091	2,550	1,304	1,246	3,447
A+B+C	371	847	10	308	20	122	171	1,792	1,421	857	564	1,983
Fleet %	21%	47%	1%	17%	1%	2%	11%	100%				

26. Hourly traffic flows are available for the three counts requested by the PPTA team in April 2014. The patterns at the project road three sites are similar:

- very little night-time traffic was observed. Between 22h00 and 06h00 3 percent of the daily total were observed at Luhe and 2 percent at Longquang and Guanmiao. 12h to 24h expansion factors are 1.2 at Luhe and 1.1 at Longquang and Guanmiao (all vehicle classes; there was no systematic variation between classes). The traffic flow pattern is of course heavily influenced by the preponderance of heavy goods vehicles at Longquang and Guanmiao
- no clearly identifiable morning or afternoon peaks. This applies to both goods and passenger vehicle traffic

27. The average pattern is shown in Figure 4.

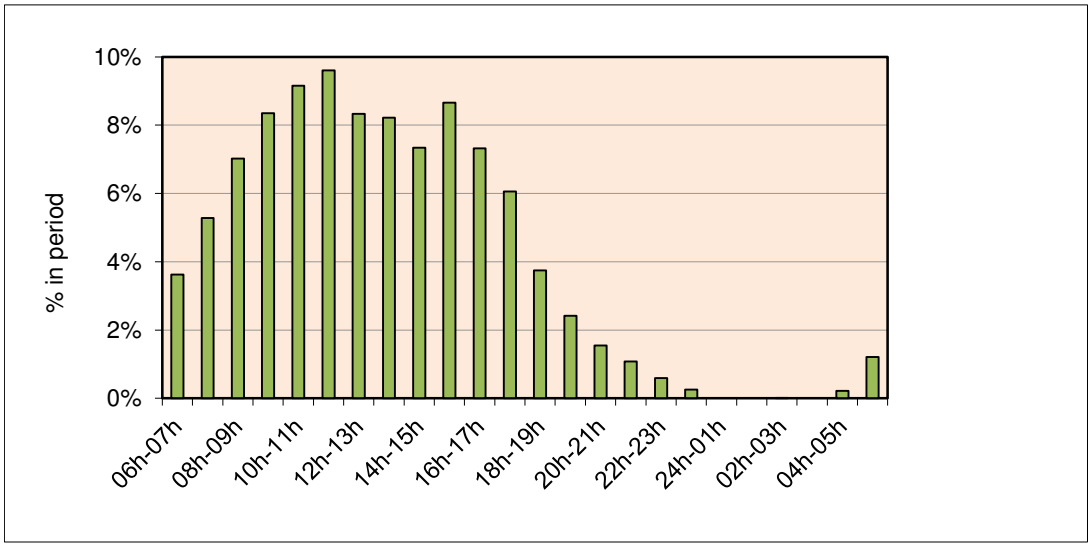


Figure 4: Hourly traffic, G316

c. S224 Shangnan to Weijiatai and Hubei boundary

28. The section of the S224 relevant to the PPTA evaluation runs from the G40 access road in the north to Weijiatai in the south. From Weijiatai it continues south and connects to sections in Hubei province. It is a two-lane road of local and regional significance. It connects settlements in Shangnan County to the urban center of Shangnan and to the G40 expressway.

29. There are no regular traffic count stations on the S224. Only project counts, undertaken in 2012 and 2014, are available for the project road. The FSR also reports annual, monthly and some daily traffic joining and leaving the G40 expressway at the ShangnanXi access point.

Table 9: S224 traffic count locations

Name	Type	Available record	Location
On S224, from north to south			
1 Shangnan city south	Project	2012,2014	North of G40 access road; captures expressway traffic; little relevance to S224 upgrade
2 Qingshan township	Project	2012,2014	Approx 13km south of start of S224 upgrade
3 Xianghe north	Project	2012,2014	37km south of start of S224 upgrade
4 Xianghe south	Project	2012,2014	40km south of start of S224 upgrade
5 Weijiatai	Project	2012,2014	54km south of start of S224 upgrade
6 Xiaolingguan	Project	2012,2014	78km south of start of S224 upgrade (south of end of original project road)
Other sites			
ShangnanXi access	Toll	2009-11	G40 access; captures traffic joining and leaving G40

Table 10: S224 project road traffic, 2005-14

Year	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
1 Shangnan city south												
2012	2,263	710	62	80	30	201	183	3,529	1,266	772	494	2,294
2014	893	978	78	107	46	229	215	2,546	1,653	1,056	597	3,711
2 Qingshan												
2012	437	588	73	210	116	84	24	1,532	1,095	661	434	1,866
2014	842	599	28	156	147	129	60	1,961	1,119	627	492	2,487
3 Xianghe north												
2012	195	410	71	243	53	51	8	1,031	836	481	355	1,216
2014	1,605	553	38	173	153	156	31	2,709	1,104	591	513	2,498
4 Xianghe south												
2012	184	368	66	243	43	58	10	972	788	434	354	1,172
2014	628	490	29	165	126	151	27	1,616	988	519	469	2,067
5 Weijiatai												
2012	244	387	46	204	41	40	10	972	728	433	295	1,108
2014	317	306	24	173	97	160	24	1,101	784	330	454	1,554
6 Xiaolingguan												
2012	188	336	73	156	32	30	16	831	643	409	234	991
2014	923	766	47	211	178	179	18	2,322	1,399	813	586	2,847
ShangnanXi G40 access												
2009								524				
2010								650				
2011								810				

Source: FSR and updates; project counts

Note: (a) excludes motor-cycles

30. Analysis of daily traffic. The G40 in Shangnan has been open since at least 2009 and so is irrelevant to traffic on the project road observed since 2012. No other network developments have affected project road traffic, as far as is known.

31. The figures below show observed traffic from north to south in 2012 and 2014. At stations 2-5, relevant to the originally proposed upgrade, traffic is consistent both along the existing road and reasonably so between years. In both years traffic at Weijiatai was approximately 70 percent of that at Qingshan, reflecting ever-increasing distance from Shangnan urban center. The results of the 2012 OD survey in the FSR confirm this: Shangnan urban center (zone 2) is the principal trip generator/attractor, accounting for 36 percent of all trips. Fleet composition remained approximately the same (approximately 45 percent goods vehicles) in both years at stations 2-4. Goods traffic accounts for a larger share at station 5, but this is attributable to fewer cars rather than an increase in trucks (whose absolute numbers are essentially the same at stations 4 and 5).

32. Observed traffic at stations 2-5 suggests an average of approximately 1,060 veh/day (excluding motor-cycles) over the original 54km to be upgraded. An MOC on 22 April indicated 104 veh/h (also excluding motor-cycles). The hourly traffic (see below) suggested a very high 1h:24h expansion factor of around 20. If a more conservative 12.5 is taken (as for the S102), the MOC suggests average daily traffic of 1,300 veh/day. This provides some confirmation that daily traffic using the DI data is not overstated.

33. The main issue with daily traffic on the S224 is the apparent jump in traffic at station 6 in 2014, a jump that was neither evident in 2012 nor during the MOC on 22 April. The MOC recorded 70 veh/h over this section (and only 40 veh/h on the connecting road in Hubei province). The MOC for this section took place between 10h30 and 11h30. Allowing for the usual late morning lull, the equivalent daily traffic would be around 1,000 veh/day (excluding motor-cycles).

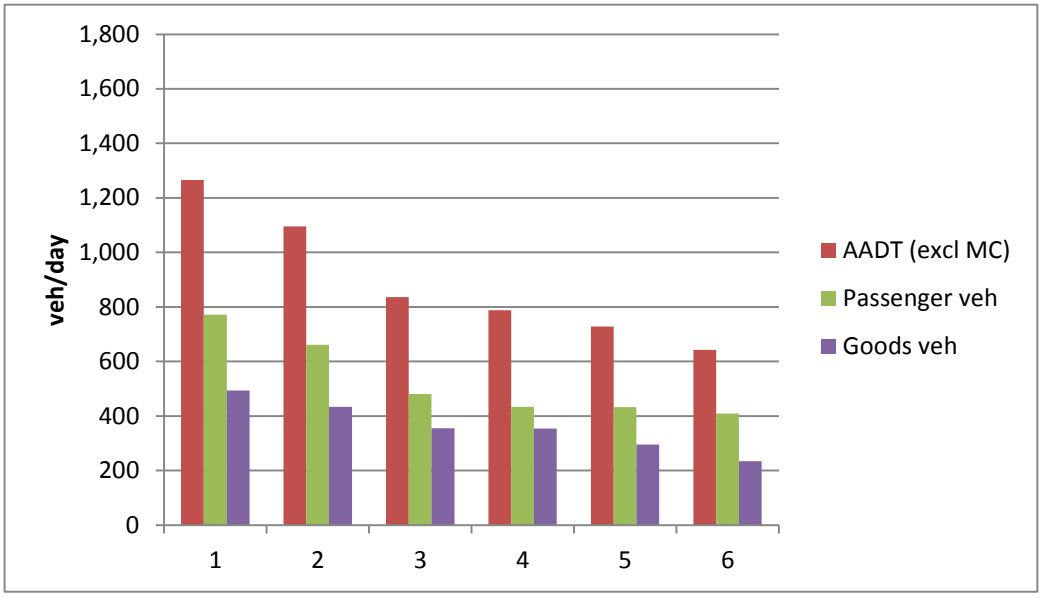


Figure 5: S224 traffic in 2012

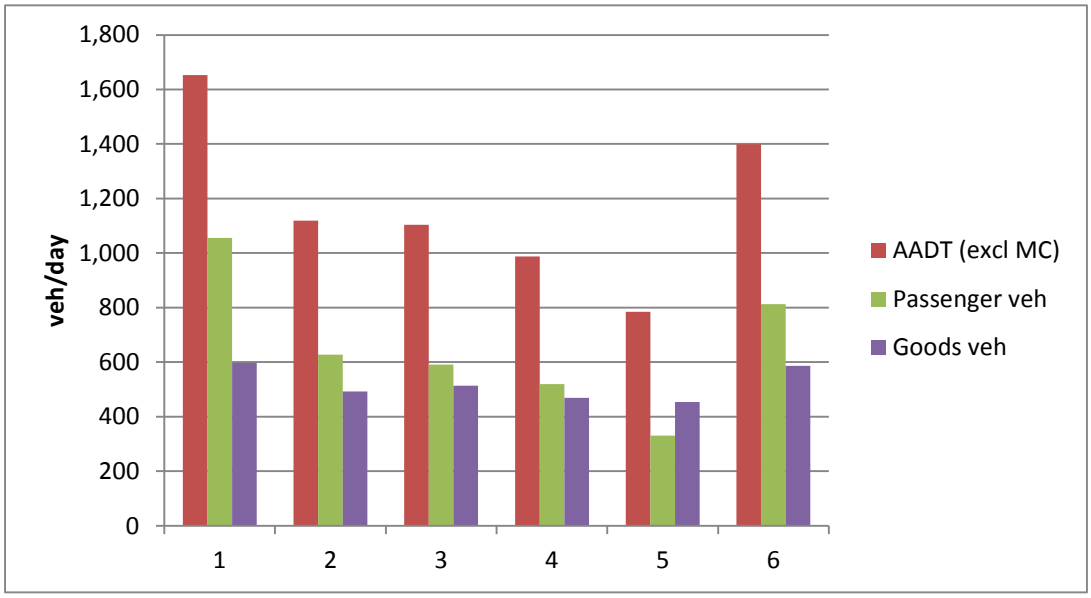


Figure 6: S224 traffic in 2014

34. In conclusion, observed traffic at stations 2-5 is a sound basis for projections on the original planned upgrade to Weijiatai, but observed traffic at station 6 cannot be used alone for the section south of Weijiatai to the Hubei provincial boundary. For this section a weighted average of 0.8 x station 5 + 0.2 x station 6 is used.

35. Estimate of base year traffic. Based on traffic and proposed changes in horizontal alignment, the S224 is divided into five sections for evaluation purposes, as set out below.

Table 11: S224: sections for evaluation

Section	km	Traffic
A	3.6	Station 2
B	7.1	Station 2
C	31.3	Average of stations 2 and 3
D	11.6	Average of stations 4 and 5
E (proposed new section)	38.0	0.8 x station 5 + 0.2 x station 6

Table 12: S224 project road base year traffic

Section	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
A	842	599	28	156	147	129	60	1,961	1,119	627	492	2,500
B	842	599	28	156	147	129	60	1,961	1,119	627	492	2,500
C	1,224	576	33	165	150	143	46	2,335	1,112	609	503	2,800
D	473	398	27	169	112	156	26	1,359	886	425	462	1,800
Av A-D	984	542	31	164	141	143	44	2,049	1,064	573	492	2,550
Fleet %	48%	26%	2%	8%	7%	7%	2%	100%				
E	438	398	29	181	113	164	23	1,345	907	427	480	1,800

Section	Passenger veh			Goods vehicles				AADT	AADTx[a]	Pax	Gds	PCU
	MC	L	H	L	M	H	T					
Av A-E	758	482	30	171	130	151	35	1,757	999	512	487	2,200
Fleet %	43%	27%	2%	10%	7%	9%	2%	100%				

36. Hourly traffic flows are available for stations 2-6. Figure 7 shows simple averages for five traffic count stations. The surprising feature is the large share of nighttime traffic. Averaged across all stations, 13 percent of traffic (including motor-cycles) occurs between midnight and 06h00 (compared with 2 percent on the S102). The proportion is higher at the northern end – 15 percent for stations 2 and 3. This is mainly attributable to goods vehicles, 25 percent of which travel between midnight and 06h00 at stations 2 and 3. Examination of the absolute numbers of vehicles suggests that these vehicles are not using the entire road – they are confined to the northern sections. Access to the G40 may be the reason for these nighttime flows, but as goods vehicles are generally reluctant to use tolled roads this is unlikely to be the complete explanation.

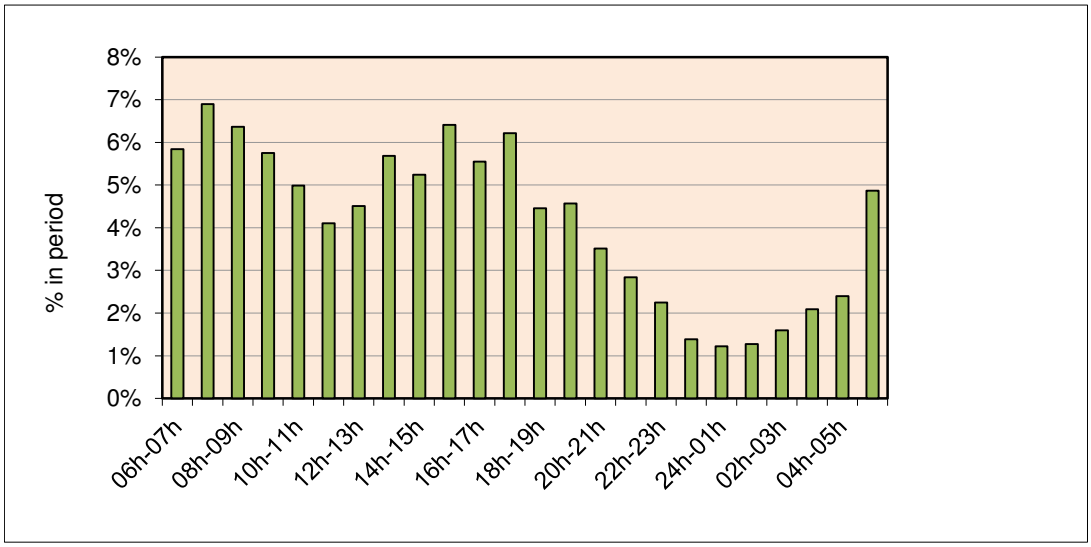


Figure 7: Traffic distribution, S224

4. Normal traffic growth

a. Introduction

37. The demand for transport is related to the output of the economy. Traffic is almost invariably positively correlated with economic activity, measured in various ways, and traffic growth similarly with growth in economic activity. In the most general terms the relationship is as follows:

$$Q = k(Y)^e$$

where *Q* is some measure of demand for transport, *k* is a constant and *e* is the elasticity of demand for transport with respect to some measure of real economic activity, *Y*. Elasticity is the proportional change in demand per unit change in economic activity, so an elasticity of 0.2 implies a 2 percent growth in travel demand in response to a 10 percent increase in real economic activity. Elasticities can be calculated by plotting indices of transport demand against indices of real GDP (or some other measure of economic activity) and fitting a power curve

using least squares regression. The elasticity is then the exponent of the GDP index.

38. In the case of passenger traffic, the measure of economic activity would typically include measures of population or household as well as income growth (e.g. GDP per head). For goods traffic GDP is the usual measure of economic activity and for passenger traffic GDP/head. In the PRC, however, it is usual to use GDP growth as the explanatory variable for both goods and passenger traffic – in analytical terms GDP and GDP per head growth rates are practically the same if population growth rates are stable, as they are in the PRC.

39. Ideally, growth rates would be inferred from records of vehicle-km for traffic in the project corridor. Such records do not exist, however, and inferences have to be drawn from:

- other studies
- historic traffic
- the growth of the provincial vehicle fleet
- national passenger-km and tonne-km statistics

b. FSR growth rates

40. FSR estimates are shown in the table below. They refer to rates of growth of traffic expressed as PCU and with the exception of the S224 exclude generated traffic. The values tabulated are simple averages of growth rates for each road section (in practice there is little variation between sections). Only in the case of the G316 is an opening year traffic estimate available.

Table 13: FSR traffic growth rates

Road	Period	Growth rate of normal traffic[a]
S102	2016-20	9.5%
	2020-25	7.7%
	2025-30	7.1%
G316	2012-16	22.4%
	2016-20	8.1%
	2020-25	4.3%
	2025-30	4.2%
S224[b]	2016-21	9.9%
	2021-26	8.3%
	2026-31	6.6%
	2031-36	5.5%

Sources: *G316 and S224 – project FSRs; S102 – supplementary note received April 2014*

Notes: *(a) traffic in PCU (including motor-cycles)*

(b) growth rate applies to traffic including generated traffic

41. Estimates in the table above exhibit a fair amount of variation. Consensus ranges are 8-10 percent in 2016-20, falling to 4-8 percent in 2020-5 and 4-7 percent in 2025-30.

42. Some information on comparative growth rates for passenger and goods vehicles can be gleaned from the FSRs:

- the S102 FSR (table 3-4 of April update) implies average rates of 5.1 percent and 5.6 percent for buses and trucks respectively
- the G316 FSR (table 3-18) implies average rates of 8.4 percent and 8.6 percent for buses and trucks respectively
- the S224 FSR (table 3.15) reports elasticities (with respect to county and city level GDP). For 2010-15 bus and truck elasticities are 0.95 and 1.0 respectively. Thereafter a single elasticity of 0.95 is used for both buses and trucks

43. The point to note is that truck traffic growth is in all cases assumed to equal or exceed that of bus traffic. In fact recent traffic data do not support this assumption (see below).

44. Some motorcycle growth rates are somewhat anomalous. Overall the average is around 5 percent per annum, but for the S102 are close to zero for 2020-25.

c. Estimates using historic traffic

45. Project road AADT records long enough to merit analysis are available at Guanmiao (G316), Qingni (S102) and Jiaojiagou, although the latter is just east of the start of the G316.

46. Figure 8 shows AADT excluding motorcycles against year at all three stations. Note that there are no records at Jiaojiagou for 2013; the points shown are simply interpolated between 2012 and 2014. Jiaojiagou traffic was undoubtedly affected by closure of the Luhe ferry in 2011. Qingni's surge in flow prior to 2010 can be traced to a spurt in goods vehicles of all classes, perhaps attributable to construction activities. Guanmiao, being a toll station, and therefore free of sampling errors, should be the best evidence of historic growth.

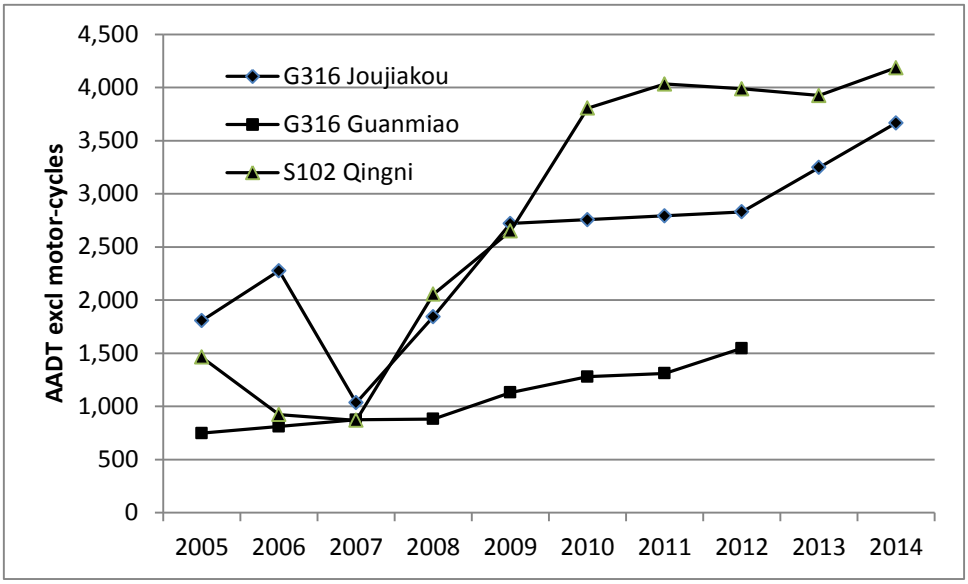


Figure 8: Annual AADT, 2005-14

47. Best estimates of historic growth from the data shown in the figure can be estimated by fitting trendlines as follows:

$$\ln(\text{traffic}) = a \times \text{year no} + b$$

where a is the annual growth rate.

Table 14: Growth rates from historic traffic

Site	AADT excluding motor-cycles	Passenger AADT	Goods AADT
Guanmiao	10.6% (2005-12) 9.6% (2009-12)	9.8% (2005-11)	10.7% (2005-11)
Jiaojiagou	5.7% (2009-14)[a]	No fit possible	
Qingni	10.6% (2008-14) 6.8% (2009-14)	10.8% (2008-14) 8.4% (2009-14)	10.2% (2008-14) 2.4% (2009-14)

Sources: *PPTA consultants' estimates*
Note: *(a) values for 2011-12 interpolated*

48. Table 14 suggests that traffic growth has slowed to around 7-9 percent and that passenger and goods vehicle growth rates are converging.

d. Estimates using provincial statistics

49. As most trips on project roads are local or regional, city and provincial GDP growth rates are the most relevant indicators of income growth. In fact there is little difference between them: annual Shaanxi GDP growth averaged 14 percent over the period 2008-12, while Ankang and Shangluo enjoyed a slightly higher rate of 15 percent.

50. Figure 9 shows passenger-km and tonne-km plotted against Shaanxi GDP. Data are plotted as indices with 2008=100. The exponent of a best fit power curve provides estimates of income elasticity:

- 1.28 for goods tonne-km
- 1.00 for passenger-km

51. These elasticities imply goods and passenger traffic growth of 18 and 14 percent respectively.

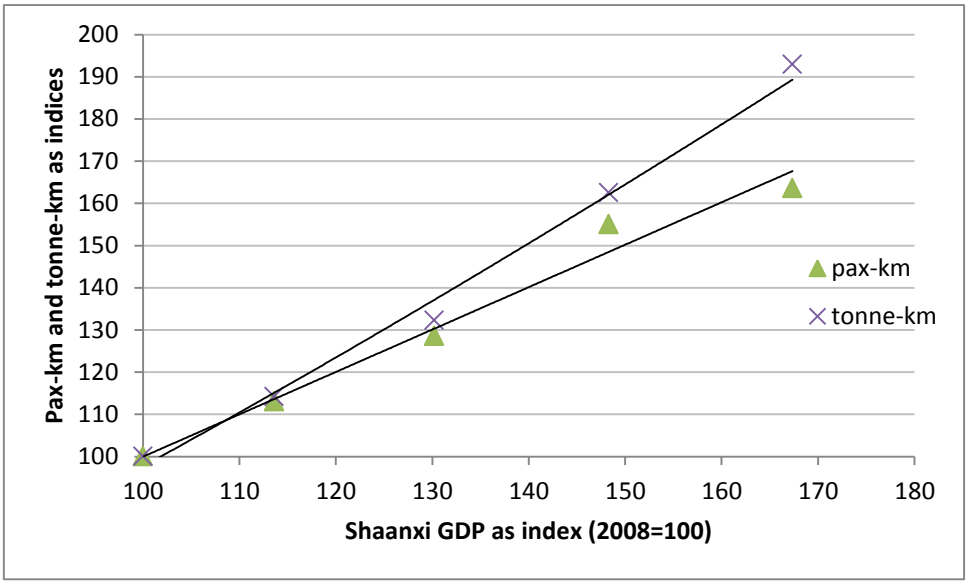


Figure 9: Shaanxi transport demand elasticities

52. Energy use is also a proxy for transport demand. National statistics include a "petroleum balance", which includes energy consumption in tonnes for transport, storage and post. The compound growth rate for the period 2005-11 is 8.7 percent, dropping to 6.4 percent for 2008-11 (2012 data will be published in the 2014 yearbook). The Shaanxi yearbook goes into more detail, giving gasoline and diesel consumption for transport only. Only data for 2012 and 2011 are available. The 2011-12 growth was very low, just 2.3 percent (from 3.84m to 3.93m tonnes).

e. Adopted normal traffic growth rates

53. Table 15 summarizes growth estimates from various sources.

Table 15: Normal traffic growth, various sources

Source	Growth rate
FSR forecasts (typically for 2016-20)	8-10%
Historic traffic (2009-2012 or 2014)	6-10%
Shaanxi passenger and tonne-km elasticities (2008-12)	14-18%
National energy use (2008-11)	6%
Shaanxi transport energy use (2010-11)	2%

Source: PPTA consultants' estimates

54. The wide range is only too apparent. Giving more weight to historic traffic and the FSR estimates, a starting growth rate for all roads of 9 percent is adopted. Based on the evidence from recent traffic, and FSR calculations, it is assumed that passenger and goods traffic grow at the same rate.

55. Historically, motorcycle traffic growth has shown huge year-to-year variation, even at the Qingni automatic traffic count station. Shaanxi provincial data actually show a small recent drop in the total number of motorcycles (from 2.46m in 2011 to 2.45m in 2012). Across the FSRs the average assumed motorcycle growth rate for 2016-20 is 6.5 percent, and the same rate is adopted here as the opening growth rate.

56. Future traffic growth will be driven by GDP growth and, ultimately, by a weakening of income elasticities. Although Shaanxi GDP growth has been greater than that for China as a whole, it is likely to mirror the slow decline in future national growth.

57. Short-term ADB China GDP growth forecasts are 7.5 percent for 2014 followed by 7.4 percent for 2015 (source: ADB ADO 2014). The IMF is a little more cautious for 2015, suggesting 7.3 percent (source: IMF WO 2014). Longer-term forecasts are not widely available, although the OECD (Economic Outlook, 2013, vol 2013/1) forecast 8.4 percent for 2012-17, 5.4 percent for 2018-30 and 2.1 percent thereafter.

58. Table 16 shows adopted forecasts.

Table 16: Traffic growth: summary of adopted rates

Road		2014-17	2018-25	2026-36
All	Goods	9.0%	7.0%	4.5%
	Passenger	9.0%	7.0%	4.5%
	Motor-cycles	6.5%	4.5%	2.5%

Source: consultants' estimates

5. Corridor diversions

59. In the medium term none of the trunk roads is expected to suffer loss of traffic as the result of diversions to other roads or to other transport modes. Similarly, the upgrades are sufficiently modest that they are unlikely to attract traffic from other roads or other transport modes.

6. Generated traffic

60. Generated traffic, also known as induced traffic, comprises additional trips made as a result of a road upgrade, specifically as a result of a fall in transport costs. It is usually expressed as a percentage of normal traffic and usually applies more to passenger than to goods traffic.

61. Generated traffic is added to normal traffic within HDM-4.

62. The FSR consultants' generated traffic allowances are 4-5 percent (of normal traffic) for all three trunk roads. The FSRs make no distinction between passenger and goods traffic.

63. In this study the weighted average perceived passenger and goods vehicle road user costs (RUC)s in the reference and project cases are calculated and compared. The weighted average passenger vehicle perceived RUC in 2025 (mid-way through the evaluation) is CNY1.6/veh-km in the reference case (excluding motor-cycles) and CNY1.3/veh/km in the project case, a drop of 16 percent. For goods vehicles the comparable values are CNY1.9 and CNY1.7/veh-km, a drop of 11 percent. Applying elasticities of -0.3 and -0.2 for passenger and goods traffic respectively implies generated traffic of 5 and 2 percent. These percentages are applied throughout, except in the case of section C of the G316. In this case, where the reduction in RUC is much less, generated traffic percentages are halved.

64. Price elasticities are applied to changes in perceived cost in order to estimate percentages of generated traffic. A wide range of elasticities can be found in the literature: a "most likely" range of -0.1 to -1.1 for all day automobile traffic is quoted in Oum et al (World Bank, Jan 1990). Applying elasticities of -0.3 and -0.2 for passenger and goods traffic respectively implies generated traffic of 5 and 2 percent. These percentages are applied throughout, except in the case of section C of the G316. In this case, where the reduction in RUC is much less, generated traffic percentages are halved.

7. Study and FSR traffic forecasts compared

65. Study forecasts are compared with FSR forecasts in the figures below.

66. Forecasts for the S102 are very similar to 2020; thereafter study estimates are lower as a result of lower study traffic growth rates.

67. In the case of the G316 the difference arises from the FSR's adoption of very high traffic growth rates for the period 2012-16 (see Table 13 above).

68. In the case of the S224 the comparison is skewed by use in the FSR of the standard PCU factor of 1.0 for motor-cycles (see Table 1) and the huge growth in motor-cycle traffic at nearly all traffic count stations between 2012 (the basis for the FSR forecasts) and 2014 (the basis for study forecasts).

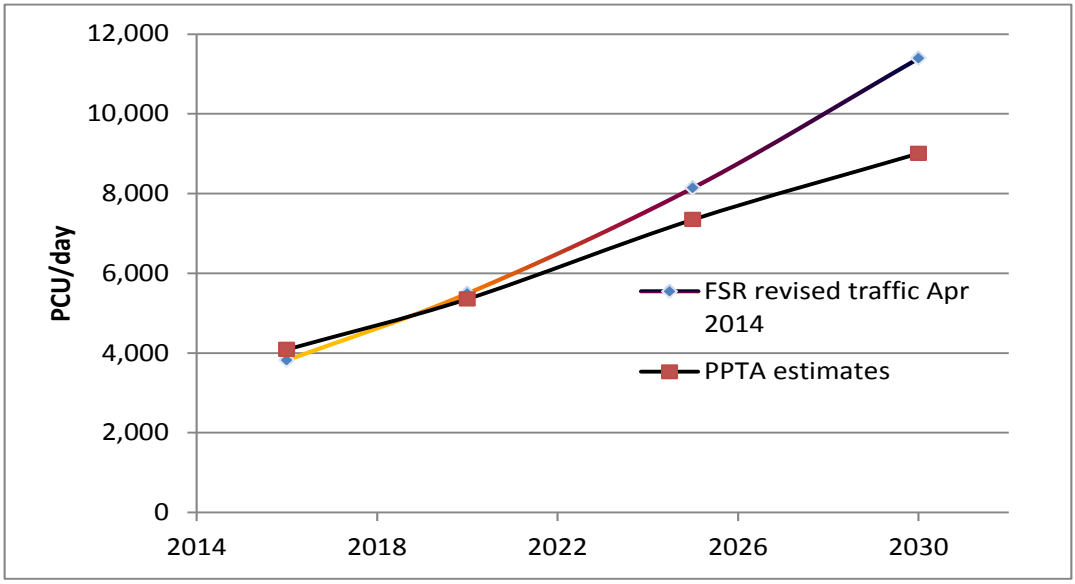


Figure 10: Study and FSR traffic forecasts: S102

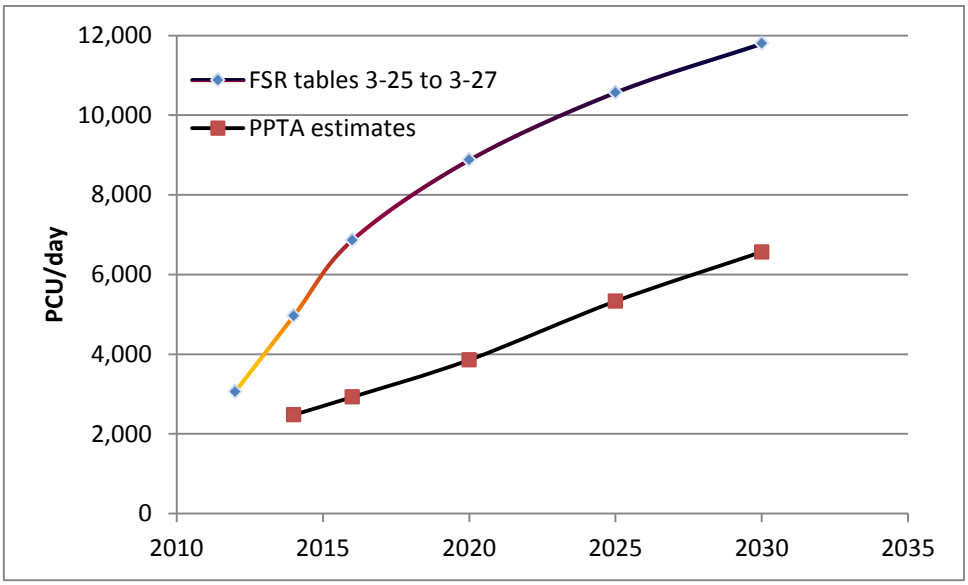


Figure 11: Study and FSR traffic forecasts: G316

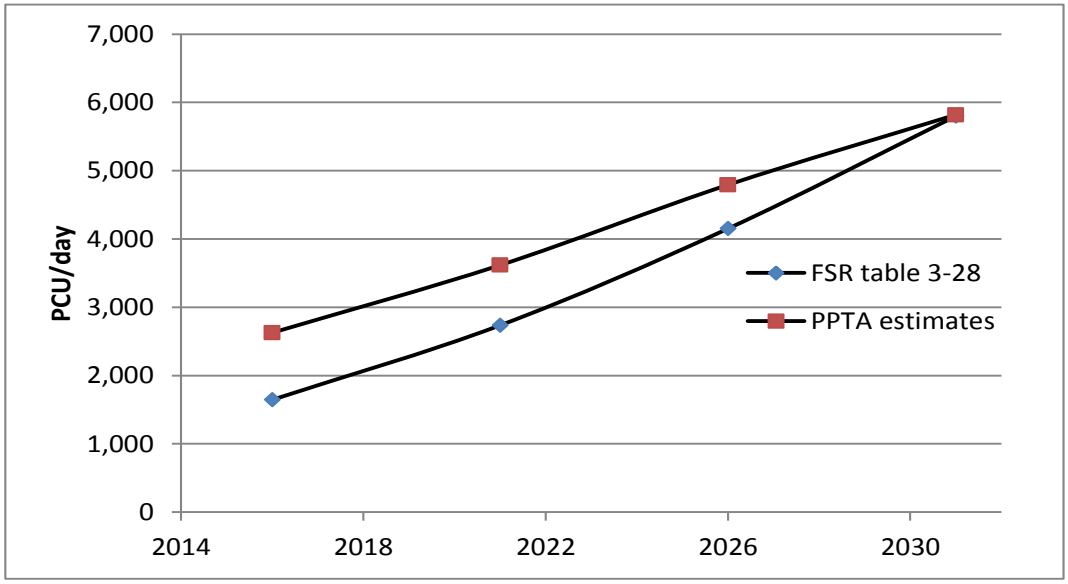


Figure 12: Study and FSR traffic forecasts: S224

8. Traffic flow patterns and speed-flow curves

69. HDM-4 requires traffic flow patterns, i.e. distributions of hourly flows across the 8,760 hours in a year. Traffic flow patterns are needed to evaluate congestion impacts, which are likely to be an issue for roads with pronounced peak flows (i.e. commuter roads). This is not the case here and congestion from inter-urban traffic is never more than a minor issue on any project roads during the evaluation period (the maximum ratio of volume to capacity is not forecast to exceed 0.5).

70. Hourly traffic data were used to estimate traffic flow patterns at a selection of sites. A selection is shown in the table below, together with the adopted distribution. The adopted distribution is similar to the MP default pattern in HDM-4.

Table 17: Traffic flow distributions

Traffic flow period	Hours		Adopted	Traffic count station			
	Cum	Int		S102-Qingni	G316–Luhe	S224-2	S224-5
1	365	365	9.0%	8.3%	10.2%	8.1%	3.5%
2	1,095	730	15.0%	16.7%	18.0%	13.8%	6.8%
3	2,190	1,095	20.0%	24.5%	25.0%	20.7%	9.9%
4	3,650	1,460	25.0%	32.3%	33.6%	24.9%	13.0%
5	8,760	5,110	31.0%	18.2%	13.2%	32.5%	66.8%
Total		8,760	100%	100%	100%	100%	100%

Source: consultants' estimates and HDM-4 documentation

71. Standard HDM-4 speed-flow curves were used. The "two lane" curve was used for the typical reference case 6.5-7m carriageway with narrow shoulders and the "two lane wide" curve for project case roads with ≥7m carriageways and wide shoulders.

C. TRAFFIC FORECASTS FOR RURAL ROADS

1. Base year traffic

72. Mid-week 12h traffic counts were undertaken in April 2014 and repeated at the time of the interim mission in July 2014. Observed traffic is shown in the tables below. For most roads (the exceptions are the C347 and the CH69) the July and April counts are as close as could be expected given the high variability of rural traffic.

73. Nighttime traffic is light on the G316 and S102 roads (24:12h expansion factors of approximately 1.1) but much heavier on the S224 (expansion factor of approximately 1.5). Nighttime traffic on hazardous rural roads is expected to be light; a nominal expansion factor of 1.1 is applied when estimating AADT.

Table 18: Rural roads observed 12h ADT, April 2014

	Road	km	Passenger veh			Goods vehicles				12h veh/day	12h veh/day excl MC	Pax	Gds	% goods
			MC	L	H	L	M	H	T					
1	X304 Shuhe-Xiaohe (km81 – western end)	38	121	196	10	48	24	132	0	531	410	206	204	50%
1	X304 Shuhe-Xiaohe (RR3 jnc, eastern end)	38	160	126	10	66	10	56	0	430	270	136	134	50%
1	X304 Shuhe-Xiaohe (c km83 – eastern end)	38	84	124	8	91	16	13	0	336	252	132	120	48%
2	C347 Lijiaba-Baiguo	7.2	21	3	0	4	0	3	1	32	11	3	8	73%
3	Beiguo-Luojia	11	75	20	0	54	0	0	0	149	74	20	54	73%
4	C852 Yangpo-Liangheguan	11.9	45	12	0	24	0	0	0	81	36	12	24	67%
5	Y305 Yanba-Dongqiao	12	35	35	6	35	20	10	0	141	106	41	65	61%
6	CH69 Zaobao-Yousheng	6.3	10	6	0	10	4	0	0	30	20	6	14	70%
7	CH39 Zaobao-Wujiashin	5	15	10	0	13	6	0	0	44	29	10	19	66%
8	Y338 Xianghe-Shuiguo (Linhuatai)	45	104	222	4	114	19	31	0	494	390	359	164	42%
8	Y338 Xianghe-Shuiguo (Qianjiaping)	45	108	233	4	122	26	40	0	533	425	237	188	44%
8	Y338 Xianghe-Shuiguo (Shuiguo)	45	112	231	4	126	25	43	0	541	429	235	194	45%

Source: DI counts

Table 19: Rural roads observed 12h ADT, July 2014

	Road	km	Passenger veh			Goods vehicles				12h veh/day	12h veh/day excl MC	Pax	Gds	% goods
			MC	L	H	L	M	H	T					
1	X304 Shuhe-Xiaohe (km76 – western end)	38	67	175	8	49	24	96	0	419	352	183	169	40%
1	X304 Shuhe-Xiaohe (eastern end)	38	102	125	10	49	10	56	0	352	250	135	115	46%
2	C347 Lijiaba-Baiguo	7.2	9	15	0	22	9	3	1	59	50	15	35	70%
3	Beiguo-Luojia	11	27	20	0	21	8	1	1	78	51	20	31	61%
4	C852 Yangpo-Liangheguan	11.9	27	11	0	29	9	2	1	79	52	11	41	79%
5	Y305 Yanba-Dongqiao	12	39	28	0	42	13	14	5	141	102	28	74	73%
6	CH69 Zaobao-Yousheng	6.3	20	20	0	23	6	0	0	69	49	20	29	59%
7	CH39 Zaobao-Wujiashin	5	20	23	0	20	8	0	0	71	51	23	28	55%
8	Y338 Xianghe-Shuiguo	45	40	168	4	55	18	44	0	329	289	172	117	40%

Source: DI counts

2. Base year traffic

74. The first step was to average April and July 2014 observed traffic. Restrictions imposed by RED, the chosen appraisal tool, mean that the base year for traffic has to be 2016. To convert 2014 12h observed traffic into an estimate of 2016 AADT the following adjustments are made:

- a nominal 24h:12h expansion factor of 1.1 is applied (the same as that found from hourly traffic on the G316 and S102 trunk roads)
- 11 percent growth from 2014 to 2016 assumed (using growth rates below)

75. In general, there is only one traffic count per road. The exceptions are the X304 (two April 2014 counts plus a 2012 count) and the Y338 (three April 2014 counts). In the case of the Y338 a simple April 2014 average is adopted, there being no significant difference between observed traffic at the three sites, before averaging again with the single July count,. In the case of the X304 adopted traffic is based on averaging the eastern and western end counts, with the 2012 count increased to 2014 levels using 2014-20 growth rates in the table below (constrained such that 2014 MiJiaPing traffic did not exceed the km81 April 2014 count).

76. Traffic estimates are at best indicative. Trips on rural roads are generated by agricultural activities, and will show strong daily, weekly and seasonal variation, none of which are here taken into account.

77. Weighted average daily traffic on all eight roads is 290 veh/day (220 veh/day excluding motor-cycles).

Table 20: Rural roads base year (2016) traffic

Road	Passenger veh			1.	Goods vehicles				ADT	ADTx[a]
	MC	L	H		L	M	H	T	2.	3.
1 X304 Shuhe-Xiaohe	162	175	12	4.	83	18	78	1	529	367
2 C347 Lijiaba-Baiguo	26	4	0	5.	5	0	4	1	40	14
3 Beiguo-Luojia	93	25	0	6.	66	0	0	0	184	91
4 C852 Yangpo-Liangheguan	56	15	0	7.	29	0	0	0	100	44
5 Y305 Yanba-Dongqiao	43	43	7	8.	43	24	12	0	172	129
6 CH69 Zaobao-Yousheng	12	7	0	9.	12	5	0	0	36	24
7 CH39 Zaobao-Wujiashin	19	12	0	10	16	7	0	0	54	35
8 Y338 Xianghe-Shuiguo	133	280	5	11	148	28	47	0	641	508

Source: PPTA calculations

Note: (a) excluding motor-cycles

78. Some roads are impassable for short periods to all save motor-cycles and SUVs. This is taken into account in the economic evaluation.

3. Normal traffic growth

79. There are no rural roads feasibility study reports, but the DIs have in some instances produced forecasts of normal and generated traffic. Their normal traffic growth rates are typically 5.4-7 percent for 2015-20, 4.2-5.5 percent for 2020-5 and around 3 percent for 2025-35.

80. The growth rates of traffic on quiet rural roads are inherently highly variable (as are the absolute levels of traffic). Assumed growth rates are therefore highly uncertain.

81. Rural incomes per head in Shaanxi have grown rapidly in recent years, as elsewhere in China. Nominal rural net income per head grew by 18 percent per annum over the period 2010-12, compared with 15 percent for urban households (source: Shaanxi statistical yearbooks, table 22-6). Nationally, the comparable values are 13.3 percent and 12.9 percent (for 2006-10). This is offset by low absolute levels of income: rural incomes are generally 25-30 percent of urban incomes. More importantly for transport demand, it is also offset by falling population. Between 2007 and 2012 Shaanxi's rural population fell by 3.2 percent a year, while its urban population rose by 4.5 percent. As a result, the ratio of rural to urban population fell by 7 percent annually over this period. (Source: Shaanxi statistical yearbooks table 4-1).

82. The arguments above suggest that rural traffic will in general grow more slowly than inter-urban traffic on the trunk roads, reflected in the proposed growth rates in the table below.

Table 21: Rural traffic growth: adopted rates

Road		2014-20[a]	2021-25	2026-35
All	Goods	5.5%	4.0%	3.0%
	Passenger	5.5%	4.0%	3.0%
	Motor-cycles	6.0%	5.0%	3.0%

Sources: consultants' estimates
Note: (a) aligned with standard intervals used in RED

4. Generated traffic

83. As with normal traffic growth rates, the DIs have in some instances produced estimates of generated traffic. The values seen are typically 5 percent of normal traffic – a low value given the large reduction in road user costs brought about by upgrading rural roads in very poor condition.

84. RED allows users to either enter generated traffic as a percentage of normal traffic or as a price elasticity for each vehicle type (an option not available in HDM-4). Using elasticities has a distinct advantage: it means that the percentages of generated traffic will automatically adjust to changes in assumed roughness. This is the approach followed.

85. Guidance from DFID (Rural Transport Knowledge Base 2001) suggests a range of -0.6 to -2.0, with an average of -1.0. A value of -1.0 is adopted. The table below shows the elasticities assumed and the approximate resulting percentages of generated traffic for alternative interventions (percentages are approximate as they vary if different IRI or journey time value assumptions are made).

Table 22: Generated traffic

Vehicle class	Price elasticity	Generated traffic as % normal[a]	
		From: unimproved bitumen IRI=15 To: concrete IRI=3	From: poor unpaved IRI=20 To: concrete IRI=3
Passenger & goods	-1.0	20%	40%

Sources: consultants' estimates
Note: (a) for typical rural road improvement scenarios shown

Appendix H

PPTA 8440 Economic Evaluation of Project Components

Contents

List of tables

I. INTRODUCTION

A. CONTENTS

1. This appendix describes the economic evaluation of proposals to upgrade three trunk road sections and eight rural road sections, and carry out safety improvements on 25 sections of additional rural roads. It is arranged in four sections: after this introductory section, section II deals with the trunk road components, section III with the rural road components and section IV with the additional roads.

B. GENERAL APPROACH

2. Each project component is evaluated using broadly the same basic approach. Conditions over a 20-year evaluation period from the assumed year of opening are compared for two cases: a do minimum (reference) case and a project case. The reference case represents future conditions in the absence of the project. Trunk and rural road components are evaluated using HDM-4 (version 2.08) and RED respectively, while the evaluation of the additional roads makes use of ChinaRAP values.

3. All predicted project costs and benefits are measured in 2014 economic prices[1] using the world price system and a domestic unit of account. That is, prices of traded goods (e.g. fuel) are expressed at world price levels plus or minus transport and distribution costs. Costs and benefits include: (i) the economic costs of construction, (ii) the economic costs of operation and maintenance, (iii) savings in road user costs (RUCs), (iv) savings in the economic costs of fatalities, injuries and crashes and (v) an estimate of the benefits of generated traffic. A major focus of the project is the reduction of fatality, injury and crash costs. A parallel ChinaRAP consultancy is responsible for proposing and evaluating safety interventions on the trunk and rural road sections and for planning a comprehensive road safety program that includes safety interventions on 566km of roads in southeast Shaanxi.

4. The FSRs use an 8 percent discount rate, whereas 12 percent is the rate conventionally applied by ADB and is the rate used here.

[1] Economic prices measure the value of project inputs and outputs in terms of the consumption of real resources. They differ from financial (market) prices. For goods that are not tradable this means excluding taxes and subsidies and making adjustments where market prices do not reflect the value of resources consumed (see note below on shadow wage rates). For tradable goods it means using world market (border) prices converted to domestic equivalents using the SER and adding transport costs.

II. EVALUATION OF THE TRUNK ROAD COMPONENTS

A. INTRODUCTION

1. Project rationale

a. Introduction

5. Three road improvement components are proposed:

- S102 Xunyang to Xiaohe (existing alignment 68.3km)
- G216 Xunyang to Ankang (existing alignment 37.9km)
- S224 (formerly X201) Shangnan to Hubei border (existing alignment 97km)

6. All three roads have poor vertical and horizontal alignments and poor pavement conditions; they are predominantly a mixture of Class III and IV standard highways. The proposed upgrades will, as far as possible at reasonable cost, achieve Class II standard. None is a strategic link. None is likely to attract traffic from other roads or transport modes and, to the best of the consultants' knowledge, none is likely to lose traffic to other roads or modes in the medium term.

7. The rationale for the upgrades, then, is the conventional one of increased consumer surplus (i.e. reduced road user costs), but with a much greater emphasis on road safety benefits than is usually the case. As explained above, a parallel consultancy is responsible for proposing and evaluating safety interventions on the trunk and rural road sections (and for planning a comprehensive road safety program which includes safety interventions on up to an additional 566km of roads in south-east Shaanxi). The costs and benefits of the road safety interventions on the trunk road sections are summarized in this section to the extent that they were available at the time of reporting.

2. Evaluation period

8. A well-maintained road can have an economic life of 70-100 years. With a discount rate of 12 percent, however, costs and benefits after about twenty years have little bearing on the analysis. The evaluation period is 20 years from opening in early 2020. 2020 is taken as the first full year of benefits and 2039 the last year of the evaluation period.

3. Pricing assumptions

9. The economic evaluation uses 2014 prices. The world price system is used with a domestic unit of account, meaning that traded goods are expressed at border parity prices, non-traded goods at market prices less taxes and labor at the value of output foregone. Cost estimates are already at 2014 prices and therefore require no adjustment for inflation. The calculations in Table 1 lead to a shadow exchange rate factor (SERF) of 1.03 and a standard conversion factor (SCF) of 0.97. With a financial exchange rate of $1 = CNY6.14 (Mar 2014 rate), this gives a shadow exchange rate of $1 = CNY6.32.

Table 1: Calculation of SERF

	2008	2009	2010	2011	2012
Imports of goods & services, US$ bn (cif) (Z)	1,132	1,004	1,396	1,742	1,819
Exports of goods & service, US$ bn (fob) (X)	1,429	1,202	1,578	1,899	2,049
Import duties, US$bn (TZ)[a]	179.0	150.8	205.4	280.0	310.0
Export subsidies, US$bn (SX)	84	95	108	142	165
Tax on production of exports, US$bn (TX)[b]	229	192	252	304	328
SCF[c]	0.99	0.98	0.98	0.97	0.96

	2008	2009	2010	2011	2012
SERF = 1/SCF	1.01	1.02	1.02	1.03	1.04

Sources: *China National Statistics 2009-13 for imports, exports & export tax rebates, IMF for duties 2008-10*
Notes: *(a) for 2011-12, import duties factored from China National Statistics data for VAT and consumption taxes on imports*
(b) estimated at 16 percent of exports
(c) SCF = (X+Z)÷(Z+TZ+X-TX+SX)

10. All other items are valued at domestic prices less taxes with the exception of (i) unskilled labor, (ii) fuel and (iii) the capital cost of vehicles. Unskilled labor is at a shadow wage rate factor of 0.80 (i.e. 80 percent of the estimated wage rate on the project)[2]. This is intended to reflect the low productivity of unskilled labor drawn specifically from poor areas. The economic opportunity cost of capital is used as the social discount rate for the economic evaluation, i.e. 12 percent per annum.

11. At the time of reporting the only breakdown of cost by factor input is for the S224. Table 2 shows the estimate of the conversion factor, 0.93, based on S224 costs received in March 2014. The same conversion factor is used for all trunk road upgrades, for maintenance costs and for the additional roads. For the rural roads, expected to have a higher labor content, a conversion factor of 0.90 is used.

Table 2: Estimation of conversion factor

Item	CNY m
Financial costs	
Financial base cost (excludes all contingencies and financing charges)	395
Adjustment to economic prices	
Adjustment for shadow wages:	
(SWRF-1)x(CNY90 x 0.987 million unskilled labor days)	-17.8
Adjustment for border prices of tradable goods:	
Steel (rebar): 2,250t x (CIF price + transport of CNY4,320/t – financial price of CNY3,700)	+1.4
Steel (other): 1,920t x (CIF price + transport of CNY4,070/t – financial price of CNY5,020)	-1.9
Sawn timber:5621m^3 x (CIF price + transport of CNY5,640 – financial price of CNY1,830)	+2.0
Adjustment for taxes:	
Adjustment for construction composite tax	-10.8
VAT on equipment	-0.4
Total adjustment	-27.5
Economic costs	
Economic cost excluding physical contingencies	333
Implied conversion factor (CF)	0.93

Sources: *World Bank Pink Sheet, March 2014, worldsteelprices.com, PPTA consultants' estimates*

[2] A "shadow" price represents the opportunity cost to the economy of using resources. A shadow wage rate factor of 0.8 implies that hiring an additional unskilled person on a project only displaces output worth 80 percent of the wage paid. That is, *without* the project, the unskilled person would be producing relatively little (e.g. working on the land) – his or her *opportunity cost* to the economy would thus be lower than the going rate for unskilled labor.

4. Project and reference case costs

a. Initial investment costs

12. Component costs include initial investment costs, including physical contingencies (at 5 percent), the value of land acquired and the cost of compensating or relocating people affected by the project.

13. Any relatively minor incremental costs over the wider network are neglected. Table 3 shows economic costs used in the evaluations.

14. Initial investment costs are assumed to be spread over four years from 2016 to 2019 in the proportions 20:30:30:20.

Table 3: Trunk road economic investment costs (2014 CNY million)

Road	Status of estimate	Section[a]	km[b]	Total DI cost including all contingencies etc	FBC[d] excl LAR, financing & contingencies	LAR[e] cost excl taxes & contingencies	Economic base cost including physical contingencies at 5%	Economic cost/km	Safety I[f]	Safety II[g]
S102 – Xunyang-Xiaohe	PD		60.2	1,089	926	45	951	15.8	20.4	N/A
	FD		60.2	1.076	937	68 [h]	986	16.4	25.3	63.9
G316 – Xunyang-Ankang	PD	A+B+C	34.4	323	277	18.8	291	8.46	9.3	N/A
	FD	A+B+C	34.4	312	265	27.2 [i]	287	8.36	9.3	39.4
	FD	A	17.5	173	142	13.9	153	8.76		
	FD	B	7.0	123	107	5.5	111	15.9		
	FD	C	9.9	17	15.5	7.8	23.3	2.36		
S224 – Shangnan-Weijiatai	PD	A-D	49.6[c]	426	364	20.4	377	7.62	11.6	N/A
	FD	A-D	49.6[c]	424	369	19.4 [j]	380	7.69	15.4	23.3
S224 – Weijiatai - Hubei boundary	DD	E	38.0	61.1	57.7	0.9	57.3	1.51	0	N/A
	FD	E	38.0	65.2	62.9	13.5	75.6[d]	1.99[d]	5.7	12.9

Source: PD costs and PPTA consultants' estimates

Notes: (a) costs by section only available for the G316
(b) project road length
(c) excludes first 4.9km of road (on which no works are proposed)
(d) FBC = financial base cost
(e) net LAR costs at PD and DD stage are approximations
(f) safety I costs are the financial base costs of the ChinaRAP safety package identified separately in DI cost estimates (already included in DI, FBC and economic costs shown in the table)
(g)safety II costs are the estimated costs of safety-related features within the final design and which are additional to the ChinaRAP package (and similarly are already included in the DI, FBC and economic costs shown in the table)
(h) includes LAR for rural road no 1
(i) includes LAR for rural road no 5
(j) includes LAR for rural road no 8

b. Project residual value

15. To account for the value of the project remaining at the end of the evaluation period, a negative cost is included in 2039 equivalent to the remaining unused portion of the project's life (i.e. its residual value). Assuming that land has a life of 100 years, earthworks 50 years, pavement 20 years and structures 25 years, a weighted average life of 37 years is obtained. At the end of a 20-year evaluation period this implies a residual value that is 45 percent of the initial investment cost. Conventionally, however, rather lower values are used and 30 percent is adopted.

c. Project and reference case maintenance costs

16. Reliable estimates of road maintenance costs are notoriously difficult to obtain. Contractors' bids are the best source but are difficult to obtain and could not be obtained for Shaanxi (although some standard rates were made available and are shown in Table 5). Table 4 sets out some rates obtained from an ADB PPTA assignment in Yunnan; they are based on 2012 bid prices to which a nominal 20 percent have been added.

Table 4: Representative unit maintenance costs

	Seal	AC 60mm	AC 60mm + 170mm CTG	AC 80mm + 200mm CTG + 100mm sub-grade
Rate in CNY/m^2	25	65	103	140

Source: PPTA consultants
Note: rates are at financial prices and include physical contingencies

17. The rates in Table 4 imply approximately CNY450,000/km for a 6cm overlay on a 10m wide road and CNY175,000/km for a reseal.

18. HDM-4 requires detailed specification and costs of works per square meter and the intervention criteria that will trigger those works. Table 5 shows the values used for both project and reference cases. Where standard Shaanxi rates were available they are shown. The same values and criteria were used for all road sections. Use of Table 5 parameters generates approximately the overlay and re-seal costs per km described above.

Table 5: HDM-4 maintenance cost parameters

Intervention	Financial cost including physical contingencies	Intervention criteria
60mm overlay	CNY65/m^2 Preparatory works: - patching CNY15/m^2 - crack sealing CNY5/m^2 Shaanxi: CNY70-75/m^2 including preparation	IRI>10, interval ≥5 years, first intervention ≥2020
Reseal	CNY20/m^2 Preparatory works: - patching CNY15/m^2 - crack sealing CNY5/m^2 Shaanxi: CNY15-24/m^2 including preparation	5%≤wide structural cracking≤15%, average rut depth<20mm

Intervention	Financial cost including physical contingencies	Intervention criteria
Pothole patching	CNY120/m^2 (Shaanxi rate)	Potholes>5/km
Drain clearing and other off-carriageway	CNY5,000/km Shaanxi: CNY150-180 per labor day	Annual

5. Project benefits

a. Scope

19. Project benefits comprise savings in road user costs (RUCs, i.e. VOCs and user time costs), savings in the costs of fatalities, injuries and crashes and the benefits of generated traffic.

b. Road user cost savings – vehicle operating costs

20. Savings in road user costs comprise savings in VOCs and user time costs. The proposed improvements will delay the onset of congestion, improve pavement quality and slow down the rate of pavement deterioration.

21. Traffic forecasts have been prepared for eight motorized vehicle types (see appendix G). For the economic evaluation the "light passenger" vehicle class is divided into two: a medium car category and a small bus category. The former is assumed to account for 80 percent of the combined category.

22. Table 6 shows representative vehicles for which local price data were obtained.

Table 6: Representative vehicles

	Vehicle types	Models	Price in CNY '000 excluding taxes
1	Passenger car – compact	Xiali Chery QQ Benben /Auto	18-44
2	Passenger car- small	VW Polo/Hyundai	40-83
3	Passenger car – medium	Toyota Crown Audi A6	55-210
4	SUVs	Changcheng M4 Toyota RAV4 Audi Q7	70-350
5	Bus (Seats>30)	Jinlong Yutong	330-560
6	Light bus and passenger van (fewer than 15 seats)	Jinbei Jinlong	34-130
7	Medium bus (15 – 30 seats)	Jieou Toyota Coaster	140-240
8	Small truck (less than or equal to 2 tons capacity)	Dongfeng	70
9	Medium truck (2 axles with 2-7 ton capacity)	Dongfeng	75-100
10	Large truck (3 or more axles with 7-14 ton capacity)	Dongfeng Jiefang	83-93
11	Articulated truck i.e. truck-trailer (greater than 14 tons capacity)	Jiefang	210-250
12	Motor-cycles, 125-150cm^3	Jialing	5-7

Sources: Consultants' price surveys, 2012, updated 2014

23. Table 7 summarizes vehicle characteristics assumed for the present evaluation. Economic vehicle and tire costs are shown in Table 9. New vehicles are subject to VAT (17 percent), a tax depending on engine capacity (1-5 percent) and vehicle tax (10 percent), while new tires attract VAT, construction tax (3 percent) and education tax (7 percent).

24. Passenger numbers are taken from FSR origin-destination (OD) results for the G316 and S102. Small passenger vehicles (cars and small buses) carried an average of 4-5 passengers, while medium buses carried approximately 26 passengers.

Table 7: Vehicle characteristics

Vehicle class	Motor-cycle	Car	Small bus	Heavy passenger vehicle	Light goods	Medium goods	Heavy goods	Truck-trailer
HDM-4 base type	**Motor-cycle**	**Car medium**	**Minibus**	**Bus medium**	**Light truck**	**Truck medium**	**Truck heavy**	**Art truck**
Fuel type	Gasoline	Gasoline	Gasoline	Diesel	Diesel	Diesel	Diesel	Diesel
No of tires	2	4	4	6	6	10	12	18
Tire type	Radial	Radial	Radial	Radial	Radial	Bias	Bias	Bias
No of axles	2	2	2	2	2	3	4	5
Km/year	10,000	25,000	50,000	70,000	50,000	60,000	70,000	70,000
Hours driven/year	600	600	1,000	2,000	1,000	1,500	2,500	2,500
Working time, h/year[a]	1,500	1,200	2,000	3,000	2,000	3,000	5,000	5,000
Service life (year)	5	10	10	12	10	10	10	12
Av no of passengers	1.5	3	8	26	1.5	1	0	0
% time private use	50	50	10	0	20	0	0	0
Work related passenger trips, %	50	60	60	50	0	0	0	0
Gross vehicle weight, t	0.2	1.2	2.5	6	2	7.5	13	28

Source: manufacturers' and consultant's estimates
Notes: (a) working time = driving time + time spent loading, unloading and waiting for work. Working time has to be specified for HDM-4. Large values used for cars and motorcycles in order to avoid spurious savings in time related VOCs

c. Road user cost savings – journey time savings

25. Values adopted for working and non-working journey-time savings are also shown in Table 9. The values placed by travelers on travel-time savings are best established using revealed or stated preference surveys. In the absence of survey results it is usual to base values on incomes.

26. According to official statistics a representative range of total cash incomes from all sources in Shaanxi was CNY6-26 per hour in 2012, of which wages account for about 60 percent. For late 2013 this implies wage income of CNY4-18/hour (the upper end of this range is comparable to a migrant worker's basic wage in an electronics factory in an eastern province). The official Shaanxi daily unskilled labor rate used in the FSRs is CNY45.

27. Rates published in official statistics are widely considered to be well below market levels, however, and for use in HDM-4 official rates are doubled. Car passengers are assumed to value working journey-time savings at a rate of CNY50/hour, dropping to CNY30 (small buses), CNY20 (buses) and CNY10 (passengers in trucks and on motor-cycles).

28. Non-working time is valued at 25 percent of working time. This is a conventional percentage, although there is evidence from relatively poor countries that a higher value than this is placed on non-working time (*Valuation of Travel Time Savings: Empirical Studies in Bangladesh, Ghana and Tanzania: IT Transport for DFID, July 2005*).

29. The real value of passenger travel time will increase as income rises. The impact is significant. It is usually assumed that the value of journey-time savings rises in line with GDP per head. If GDP per head rises at the lower of 5 percent or forecast GDP growth adjusted for population growth, a typical result is that EIRR rises by 5-6 percent when compared with the results of an evaluation that makes no such allowance. HDM-4 does not accommodate increases in time values – they are fixed in real terms for the entire evaluation. There are ways around this. A conservative approach is simply to increase the single value of time such that its PV is the same as that of a value that increases at (say) 5 percent annually – conservative as it ignores the growth in passenger traffic. At this stage real changes in the value of travel time are ignored.

30. Goods in transit are unproductive – they represent inventory costs. Thus there is a value in reducing travel times. This value can be substantial for that portion of goods that are time sensitive, i.e. where the shipper or recipient bears substantial costs arising from late collection or delivery, or when time savings make an additional trip possible in a working day. Even then cargo holding costs are quite low: for a load of 1 tonne with a value of CNY10,000 (roughly the unit retail value of a tonne of gasoline) and a discount rate of 12 percent, saving one hour is worth CNY0.14. Allowing for increasing real unit values over time a value of CNY0.2 per tonne-hour is reasonable.

31. Much higher values are quoted in the literature. Reporting on an international survey of cargo holding values in developed countries, Button (*Transport Economics*, 3rd edition, 2010) cites values with a wide range but whose average is €38/tonne-hour. Many of these values are based on stated preference techniques; the small number of revealed preference results averages around €8/tonne-hour. Values in China are likely to be much lower, although decreasingly so.

32. For the analysis CNY0.2/tonne-hour is adopted.

d. Fuel costs

33. ADB's preferred approach is to deduct taxes from pump prices, rather than use a border parity price approach. Pump prices in late October 2014 were CNY6.94 per liter for 93 octane gasoline, CN7.45 for 97 octane and CNY6.58 for diesel. Assuming the predominant octane rating is 93, this gives economic prices of CNY5.9 (gasoline) and CNY5.8 (diesel). These values are used in the economic evaluation.

e. Labor costs

34. The costs of employing drivers, other crew members and maintenance staff are part of vehicle operating costs. Wages vary enormously; social costs are also not standard. The values in Table 8 are believed to representative of wages plus social costs in the project area.

Table 8: Labor costs

	CNY per annum	CNY per hour
Driver and crew	36,000	19
Maintenance labor	36,000	19

Note: hourly rates assume 1,920 hours worked per year

f. Other costs

35. Vehicles owned to carry out official duties or earn a commercial return have associated administration costs such as managing vehicle crews, organizing the use of vehicles and scheduling maintenance. In the light of data from previous studies, these and other overhead costs are set at 5 percent of the sum of all (other) financial VOCs. Since the resources involved are mainly skilled labor, for which the shadow wage rate factor is unity, the economic and financial costs are effectively the same. As the benefits of improved safety are considered separately, insurance is not included as an economic relevant cost.

Table 9: Economic values of vehicles, tires, labor and time

Vehicle class	Unit	Motor-cycle	Car	Small bus	Heavy passenger vehicle	Light goods	Medium goods	Heavy goods	Truck-trailer
Vehicle cost	CNY	5,000	100,000	100,000	375,000	150,000	245,000	395,000	590,000
Replacement tire	CNY	150	290	300	470	350	620	700	700
Maintenance labor	CNY/h	10	19	19	19	19	19	19	19
Driver	CNY/h	10	0	19	19	19	19	19	19
Driver's helper	CNY/h	-	-	-	10	10	10	10	10
Total crew	CNY/h	10	0	19	29	29	29	29	29
Annual overhead	CNY	600	3,000	5,000	20,000	7,500	14,000	19,000	19,000
Passenger working time	CNY/h	10	50	30	20	10	10	0	0
Passenger non-working time	CNY/h	3	12	8	5	3	3	0	0

Source: manufacturers' and consultant's estimates

g. Calibration of HDM-4

36. Work elsewhere in Asia has indicated that use of HDM-4's default coefficients for vehicle speed, maintenance, fuel consumption and tire wear will yield misleading results. In particular it will tend to predict higher speeds than those actually observed and lower maintenance, fuel consumption and tire wear.

37. Passenger vehicles in China are, from the HDM-4 perspective, the same as those in developed countries. Trucks, however, are frequently poorly maintained and overloaded and there is some justification for using modified coefficients. Tables 10-12 show adopted and HDM-4 default coefficients for speeds, maintenance and tire wear.

Table 10: Speed calibration coefficients

Vehicle type	VDES2 km/h	β, speed beta	ARVMAX	VCURVE		Braking power, kW
				VCURVE_a0	VCURVE_a1	
Heavy goods	80 (88.56)	0.70 (0.11)	130 (180)	1.1 (4.6)	0.50 (0.28)	100 (255)
Medium goods	90 (105.48)	0.55 (0.164)	130 (200)	0.9 (4.8)	0.55 (0.29)	30 (70)
Light truck	110 (128.16)	0.55 (0.191)	150 (200)	0.9 (4.8)	0.55 (0.29)	20 (45)

Sources: draft Priority Investment Plan Study (2007) for Dept. of Roads, Nepal and HDM-4
Note: HDM-4 default values are shown in brackets

Table 11: Maintenance cost parameters

Parameter	Goods vehicles
Labor hours constant	242.0 (242.0-301.46)
Parts consumption exponent of labor hours model	0.35 (0.52)

Sources: Fourth Road Improvement Project, 2000, for Dept of Roads, Nepal and HDM-4
Note: HDM-4 default values are shown in brackets

Table 12: Fuel consumption and tire wear coefficients

Vehicle type	Fuel consumption		Tire wear	
	IDLE_FUEL, ml/s	Kpea	Wear constant term, C0TC, dm^3	Wear coefficient, CTCTE, dm^3/J-m
Heavy goods	1.12 (1.12)	1.00 (1)	0.11 (0.003529)	0.003 (0.00275)
Medium goods	0.37 (0.37)	1.25 (1)	0.09 (0.02585)	0.004 (0.00201)
Light truck	0.37 (0.37)	1.00 (1)	0.06 (0.024)	0.003 (0.00187)

Sources: draft Priority Investment Plan Study (2007) for Dept. of Roads, Nepal and HDM-4
Note: HDM-4 default values are shown in brackets

6. Generated traffic

38. Generated traffic is additional trips made by existing users of the corridor because journeys are now cheaper or quicker and trips made by others who, in the absence of the project, are deterred from making them because the cost or time is perceived to be prohibitive. Estimates of generated traffic are made by calculating the generalized cost savings arising from each project and applying price elasticities. For further detail see **Appendix G**.

7. Greenhouse gas emissions

39. Changes in pavement quality affect engine performance which in turn affects tailpipe greenhouse gas (GHG) emissions. HDM-4 models outputs of hydrocarbons (HC), carbon monoxide (CO), the various oxides of nitrogen (NOx), sulfur dioxide (SO_2), particulates (PM), lead (Pb) and carbon dioxide (CO_2). The modeling framework used by HDM-4 calculates emissions from fuel consumption. This approach has been criticized and better alternatives proposed (see for example ETSU: *Emissions Modeling Framework for HDM-4*, working paper, 1997). A model written for ADB, TEEMP (Transport Emissions Evaluation Model for Projects, March 2014), was tried for the S102. It proved cumbersome to use but its results for reference case CO_2 emissions were very close to those generated by HDM-4.

40. Highway upgrades tend to reduce fuel consumption and hence GHG emissions. However, this gain is offset by the emissions of generated traffic and the carbon embedded in the construction of the upgrade, which is not included in the analysis.

41. Table shows net CO_2 emissions for all three trunk roads and compares the evaluation period impact with the reference case total. (Strictly speaking, all the contaminants should be converted to equivalent tonnes of CO_2, known as CO_2e. HDM-4 does not do this, but for vehicle emissions the difference between CO_2e and CO_2 is very small).

42. Overall, Table shows that net impacts are substantial for the S102 and S224, where substantial improvements are proposed. However, these gains are offset by the emissions of generated traffic and the carbon embedded in the construction of the upgrade, which is not included in the analysis. As the analysis is partial, the results are not included in project evaluation.

Table13: Trunk road CO_2 operational emissions

Road	2017	2020	2025	2030	2036	Ref case total, tonnes	Project case, tonnes	Saving, tonnes	Saving as % reference case	PV in CNY million
	Net impact, tonnes[a]									
S102	3,990	3,970	4,780	5,000	10,440	892,520	782,910	109,610	12%	3.7
G316	1,960	1,970	1,930	2,240	3,700	457,570	415,200	42,370	9.3%	1.6
S224									44%	14.5
A to D	11,530	13,650	18,950	23,380	31,370	916,500	513,110	403,380		

Source: Consultants' HDM-4 output
Note: (a) a positive net impact means a drop in emissions. Impacts do not include those of carbon embedded in construction

B. SAFETY BENEFITS

43. Road safety interventions and resulting changes in the expected costs of fatalities, serious injuries and crashes are handled by ChinaRAP as part of a separate consultancy, but are reported here in summary form.

44. The table below shows ChinaRAP's estimates of annual crash costs for each trunk road. To be compatible with the remainder of the economic analysis, safety benefits accrue from 2020. The PV at mid-year 2016 of an annuity from 2020 to 2039 inclusive is 5.32 times the annual crash cost saving: this is the basis of the PVs shown in the analysis tables below.

Table 14: Fatality, serious injury and crash cost annuities, CNYm

Road	Reference case	PD	FD
S102	381.1	370.3	353.7
G316	230.9	193.2	170.8
S224 (A to D only)	76.4	49.1	42.9
S224 (E)	49.7	-	28.5

Source: ChinaRAP
Notes: (a) this section was a late addition to the program and does not have a PD

45. Road safety costs and benefits are incorporated into the evaluations at project (rather than section) level. Safety costs shown in the trunk road evaluation tables are the PVs of FD total estimated road safety costs (e.g. CNY48.6m in the case of the G316), multiplied by 0.93, the conversion factor, and spread over the evaluation period in the same way as other investment costs (see above). Safety investment benefit-cost ratios (BCRs) are quoted in the text in each case and are given in order to be compatible with ChinaRAP's presentations.

C. EVALUATION OF TRUNK ROAD COMPONENTS

1. Introduction

46. Each evaluation compares project and reference case road agency and road user costs. In order to avoid the distortions that arise when a project case is compared with a reference case involving little maintenance, the same maintenance interventions are assumed for both the project and reference cases (see text above). This results in relatively low VOC savings; journey-time savings tend to dominate in the calculation of benefits.

47. Initial (reference case) road geometry is estimated from field GPS measurements. Project case geometry is calculated from design drawings. Initial pavement condition is not well established. Initial IRI roughness, which has a dominant impact on operating speeds, is fixed by ensuring that predicted and observed survey vehicle operating speeds are consistent. Other pavement characteristics (cracking etc) are only reported in DI documents for S224 section E; for other sections adopted values inferred by comparison with S224/E. (Within the usual bounds, evaluation results are not highly sensitive to initial assumptions concerning cracking etc).

2. S102 Xunyang to Xiaohe

48. HDM-4 evaluation parameters are summarized in Table. Reference case geometry is estimated from the output from a hand held GPS device; project values are taken from PD drawings.

49. The survey vehicle speed of, on average, 42km/h, represents the operating speed of a carefully driven SUV driving from north to south, i.e. largely downhill. HDM-4 replicates this in the reference case, with a car operating speed of 43km/h and a fleet average of 34km/h. In the project case fleet averages rise by 8-9km/h to 43km/h. In this case no traffic calming measures are proposed as part of the road safety program and so it is not necessary to accommodate their effect on operating speeds within HDM-4.

Table 15: S102 HDM-4 evaluation parameters

Characteristic	Section A (17.4km)		Section B (50.9km)	
	Reference case	Project case	Reference case	Project case
Project economic cost	CNY933m or CNY15.4m per km of upgraded road (costs by section not available)			
Section length:	17.4km	17.4km	50.9km	42.9km (0.84xreference case)
Pavement geometry	2x3.5m lanes + 2x1.5m paved shoulders (10m total)	As reference case	2x3.5m lanes	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)
Intervention	N/A	Pavement reconstruction	N/A	Re-alignment and reconstruction
Geometry	R&F: 13m/km, 2.1no/km Curvature: 220deg/km	R&F: 12m/km, 2.1no/km Curvature: 200deg/km	R&F: 21m/km, 2.1no/km Curvature:360deg/km	R&F: 16m/km,1.6no/km Curvature: 270deg/km
Speed flow curve:	2 lane wide	2 lane wide	2 lane	2 lane wide
Road-side friction:	0.8	0.9	0.9	0.9
Survey veh speed:	44km/h		41km/h	
HDM-4 predicted operating speeds:	Car: 43km/h Fleet: 35km/h	Car: 54km/h Fleet: 43km/h	Car: 43km/h Fleet: 34km/h	Car: 54km/h Fleet: 43km/h
Initial condition	IRI=6.0		8.0	

Sources: Consultants' calculations and assumptions
Notes: (a) assumed values as no pavement condition data were available
(b) HDM-4 defaults

50. Even without consideration of road safety benefits and costs the project EIRR is satisfactory (Table).

51. The safety improvements within the final design represent 13 percent of total benefits. The incremental benefit-cost ratio (BCR) of all the safety investments in the FD is 2.1.

Table 16: S102 evaluation results

Design scenario	Section	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
			MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding safety benefits								
PD	Project	774	438	546	-	984	211	14.8%
Analysis including safety benefits								
PD	Project	774	438	546	57	1,041	268	15.5%
FD	Project	765	438	546	145	1,129	365	16.8%
FD safety investments only								
FD	Project	70	-	-	145	145	75	23.2%

Source: consultants' HDM-4 runs and ChinaRAP
Note: all PVs discounted at 12 percent

3. G316 Xunyang to Ankang

52. HDM-4 evaluation parameters are summarized in Table below. Reference case geometry is estimated from the output from a hand held GPS device; project values are taken from PD drawings.

53. The survey vehicle speed of, on average, 45km/h, represents the operating speed of a carefully driven SUV. HDM-4 replicates this in the reference case, with a car operating speed of 43km/h and a fleet average of 34km/h. In the project case fleet averages rise by 8-9km/h to 43km/h. In the case of the G316 only two traffic-calming measures are proposed as part of road safety measures; their aggregate effect on average operating speeds would be negligible.

Table 17: G316 HDM-4 evaluation parameters

Characteristic	Section A (17.5km)		Section B (7.0km)		Section C (9.9km)	
	Reference case	Project case	Reference case	Project case	Reference case	Project case
Project economic cost	-	CNY9.47m/km	-	CNY14.7m/km	-	CNY1.48m/km
Section length:	20.0km	17.5km (0.88x reference case)	8.0km	7.0km (0.88xreference case)	9.9km	9.9km
Pavement geometry	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x0.75m paved shoulders (8.5m total)	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x0.75m paved shoulders (8.5m total)	2x3.5m lanes + 2x2.5m paved shoulders (12m total)	2x3.5m lanes + 2x2.5m paved shoulders (12m total)
Intervention	N/A	Re-alignment and reconstruction	N/A	Re-alignment and reconstruction	N/A	Reconstruction
Geometry	R&F: 25m/km, 2no/km Curvature: 420deg/km	R&F: 25m/km, 1.6no/km Curvature: 150deg/km	R&F: 25m/km, 2.5no/km Curvature:850deg/km	R&F: 22m/km,2.2no/km Curvature: 200deg/km	R&F: 17m/km, 1.7no/km Curvature:110deg/km	R&F: 17m/km,1.7no/km Curvature: 110deg/km
Speed flow curve:	2 lane	2 lane wide	2 lane	2 lane wide	2 lane wide	2 lane wide
Road-side friction:	0.7	0.9	0.7	0.9	0.9	0.9
Survey veh speed:	46km/h	-	40km/h	-	52km/h	
HDM-4 predicted operating speeds:	43km/h (SUV) 28km/h (fleet)	54km/h (SUV) 37km/h (fleet)	41km/h (SUV) 28km/h (fleet)	54km/h (SUV) 37km/h (fleet)	53km/h (SUV) 41km/h (fleet)	54km/h (SUV) 45km/h (fleet)
Initial condition	IRI=9.0		10.0		8.0	

Sources: consultants' calculations, field measurements and assumptions

54. Without consideration of road safety benefits and costs the project EIRR falls below the threshold rate. Safety benefits bring the EIRR to over 20 percent, however.

55. The incremental BCR of the FD safety investments is 8.3.

Table 18: G316 evaluation results

Design scenario	Section	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
			MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding safety benefits								
PD	Project	229	127	83	-	210	-19	11.0%
Analysis including safety benefits								
PD	Project	229	127	83	201	389	181	20.2%
FD	Project	222	127	83	320	530	309	25.5%
FD safety investments only								
FD	Project	38	-	-	320	320	282	59%

Source: consultants' HDM-4 runs, ChinaRAP
Note: all PVs discounted at 12 percent

4. S224 Shangnan to Hubei boundary

56. HDM-4 evaluation parameters are summarized in tables 19 and 20 below. Reference case geometry is estimated from the output from a hand held GPS device; project values are taken from PD drawings.

57. The survey vehicle speed of, on average, 38km/h, represents the operating speed of a carefully driven SUV driving from north to south, with a small net elevation gain of approximately 50m. HDM-4 replicates this in the reference case, with a car operating speed of 39km/h and a fleet average of 31km/h. Extensive traffic calming measures are proposed for this road as part of the road safety program. Their aggregate effect is expected to reduce speeds over a distance of 9.6km by approximately 10km/h. Over the sections A to D this should limit the average speed increase to around 6-7km/h (rather than 8-9km/h without calming). Thus, as seen in the tables below, the project case lifts average operating speeds by just 5km/h for cars and for 6-7km/h for the fleet as a whole.

Table 19: S224 HDM-4 evaluation parameters (sections A-D)

Characteristic	Section A (3.6km)		Section B (7.1km)		Section C (31.3km)		Section D (11.6km)	
	Reference case	Project case	Reference case	Project case	Reference case	Project case	Reference case	Project case
Project economic cost	CNY356m or CNY7.19m per km of upgraded road (costs by section not available)							
Section length:	3.6km	3.6km	7.1km	6.4km (0.9xreference case)	31.3km	28.0km (0.9xref case)	11.6km	11.6km
Pavement geometry	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)
Intervention	N/A	Re-alignment and reconstruction	N/A	Re-alignment and reconstruction	N/A	Re-alignment and reconstruction	N/A	Re-alignment and reconstruction
Geometry	R&F: 59m/km, 11no/km Curvature: 170deg/km	R&F: 38m/km, 0.5no/km Curvature: 150deg/km	R&F: 120m/km, 6.5no/km Curvature:660deg/km	R&F: 38m/km,0.5no/km Curvature: 200deg/km	R&F: 120m/km, 9.0no/km Curvature:610deg/km	R&F: 39m/km,0.5no/km Curvature: 200deg/km	R&F: 79m/km, 8.0no/km Curvature:720deg/km	R&F: 39m/km,0.5no/km Curvature: 200deg/km
Speed flow curve:	2 lane	2 lane wide	2 lane	2 lane wide	2 lane	2 lane wide	2 lane	2 lane wide
Road-side friction:	0.7	0.9	0.7	0.9	0.7	0.9	0.7	0.9
Survey veh speed:	30km/h		29km/h		39km/h		45km/h	
HDM-4 predicted operating speeds:	39km/h (SUV) 32km/h (fleet)	44km/h (SUV) 38km/h (fleet)	39km/h (SUV) 30km/h (fleet)	44km/h (SUV) 37km/h (fleet)	39km/h (SUV) 30km/h (fleet)	44km/h (SUV) 37km/h (fleet)	39km/h (SUV) 31km/h (fleet)	44km/h (SUV) 37km/h (fleet)
Initial condition	IRI=10.0		10.0		8.0		7.0	

Sources: consultants' calculations, field observations and assumptions

Table 20: S224 HDM-4 evaluation parameters (section E)

Characteristic	Section E (38.0km)	
	Reference case	Project case
Section length:	38.0km	38.0km
Pavement geometry	2x3.25m lanes + 2x0.5m paved shoulders (7.5m total)	2x3.5m lanes + 2x1.5m paved shoulders (10m total) (where possible)
Intervention	N/A	Reconstruction & minor realignment
Geometry	R&F: 87m/km, 8.7no/km Curvature:640deg/km	R&F: 80m/km, 8no/km Curvature: 640deg/km
Speed flow curve:	2 lane	2 lane wide
Road-side friction:	0.7	0.9
Survey veh speed:	41km/h	
HDM-4 predicted operating speeds:	39km/h (SUV) 31km/h (fleet)	44km/h (SUV) 34km/h (fleet)
Initial condition	IRI=6.5	

Sources: consultants' calculations, field observations and assumptions
Note: values are preliminary at the time of reporting

58. Even without consideration of road safety benefits and costs the project EIRR is satisfactory.

59. The incremental BCR of the FD safety investments is 5.8.

Table 21: S224 evaluation results, sections A to D

Design scenario	Section	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
			MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding safety benefits								
PD	Project	297	481	147		628	331	21.6%
Analysis including safety benefits								
PD	Project	297	481	147	145	773	476	25.4%
FD	Project	300	481	147	178	806	507	26.1%
FD safety investments only								
FD	Project	31	-	-	178	178	148	47.9%

Source: consultants' HDM-4 runs and ChinaRAP
Note: PVs discounted at 12 percent

60. The results for section E and the combined results for all five sections are shown in the following two tables. Without safety enhancements, reconstruction of section E barely achieves the required rate of return. Safety enhancements make an enormous difference, however, bringing the EIRR to 31 percent. The BCR of the FD safety investment is 7.6. For the entire S224 the safety BCR is slightly lower at 6.4.

Table 22: S224 evaluation results, section E

Design scenario	Section	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
			MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding safety benefits								
DD	Project	40.0	39.1	1.4	-	40.5	0.4	12.2%
Analysis including safety benefits								
FD	Project	53.0	39.1	1.4	113	153	100	30.7%
FD safety investments only								
FD	Project	14.7	-	-	113	113	98	56.4%

Source: consultants' HDM-4 runs and ChinaRAP
Note: PVs discounted at 12 percent

Table 23: S224 evaluation results, all sections A to E

Design scenario	Section	PV incremental cost, CNY million	PVs of benefits, CNY million				NPV, CNY million	EIRR %
			MT VOC savings	MT time savings	Safety benefits	Total		
Analysis excluding safety benefits								
PD+DD	Project	337	520	148	-	668	331	20.9%
Analysis including safety benefits								
FD	Project	353	520	148	291	960	607	26.7%
FD safety investments only								
FD	Project	45.3	-	-	291	291	246	50.8%

Source: consultants' HDM-4 run

D. TRUNK ROAD USER ECONOMIC INDICATORS

61. The table below summarizes road user costs and journey time savings for each of the trunk roads.

Table 24: Trunk road user indicators

		Reference case				Project case		
		IRI	Car	MGV		IRI	Car	MGV
VOC[a]	G316	6.00	2.53	4.55		4.50	2.33	3.90
CNY/veh-km	S102	5.40	2.47	4.53		3.60	2.21	3.81
	S224	5.70	2.51	5.75		4.10	2.33	4.33
VOT[a]	G316	6.00	2.50	0.12		4.50	1.95	0.10
CNY/veh-km	S102	5.40	2.45	0.12		3.60	1.94	0.09
	S224	5.70	2.69	0.13		4.10	2.37	0.10
RUC[b]	G316	6.00	5.03	4.67		4.50	4.28	4.00

		Reference case				Project case		
		IRI	Car	MGV		IRI	Car	MGV
CNY/veh-km	S102	5.40	4.92	4.65		3.60	4.15	3.90
	S224	5.70	5.20	5.88		4.10	4.70	4.43
Time[c]	G316		1h26	2h14			1h11 (15min)	1h50 (24min)
h:min	S102		0h45	1h13			0h39 (6min)	1h01 (12min)
	S224		2h22	3h43			2h12 (10min)	3h06 (27min)

Source: PPTA consultants' HDM-4 runs

Notes: (a) IRIs shown are averages over evaluation period. VOC and time savings are values corresponding to average IRIs

(b) sum of VOC and time savings

(c) time savings shown in brackets in project case

III. EVALUATION OF THE RURAL ROAD COMPONENT

A. INTRODUCTION

1. RED

62. The eight proposed rural road upgrades are evaluated using the same general approach as that adopted for the trunk roads and described in sections I.B and II.A, except that RED (Road Economic Decision Model, World Bank 2004) is used in place of HDM4.

63. The principal differences between HDM-4 and RED are that the former models pavement deterioration over time and congestion effects, while RED assumes that pavement conditions are constant throughout the evaluation period. It also takes no account of congestion. According to the RED user guide it is intended for roads carrying around 50 to 300 veh/day in predominantly rural areas, although the same guide cites a case study where opening traffic is 900 veh/day. In this study the eight roads carried from 50 to 400 veh/day in 2014, indicating that RED is well suited to their analysis.

64. RED uses essentially the same inputs (vehicle characteristics, fuel costs etc) and calibration coefficients as HDM4, except that the time value of goods in transit is set to zero, as is appropriate for the low unit value agricultural produce that dominates goods transport on these roads.

65. In its downloaded form, RED, like HDM4, does not allow for real terms growth in the value of journey time savings. It can be amended to do so, however, and the amendment made here includes an annual growth rate of 5 percent (below historic rates at which GDP per head has grown).

66. Construction is assumed to take one year, with the upgraded roads open in the following year, 2017. The evaluation period in RED is limited to 20 years, i.e. from 2016 to 2035, but the evaluation results are adjusted to make them compatible with the longer period adopted for evaluation of the trunk roads (see below).

2. Road investment and maintenance costs

a. Investment costs

67. In the pursuit of cost-effectiveness, rural roads costs have gone through three design iterations, even before the application of safety improvements. The weighted average unit preliminary investment cost in April 2014 was CNY1.1m/km (financial cost including all contingencies etc). In June 2014 the adoption of higher standards and in particular more re-alignment meant an increase to CNY2.5m/km. After discussion of the poor economic returns (at CNY2.5m/km, only roads numbers 1 and 8 exceeded the 12 percent threshold) more modest standards were applied, bringing the unit cost down to CNY1.2m/km. By January 2015, further revisions brought the unit economic cost (excluding ChinaRAP safety packages) to CNY1.4m/km.

Table 25: Rural roads investment costs in CNYm

Road		km[a]	Total cost[b]	Safety package[c]	FBC excl LAR[d]	LAR cost net of taxes & contingencies	Economic cost[e]	Economic cost excl safety[f]	**Economic cost excl safety per km**
1	X304 Shuhe-Xiaohe	38.4	87.6	4.31	79.8	(S102)	75.4	71.3	1.86
2	C347 Lijiaba-Baiguo	7.88	6.22	0.514	6.06	0.644	6.40	5.92	0.75
3	Beiguo-Luojia	7.25	5.67	0.662	5.55	0.593	5.87	5.24	0.72
4	C852 Yangpo-Liangheguan	16.6	12.2	1.29	11.8	1.36	12.6	11.4	0.69
5	Y305 Yanba-Dongqiao	10.7	30.0	1.77	25.5	(G316)	24.1	22.4	2.10
6	CH69 Zaobao-Yousheng	4.16	3.87	0.704	3.76	0.149	3.71	3.04	0.73
7	CH39 Zaobao-Wujiashin	9.34	8.25	1.34	8.01	0.334	7.92	6.65	0.71
8	Y338 Xianghe-Shuiguo	45.3	83.8	5.12	81.4	(S224)	76.9	72.1	1.59
Total		140	238	15.7	222	3.08	213	198	1.42

Notes: (a) project road length

(b) DI figure including all contingencies, LAR etc

(c) ChinaRAP base cost identified and included in DI total cost

(d) excludes contingencies, interest during construction (IDC) and LAR costs

(e) economic cost = (FBC excl LAR x 0.9 + net LAR cost) plus 5% physical contingencies

(f) as (e) but ChinaRAP safety package deducted from FBC

3. Maintenance costs

68. RED accepts maintenance costs specified as:

- an annual cost per km
- an annual cost per unit of AADT per km

69. Both may be combined for any road section. In practice specifying cost per unit of AADT is most relevant to unpaved roads as it allows the user to replicate the cost implications of shorter re-gravelling cycles as traffic increases.

70. For both the reference and project case it is assumed that sections with paved surfaces are patched to the extent that current (or improved) conditions do not deteriorate significantly. Off-carriageway (financial) costs are taken as CNY2,000 /km/year, compared with CNY5,000 for trunk roads. Pothole patching at CNY120/m^2 is estimated to cost CNY200/km (equivalent to 15-20 potholes per km if each has an area of 0.1m^2). No data for concrete pavements are available and their costs are assumed to be the same as those of bituminous pavements.

71. Routine maintenance of unpaved roads typically comprises clearing drains, grading the road once or twice a year and some spot re-gravelling. Periodic maintenance amounts to re-gravelling, at intervals from say five years in the case of roads carrying little traffic, to every year for heavily used roads. Information from Shaanxi puts annual grading at CNY8,000/km. To this is added CNY2,000/km for drain-cleaning etc. (compared with CNY5,000 in the case of the trunk roads). Re-gravelling or spot re-gravelling is priced by Shaanxi at CNY17-22.5/m^2. Taking the mid-point of this range, a depth of 150mm and a five year interval gives CNY20,000/km/year.

Table 26: Maintenance costs used in RED, CNY/km/year

Pavement	Off-carriageway	Carriageway	Total
Paved	2,000	200	2,200
Unpaved	2,000	28,000	30,000

Source: PPTA consultants
Note: rates are assumed to be at economic prices and include physical contingencies

4. Road characteristics

72. Summary road characteristics are shown in the table overleaf. Pavement and terrain are defined by:

- IRI roughness, with default values of 15 for poor bitumen, 20 for poor unpaved and 3 for a concrete upgrade
- pavement type, with a single predominant type (shown underlined) adopted for each road. In reality, most roads labelled "bitumen" have little remaining serviceable bituminous pavement and the label is of mainly historic interest
- a road in "mountainous" terrain is defined within RED as having rises and falls of 150m/km and a curvature of 1,200deg/km. All other roads are treated as "hilly" and have rises and falls of 100m/km and curvature of 750deg/km. (Rates of return display only slight sensitivity to terrain)

73. Anecdotal evidence during field visits indicated that many roads are impassable to all but motor-cycles and SUVs for at least several days per year. No systematic data were available

but it was felt important to recognize this, however approximately, in the analysis. This "denial of service" can be handled within RED by assuming that, for a few days a year, vehicles are obliged to make detours in order to reach their destinations. These few days are labelled "wet season" and it is assumed that transport demand during this wet season is the same as during the dry season but is obliged to travel a few kilometers further on a road that is in the same condition as the dry season without project road. The durations and lengths of wet season diversions appear in the "comments" column of the table overleaf.

Table 27: Rural road characteristics

Road		ADTx in 2016	km	Survey vehicle km/h	R&F m/km	Deg/km	Pop/km	Reference case[b]	Project case	Comments[c]
1	X304 Shuhe-Xiaohe	367	38.4	30	110	680	520	Cl IV bitumen, 4.5-5.5m IRI=15 Terrain=hilly	Cl IV concrete, 5.5-6.5m IRI=3	All weather. Commercially and agriculturally an important road
2	C347 Lijiaba-Baiguo	14	7.88	–	–	–	130	Unclassified, 16% unpaved, remainder bitumen, 2.5-4m IRI=20 Terrain=hilly	Unclassified concrete, 5.0m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=2.5
3	Beiguo-Luojia	91	7.25	16	160	1,300	180	Unclassified bitumen/concrete, 3-4m IRI=15 Terrain=mountainous	Unclassified concrete, 5.0m IRI=3	Impassable at times Wet season diversion= 10d Additional km=2.5
4	C852 Yangpo-Liangheguan	44	16.6	11	150	1,200	240	Unclassified, unpaved, 2-5m IRI=20 Terrain=mountainous	Unclassified concrete, 5.0m IRI=3	Impassable at times Wet season diversion= 10d Additional km=5
5	Y305 Yanba-Dongqiao	129	10.7	–	–	–	320	Unclassified bitumen/concrete, 4-6m IRI=15 Terrain=mountainous	Unclassified concrete,6.5m IRI=3	Impassable at times Wet season diversion= 10d Additional km=2.5
6	CH69 Zaobao-Yousheng	24	4.16	–	–	–	280	Unclassified, unpaved, 3.5-4.5m IRI=20 Terrain=mountainous	Unclassified concrete, 5.5m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=1
7	CH39 Zaobao-Wujiashin	35	9.34	–	–	–	90	Unclassified, unpaved, 3.5-4.5m IRI=20 Terrain=hilly	Unclassified concrete, 5.5m IRI=3	May be impassable for short periods Wet season diversion= 5d Additional km=2.5
8	Y338 Xianghe-Shuiguo	508	45.3	31	88	680	470	Cl IV bitumen, 5.5m IRI=15 Terrain=hilly	Cl IV concrete, 6.5m IRI=3	All weather. Connectivity gains: links S224 and G312.

Source: PD costs and PPTA consultants' estimates
Notes: (a) no data; terrain assessment made from visual inspection
(b) undefined pavement type used in RED

(c) see text

74. Operating speeds on the two county roads (numbers 1 and 8) are around 30km/h, but are approximately half this on the very steep roads that are often little more than tracks. RED is unable to generate operating speeds much lower than 20km/h and so the focus is on generating reasonable journey time savings rather than replicating observed speeds.

75. For unpaved roads with IRI=20 and a speed limit of 22km/h, RED generates a fleet average operating speed of 21km/h. For an upgraded concrete road with IRI=3 and a speed limit of 29km/h the generated operating speed is 28km/h. The speed difference, 7km/h, may seem large but is misleading: the journey time savings would be the same if the two speeds were 15km/h in the reference case and 18.3km/h in the project case. Upgrading from poor bitumen with IRI=15 the RED speed difference is 6km/h, from 22 to 28km/h, in journey time saving terms the same as from 20 to 24.8km/h. To conclude, modelled speeds lead to prudent estimates of journey time savings.

B. SAFETY BENEFITS

76. ChinaRAP carried out safety assessments and proposed additional works on roads 1 and 8 only, i.e. on 83.9 of a total of 140km.

77. They estimate annual fatality, injury and crash costs in the reference case at CNY68.2m. The change in crash costs implicit in the FD has not been estimated; for present purposes it is assumed that there is no change.

78. After application of the ChinaRAP safety interventions (base cost CNY15.7m – see table 25) annual crash costs rise to CNY76.2m. Scaled up to the full length of all the rural roads the annual disbenefit is CNY13.3m. Expressed as a present value over the evaluation period from 2016 to 2039, the annuity is equivalent to CNY103m, or CNY0.73m/km.

79. This increase in fatality injury and crash costs is largely attributable to increased numbers of cyclist and pedestrian fatalities, an unintended consequence of increased speeds.

C. RESULTS

80. Results are shown below. Note that the case reported on in the table excludes both the ChinaRAP safety package costs and their disbenefits. It implicitly assumes that there is no change in crash costs between the reference and FD cases.

81. While the entire rural roads package has an EIRR that comfortably exceeds 12 percent, only four roads, when evaluated individually, do so.

Table 28: Rural road evaluations

Road		AADTx in 2016	km	Economic cost, CNY million/km	EIRR%[a]	NPV/km[a] CNY million	NPV[a] CNYm
1	X304 Shuhe-Xiaohe	367	38.4	1.86	20.4%	1.18	55.5
2	C347 Lijiaba-Baiguo	14	7.9	0.75	6.3%	-0.32	-2.3
3	Beiguo-Luojia	91	7.3	0.72	17.1%	0.24	2.3
4	C852 Yangpo-Liangheguan	44	16.6	0.69	13.3%	0.021	1.2
5	Y305 Yanba-Dongqiao	129	10.7	2.10	8.1%	0.71	-6.5
6	CH69 Zaobao-Yousheng	24	4.2	0.73	6.5%	-0.295	-1.1
7	CH39 Zaobao-Wujiashin	35	9.3	0.71	9.8%	-0.153	-1.1
8	Y338 Xianghe-Shuiguo[a]	508	45.3	1.59	27.1%	2.078	109
Totals/weighted averages		220	140	1.42	20.5%	1.12	157

Source: PPTA consultants' estimates
Notes: (a) EIRRs and NPVs take the RED net benefit value in 2035 and continue it to 2039 in order to be consistent with the trunk road evaluations

D. RURAL ROAD USER ECONOMIC INDICATORS

82. The table below summarizes road user costs and journey time savings for each of the rural roads.

Table 29: Rural road user indicators

		Reference case				Project case		
		IRI	Car	MGV		IRI	Car	MGV
VOC	RR1&8	15	2.34	6.51		3	1.85	5.14
CNY/veh-km	RR2&7	20	2.78	7.43		3	1.85	5.14
	RR4&6	20	2.89	8.60		3	2.04	6.38
	RR3&5	15	2.70	8.16		3	2.04	6.38
VOT	RR1&8	15	3.96	-		3	3.27	-
CNY/veh-km	RR2&7	20	4.36	-		3	3.27	-
	RR4&6	20	4.37	-		3	3.28	-
	RR3&5	15	4.04	-		3	3.28	-
RUC[a]	RR1&8	15	6.3	6.5		3	5.1	5.1
CNY/veh-km	RR2&7	20	7.1	7.4		3	5.1	5.1
	RR4&6	20	7.3	8.6		3	5.3	6.4
	RR3&5	15	6.7	8.2		3	5.3	6.4
Speed	RR1&8	15	23			3	28	
km/h[b]	RR2&7	20	21			3	28	
	RR4&6	20	21			3	28	
	RR3&5	15	22			3	27	

Source: PPTA consultants' HDM-4 runs

Notes: (a) sum of VOC and time savings

(b) fleet averages

IV. EVALUATION OF ADDITIONAL ROADS

83. Unlike the trunk and rural roads, the only works proposed on 25 sections of additional rural road (566km in all) are related to safety. The evaluation is therefore taken directly from work by ChinaRAP, adjusted only to make it consistent with the evaluation period assumptions made for the trunk and rural roads.

84. The table below shows relevant costs and benefits.

Table 30: Additional roads costs and benefits, CNYm

Total cost incl contingencies etc	Cost excl contingencies[a]	Economic cost[b]	Annual fatality, injury and crash costs			Safety benefit of FD
			Reference case	PD	FD	
84	81.6	79.6	486.0	413.4	387.0	98.0

Source: ChinaRAP and PPTA consultants
Note: (a) assumes contingencies are 3.0% of base costs (as per rural roads)
(b) 0.93 x cost excluding contingencies plus 5 percent PPTA physical contingencies

85. The safety benefit accrues from 2020 to 2039, while the cost is incurred between 2016 and 2019. Maintenance costs are estimated by taking 20 percent of the initial economic cost and spreading it uniformly over the evaluation period. (90 percent of the additional roads are sealed. The total routine and periodic maintenance costs of trunk road upgrades over the entire evaluation period represent 12-30 percent of initial investment costs).

86. Evaluation results are shown in the table below.

Table 31: Additional roads evaluation

PV incremental costs, CNYm	PV safety benefits, CNYm	Benefit-cost ratio (BCR)	NPV, CNYm	EIRR%
71.3	526	7.4	455	57%

Source: ChinaRAP and PPTA consultants

APPENDIX I: Financial Management Assessment of Executing Agency (FFPO)

Table 1 : Responses to the Financial Management Assessment Questionnaire

Topic	Response	Remarks
1. Implementing		
1.1. a .Which entity is the EA?	Shaanxi Provincial Department of Transport	FFPO will act on their behalf as PMO
1.1.b What is your organization's legal status / registration?	FFPO is independent legal entity.	FFPO is state-run/non-profit institution under administration of SPDOT
1.2. a. Has the entity implemented an externally-financed project in the past (if so, please provide details)?	Yes.	Shaanxi Road Development Project II supporting by World Bank; Shaanxi Ankang Road Development Project supporting by World Bank; Shaanxi Highway Development Project by ADB.
1.2.b Will financial management of the project be the responsibility of a stand alone PIU? - or of a PIU using EA financial systems?	Financial management of the project will be responsible by FFPO	Supporting units(such as Ankang and Shangluo Transport Bureaus) will help FFPO in construction supervision and management.
1.3. What are the statutory reporting requirements for the entity?	Shaanxi Provincial Department of Transport	
1.4. Is the governing body for the project independent?	Yes. It is one part of government	
1.5. Is the organizational structure appropriate for the needs of the project?	Yes	FFPO was set up according to requirements on organization structure of state-run institution.
2. Funds Flow Arrangement		

Topic	Response	Remarks
2.1. Describe (proposed) project funds flow arrangements, including a chart and explanation of the flow of funds from ADB, government, and other financing sources.	The proposed funds of trunk road source from ADB loan, subsidy from MOT and local government counterpart. The proposed funds of rural road source from ADB loan and local government counterpart.	See attachment of funs of flow
2.2. Are the (proposed) arrangements to transfer the proceeds of the loan (from the government/ Finance Ministry) to the entity (your organization) satisfactory?	Yes.	
2.3. Does the entity have previous experience of using imprest fund and SOE procedures? **Have there been the major problems in the past in receipt of funds by the entity?** **Were there any problems or issues encountered by project staff in the operation of the imprest fund or SOE procedures in the past?**	Yes. FFPO had implemented and managed three WB projects and one ADB project. No problem happened in receipt of funds. No issue at current.	
2.4. In which bank will the Imprest Account be opened?	It was decided by finance department. Here it is Shaanxi Provincial Department of Finance.	There is only one imprest account in Shaanxi Province under administration of SPDOF. The imprest account had been opened when the first WB project.
2.5. Does the (proposed) project Implementing Unit have experience in the management of disbursements from ADB?	Yes. IA had treated disbursements of one ADB project and three WB projects.	

Topic	Response	Remarks
2.6. a. Does the entity have/need a capacity to manage foreign exchange risks?	Have capacity to manage.	When SPDOT and SPDOF prepare annual finance budget for the proposed project, foreign exchange risks were considered a
2.7. How are the counterpart funds accessed?	Counterpart funds have been included in annual budget when project proposal was approved.	
2.8. How are the payments made from the counterpart funds	Payments will be made according to implementation schedule.	
2.9. If part of the project is implemented by communities or NGOs, does the PIU have the necessary reporting and monitoring features built into its systems to track the use of project proceeds by such agencies	No system at current.	
2.10. Are beneficiaries required to contribute to project costs?	No required.	
If the beneficiaries have an option to contribute in kind are proper guidelines formulated to record and value the contribution?	/	
3. Staffing		
3.1. What is the (proposed) organizational structure of the accounting department? (Attach an organization chart.)		
3.2. Identify the (proposed) accounts staff, Including name, job title, responsibilities, educational background, and professional certification). Attached job descriptions and CVs of key accounting staff.	Ms.Li Wei, Master, Senior Accountant Ms.Yong Xiling, College, Accountant Ms. Ren Jing, Master, Accountant Mr. Liu Yilin, Bachelor, Junior Accountant	
3.3. Is the project finance and accounting function staffed adequately?	Yes	As required by State-run institution

Topic	Response	Remarks
3.4. Is the finance and accounts staff adequately qualified and experienced?	Yes	Accounts staff in FFPO have enough experienced. Ms. Li Wei has 18 years experience, Ms. Yong Xiling has 29 years, Ms. Ren Jing has 7 years and Mr. Liu Tielin has 2 years.
3.5. Are finance and accounting staffs trained in ADB procedures?	Yes.	Ms. Li Wei and Ms. Yong Xiling attended ADB disbursement policy training at 2001.
3.6. What is the duration of the contract with the finance and accounts staff?	It is long term contract.	They are all regular employees.
3.7. Indicate key positions not contracted yet, and the estimated date of appointment.	No position	
3.8. Does the organization (the project) have written position descriptions, which clearly define duties, responsibilities, lines of supervision, and limits of authority for all officers, managers, and staff?	Yes.	
3.9. At what frequency are personnel transferred?	No transferring.	All staffs are fixed employees.
3.10. What is training policy for the accounting staff?	Accountant attended annual national accounting training and further education.	
4. Accounting Policies and Procedures		
General		

Topic	Response	Remarks
4.1. Does the entity have an accounting system that allows for proper recording of project financial transactions, including the allocation of expenditures in accordance with the respective components, disbursement categories, and source of funds? Will the project use the entity accounting system?	FFPO has an accounting system of administrative institution. The proposed project will use accounting system of the state-run/non-profit construction unit.	
4.2. Are controls in place concerning the preparation and approval of transactions, ensuring that all transactions are correctly made and adequately explained?	Yes.	
4.3. Is the chart of accounts adequate to properly account for and report on project activities and disbursements categories? **Are reconciling items properly identified (with sufficient details provided) and dispositioned in a timely manner?**	Yes. It is adequate. Yes. It is.	
4.4. Are cost allocations to the various funding sources made accurately and in accordance with established agreements?	Yes. All funds have been included in annual plan and allocation will be further confirmed during PPTA.	
4.5. Are the general ledger and subsidiary ledgers reconciled and in balance?	Yes.	
4.6. Are all accounting and supporting documents retained on a permanent basis in a defined system which allows authorized users easy access?	Yes.	
Segregation of Duties		

Topic	Response	Remarks
4.7. Are the following functional responsibilities performed by different units or persons: 1. Authorize transactions； 2. Record transactions； 3. Maintain custody of assets involved in transaction	Yes	
4.8. Are the functions for ordering, receiving, accounting for goods and services segregated?	Yes	
4.9. Are bank reconciliations prepared by someone other than those who make or approve payments?	Yes	
Budgeting System		
4.10. Do budgets include physical and financial targets?	Yes	
4.11. Are budgets prepared for all significant activities in sufficient detail to provide a meaningful tool with which to monitor subsequent performance?	Yes	
4.12. Are actual expenditures compared with the budget with reasonable frequency, and explanations required for significant variations from the budget?	Yes	
4.13. Are approvals for variations from budget required in advance or after the fact?	In advance	
4.14. Who is responsible for preparation and approval of budgets?	The budgets were prepared by special persons. Budget related with projects were prepared under supporting by professional organization and budget related with FFPO operation and maintenance was prepared by Finance Division. Director of FFPO will audit it and submit to SPDOT for approval.	

Topic	Response	Remarks
4.15. Are procedures in place to plan project activities, collect information from the units in charge of different projects, and prepare budgets?	Yes	
4.16. Are the project plans and budgets of project activities realistic, based on valid assumptions, and developed by knowledgeable individuals?	Yes	
Payments		
4.17. Do invoicing processing procedures provide for: 1. Copies of purchase orders and receiving reports be obtained directly from issuing departments? 2. Comparison of invoice quantities, prices, and terms with those indicated on the purchase order and with records of goods actually received? Comparison of invoice quantities with those indicated on the receiving report? 4. Checking accuracy of calculations?	Yes	Same requirements from national accounting regulations
4.18. Are all invoices:		
4.18.1. Stamped PAID?	Yes	
4.18.2. Dated?	Yes	
4.18.3. Reviewed and approved?	Yes	
4.18.4. Marked for account code assignment?	Yes	
4.19. Do controls exist for the preparation of the payroll and are changes to the payroll properly authorized? What controls exist for the preparation of payroll?	Payroll should be prepared according to standards issued by Ministry of Finance and Ministry of Human Resources and Social Security. End of each year, it will conduct annual checking and appraisal. If qualified, salary will be improved after getting approval from SPDOT and Province HRSS.	
Policies and Procedures		

Topic	Response	Remarks
4.20. What is the basis of accounting (e.g. cash or accrual)?	Accrual	
4.21. What accounting standards are followed?	Accounting Standards For State-run/Non-profit Organization	
4.22. Does the organization have adequate policies and procedures manual to guide activities and ensure staff accountability?	Yes	
4.23. Is the accounting policy and procedure manual updated for project activities?	Yes	
4.24. Do procedures exist to ensure that only authorized persons can alter or establish a new accounting principle, policy, or procedure to be used by the organization?	Yes	
4.25. Are there written policies and procedures covering all routine financial management and related administrative activities?	Yes	
4.26. Do policies and procedures clearly define conflict of interest and related party transactions (real and apparent) and provide safeguards to protect the organization?	Yes	
4.27. Are manuals distributed to appropriate personnel?	Yes. Distributed to appropriate personnel	
Cash and banking		
4.28. Indicate names and positions of authorized signatories of the bank accounts.	Mr. Nan Haolin Director of FFPO	
4.29. Does the organization maintain an adequate up-to-date cashbook, recording receipts and payments?	Yes	

Topic	Response	Remarks
4.30. Do controls exist for the collection, timely deposit and recording of receipt at each collection location?	Yes	
4.31. Are bank and cash reconciled on a monthly basis?	Yes	
4.32. Are all unusual items on the bank reconciliation reviewed and approved by a responsible officer?	Yes	
4.33. Are all receipts deposited on a timely basis?	Yes	
Safeguarding Assets		
4.34. Is there a system of adequate safeguards to protect assets from fraud, waste and abuse?	Yes	
4.35. Are subsidiary records of fixed assets and stocks kept up to date and reconciled with control accounts?	Yes	
4.36. Are there periodic physical inventories of fixed assets and stocks?	Yes	
4.37. Are assets sufficiently covered by insurance policies?	Yes. SPDOT, Ankang and Shangluo Government will provide insurance.	It is depending on institutional arrangement.
Other Offices and Implementing Agencies		
4.38. Are there other regional offices or executing agencies participating in implementation?	Yes. There are supporting units including Ankang Transport Bureau and Shanluo Transport Bureau, District Bureau)	It is depending on institutional arrangement.
4.39. Has the project established controls and procedures for flow of funds, financial information, accountability, and audits in relation to other offices or implementing agencies?	ADB loan will be managed and controlled by FFPO, SPDOT and SPDOF Counterpart funds will be managed and controlled by SPDOT and SPDOF.	

Topic	Response	Remarks
4.40. Does information among different implementing agencies flow in an accurate and timely fashion?	/	Only one IA in the project.
4.41. Are periodic reconciliations of financial information performed among the different offices/implementing agencies?	/	
Advance Payments		
4.42. Does the entity have adequate guidelines for advance payments to individual staff and regional offices (if applicable)? **4.43. Do the guidelines clearly define proper authorizations, ceiling of advance amounts and appropriate liquidation periods?** **Are controls in place to monitor outstanding advances and ensure frequent liquidation? Are the outstanding advances periodically confirmed with the concerned staff?** **Do regional offices open separate bank accounts or maintain cash books to be used exclusively for advances from ADB financing, counterpart funding and other financiers? Are the bank account and cash book reconciled to the general ledger or sub-ledger on a monthly basis?**	4.42 Yes. FFPO has guideline. No regional offices will be set up. 4.43Yes. Guidelines clearly define related information. Proper controls were set for monitoring. Yes. Outstanding advances confirmed with the concerned staff. No regional offices.	
Other		

Topic	Response	Remarks
4.44. Has the project advised employees to whom to report if they suspect fraud, waste, or misuse of project resources or property?	Yes.	
5. Internal Audit		
5.1. Is there an internal department in the organization?	No	In FFPO, there is no internal department specially for audit but by task force. SPDOT will check and audit FFPO annually.
5.2. What are the qualifications and experience of the internal audit department staff?		Staff of financial division will conduct internal control but not special auditor.
5.3. To whom does the head of internal audit report?	Staff of Financial Division will report to director of FFPO	
5.4. Will the internal audit department include this project in its work program?	Yes.	
5.5. Are actions taken on the internal audit staff's findings?	Rectification	
6. External Audit		
6.1. Is the entity financial statement audited regularly by an independent auditor? Who is the auditor?	Yes. Shaanxi Provincial Audit Office	Ms. Ouyang Juanjuan, Director of Foreign Trade Division of Shaanxi Provincial Audit Office is responsible for auditing last foreign fund projects.
6.2. Are there any delays in audit of the entity? When is the audit report issued?	No delay. All reports were submitted as required by WB and ADB.	
6.3. Is the audit of the entity conducted according to International Standards on Auditing?	No. According to China National Standards on Auditing.	

Topic	Response	Remarks
6.4. Were there any major accountability issues brought up in the audit reports in the last three years? **Were there any issues noted in prior audit reports related to the operation of imprest account or use of SOE procedures?**	No issues was happened.	
6.5. Will the entity auditor audit the project accounts or will another auditor be appointed to audit the project's financial statements?	Yes	
6.6. Are there any recommendations made by the independent auditors in prior audit reports or management letters that have not been implemented?	No	
6.7. Is the project subject to an audit from an independent governmental entity in addition to the external audit?	Yes.	Audit Company
6.8. Has the project prepared acceptable terms of reference for an annual project audit?	Yes.	It was prepared during last ADB project.
7. Reporting and Monitoring		
7.1. Are financial statements prepared for the entity? In accordance with which accounting standards ?	Yes. The financial statements were prepared according to regulation issued by MOF such as <National Fixed Asset Investment Financial Statement>.	
7.2. Are financial statements prepared for the implementing unit?	Yes.	

Topic	Response	Remarks
7.3. What is the frequency of the financial statements' presentation? Are the reports prepared in a timely fashion so as to be useful to management for decision making?	The financial statements wer prepared half year. All semi-annual report were prepared in time.	
7.4. Does the reporting system need to be adapted to report on the project components?	Yes.	
7.5. Does the reporting system have the ability to link the financial information with the project's physical progress? If a separate system is used to gather and compile physical data, what controls are in place to reduce the risk that the physical data may not synchronize with the financial data?	Yes	
7.6. Does the project have established financial management reporting responsibilities that specify which reports are to be prepared, what they are to contain, and how they are to be used?	Yes	
7.7. Are financial management reports used by management?	Yes	
7.8. Do the financial reports compare actual expenditures with budgeted and programmed allocations?	Yes	
7.9. Are financial reports prepared directly by the automated accounting system or are they prepared by spreadsheets or some other means?	Prepared by spreadsheet including Yongyou soft, excel and other special soft agreed by MOF.	
8. Information Systems		

Topic	Response	Remarks
8.1. Is the financial management system computerized?	Yes	
8.2. Can the system produce the necessary project financial reports?	Yes	
8.3. Is the staff adequately trained to maintain the system?	Yes. Yongyou Company provided trainings.	
8.4. Does the management organization and processing system safeguard the confidentially, integrity, and availability of the data?	Yes	

Appendix J: Procurement Capacity Assessment

Risk Rating	Extremely High	High	Average	Low

I. Specific Assessment and Ratings

Question	Response	Risk
A. Organizational and Staff Capacity		
A.1. How many years experience does the head of the procurement department/unit have in a direct procurement role?	The division director has 17 years experience on procurement.	Low
A.2. How many staff in the procurement department/unit are:	Seven person	Low
i. Full Time?	Seven person are full time staff.	
ii. Part Time?		
iii. Seconded?		
A.3. Does the procurement staff have English language proficiency?	Yes.	Low
A.4. Are the number and qualifications of the staff sufficient to undertake the additional procurement that will be required under the proposed project?	Yes. They did last several foreign funded projects.	Low
A.5. Does the unit have adequate facilities, such as PCs, internet connections, photocopy facilities, printers, etc., to undertake the planned procurement?	Yes	Low
A.6. Does the agency have a procurement training program?	Yes. FFFPO will prepare program based on demand. At current, each year training will be conducted based on projects demand. According to proposed project, 1-2 times training will be arranged.	Low
A.7. Does the agency have a Procurement Committee that is independent from the head of the agency?	Yes	Low
A.8. Does the agency have a procurement department/unit, including a permanent office that performs the function of a Secretariat for the Procurement Unit, and which serves as the main support unit of the Procurement Committee??	Yes	Low
A.9. If yes, what type of procurement does it undertake?	Goods and civil work, consulting service, Including ICB and NCB.	
A.10. At what level does the department/unit report (to the head of agency, deputy etc.)?	Director of FFFPO	Low
A.11. Do the procurement positions in the agency have job descriptions, which outline specific roles, minimum technical requirements and career routes?	Yes	Low
A.12. Is there a procurement process manual for goods and works?	Yes	Low
A.13. If there is a manual, is it up to date and does it cover foreign-assisted projects?	Yes	
A.14. Is there a procurement process manual for consulting services?	Yes. It is cumulative and updated from foreign fund projects.	
A.15. If there is a manual, is it up to date and does it cover foreign-assisted projects?	Yes	
A.16. Are there standard documents in use, such as Standard Procurement Documents/Forms, and have they been approved for use on ADB funded projects?	Yes	

A.17. Does the ToR follow a standard format such as background, tasks, inputs, objectives and outputs?	Yes	
A.18. Who drafts the bidding documents?	IA and Tendering & bidding Agency	
A.19. Who manages the sale of the bidding documents?	Tendering & bidding Agency	
A.20. Who identifies the need for consulting services requirements?	Owner	Low
A.21. Who drafts the terms of reference (ToR)?	IA and Tendering & bidding Agency	
A.22. Who prepares the request for proposals (RFPs)?	IA and Tendering & bidding Agency	
B. Information Management Framework		
B.1. Is there a referencing system for procurement files?	Yes.	Low
B.2. Are there adequate resources allocated to record keeping infrastructure, which includes the record keeping system, space, equipment and personnel to administer the procurement records management functions within the agency?	Yes	Low
B.3. For what period are records kept?	More than 10 years	Low
B.4. Are copies of bids or proposals retained with the evaluation?	Yes	Low
B.5. Are copies of the original advertisements retained with the pre-contract papers?	Yes	Low
B.6. Is there a single contract file with a copy of the contract and all subsequent contractual correspondence?	Yes	Low
B.7. Are copies of invoices included with the contract papers?	Yes	Low
C. Procurement Practices		
Goods and Works		
C.1. Has the agency undertaken foreign-assisted procurement of goods or works recently (last 12 months, or last 36 months)? (If yes, please indicate the names of the development partner/s and the Project/s.)	Yes. World Bank Project- Shaanxi Ankang Road Project.	Low
C.2. If the above answer is yes, what were the major challenges?	Procurement progress is more complex and longer.	
C.3. Is there a systematic process to identify procurement requirements (for a period of one year or more)	Yes	Low
C.4. Is there a minimum period for preparation of bids and if yes how long?	6 weeks	Low
C.5. Are all queries from bidders replied to in writing?	Yes	
C.6. Does the bidding document state the date and time of bid opening? and how close is it to the deadline for submission?	Yes. The bidding document state all clearly according to the PRC laws and usually is 45 days.	Low
C.7. Is the opening of bids done in public?	Yes	Low
C.8. Can late bids be accepted?	Not accepted	
C.9. Can bids be rejected at bid opening?	No, unless the bid didn't follow the bidding document requirements. For example, it wasn't sealed.	
C.10. Are minutes of the bid opening taken?	Yes. There are minutes.	Low
C.11. Who may have a copy of the minutes?	Administrative supervision, IA and bidders	
C.12. Are the minutes free of charge?	Yes	
C.13. Who undertakes the evaluation of bids (individual(s), permanent committee, ad-hoc committee)?	IA (Owners) and experts. Experts were decided from the government bid evaluation list randomly.	Low
C.14. What are the qualifications of the evaluators with respect to procurement and the goods and/or works under evaluation?	Senior and professional titles that are issued by PRC.	Low
C.15. Is the decision of the evaluators final or is the	Usually evaluation result are the final result.	Low

evaluation subject to additional approvals?	To World Bank and ADB project, it should get no rejection from the Bank.			
C.16. Using at least three real examples, how long does it normally take from the issuance of the invitation for bids up to contact effectiveness?	Project	Bid invitation	Contract effectiveness	Low
	WB-Ankang road project Civil works (ICB)	2007 April 20	2007 Nov. 23	
	WB-Ankang road project Equipment (NCB)	2008 Jan 15	2008 Aug 19	
	Domestic project -Ankang-Maoli Expressway project Civil works	2013 May 13	2013 July 20	
C.17. Are there processes in place for the collection and clearance of cargo through ports of entry?	Yes			Low
C.18. Are there established goods receiving procedures?	Yes			Low
C.19. Are all goods that are received recorded as assets or inventory in a register?	Yes			Low
C.20. Is the agency/procurement department familiar with letters of credit?	Know some only			average
C.21. Does the procurement department register and track warranty and latent defects liability periods?	Yes			Low
Consulting Services				
C.22. Has the agency undertaken foreign- assisted procurement of consulting services recently (last 12 months, or last 36 months)? (If yes, please indicate the names of the development partner/s and the Project/s.)	No. The lasted project of IA conducted is World Bank project in 2006.			Average
C.23. If the above answer is yes, what were the major challenges?	IA is not familiar with international companies and it is difficult to know the experts' disposition in detailed.			Average
C.24. Are assignments and requests for expressions of interest (EOIs) advertised?	Yes. According to national regulations notices.			Low
C.25. Is a consultants' selection committee formed with appropriate individuals, and what is its composition (if any)?	Yes. experts who are expertise in related areas and one staff from owner. Total number is odd.			Low
C.26. What criteria is used to evaluate EOIs?	PRC laws and regulations, ADB/WB guidelines.			Low
C.27. Historically, what is the most common method used (QCBS, QBS, etc.) to select consultants?	QCBS			Low
C.28. Do firms have to pay for the RFP document?	Yes			Low
C.29. Does the proposal evaluation criteria follow a pre-determined structure and is it detailed in the RFP?	Yes			Low
C.30. Are pre-proposal visits and meetings arranged?	Yes			Low
C.31. Are minutes prepared and circulated after pre-proposal meetings?	Yes			
C.32. To whom are the minutes distributed?	Companies in shortlist			
C.33. Are all queries from consultants answered/addressed in writing?	Yes			Low
C.34. Are the technical and financial proposals required to be in separate envelopes?	Yes			Low
C.35. Are proposal securities required?	Yes			Low
C.36. Are technical proposals opened in public?	Yes			Low
C.37. Are minutes of the technical opening distributed?	Yes			

C.38. Do the financial proposals remain sealed until technical evaluation is completed?	Yes	Low
C.39. Who determines the final technical ranking and how?	Scoring method used. The bid evaluation committee collect each member's evaluation result and calculated and then decide.	
C.40. Are the technical scores sent to all firms?	Yes	
C.41. Are the financial proposal opened in public?	Yes	Low
C.42. Are minutes of the financial opening distributed?	Yes	
C.43. How is the financial evaluation completed?	Integrated scoring	Low
C.44. Are face to face contract negotiations held?	Yes	
C.45. How long after financial evaluation is negotiation held with the selected firm?	Publication of evaluation tende's results is after 3 days and within 10 days usually. To WB and ADB project, it need to get no rejection. It will be 3-6 months.	
C.46. What is the usual basis for negotiation?	Bidding and tendering documents	
C.47. Are minutes of negotiation taken and signed?	Yes	
C.48. How long after negotiation is the contract signed?	It is 15 days after receiving no rejection from the Bank.	Low
C.49. Is there an evaluation system for measuring the outputs of consultants?	Yes	Low
Payments		
C.50. Are advance payments made?	Yes	Low
C.51. What is the standard period for payment included in contracts?	56 days	Low
C.52. On average, how long is it between receiving a firm's invoice and making payment?	14 days	
C.53. When late payment is made, are the beneficiaries paid interest?	Yes	
D. EFFECTIVENESS		
D.1.Is contractual performance systematically monitored and reported?	Yes	Low
D.2. Does the agency monitor and track its contractual payment obligations?	Yes	Low
D.3. Is a complaints resolution mechanism described in national procurement documents?	Yes	Low
D.4. Is there a formal non-judicial mechanism for dealing with complaints?	No	Low
D.5. Are procurement decisions and disputes supported by written narratives such as minutes of evaluation, minutes of negotiation, notices of default/withheld payment?	Yes	Low
E. Accountability measures		
E.1. Is there a standard statement of ethics and are those involved in procurement required to formally commit to it?	Yes	Low
E.2. Are those involved with procurement required to declare any potential conflict of interest and remove themselves from the procurement process?	Yes	Low
E.3. Is the commencement of procurement dependent on external approvals (formal or de-facto) that are outside of the budgeting process?	Yes	Low
E.4. Who approves procurement transactions, and do they have procurement experience and qualifications?	EA	Low
E.5. Which of the following actions require approvals outside the procurement unit or the evaluation committee, as the case may be, and who grants the approval?		Low
a) Bidding document, invitation to pre-qualify or RFP	EA	

b) Advertisement of an invitation for bids, pre-qualification or call for EOIs	EA	
c) Evaluation reports	Evaluation committee	
d) Notice of award	EA	
e) Invitation to consultants to negotiate	EA	
f) Contracts	EA	
E.6. Is the same official responsible for: (i) authorizing procurement transactions, procurement invitations, documents, evaluations and contracts; (ii) authorizing payments; (iii) recording procurement transactions and events; and (iv) the custody of assets?	No. All are different person.	Low
E.7. Is there a written auditable trail of procurement decisions attributable to individuals and committees?	Yes	Low

II. General Ratings

Criterion	Risk
A. Organization and Staff Capacity	Low
B. Information Management Framework	Low
C. Procurement Practices	Low
D. Effectiveness	Low
E. Accountability Measures	Low
OVERALL RISK RATING	Low

APPENDIX K - Social and Poverty Assessment

CONTENTS

TABLES

FIGURES

I. OVERVIEW

A. PROJECT DESCRIPTION

1. The project investments will be located in Ankang and Shangluo, two prefecture-level cities in the Qinba Mountains area in Shaanxi Province. Together, these municipalities account for almost 15% of Shaanxi Province's population. Both Ankang and Shangluo have strong potential for expansion of agriculture and related processing, mineral and hydropower industries, and the development of tourism. Lack of adequate transport accessibility and highly unsafe road conditions are major constraints on the social and economic development of the region.

2. The proposed project will support the improvement of the road networks in the project area and thereby improve access and road safety through three components: (i) component 1: 186.95 km of trunk road rehabilitation including improvements to the S102 between Xunyang County and Xiaohe Town, the G316 between Xunyang County and Hanbin District, and the S224 between Chengguanzhen township in Shangnan County to Yunxian; (ii) component 2: upgrading of 8 rural roads totaling 139.66 km; (iii) road safety improvements on component 1 and 2 roads and an additional 569.66 km of roads.

B. OBJECTIVES

3. The study is guided by ADB Handbook of Poverty and Social Analysis (ADB 2012) as well as ADB Technical Note of Social Analysis for Transport Projects (ADB Technical Note 2008). The overall objectives of the social and poverty analysis are to review and assess social, ethnic minority and gender dimensions in terms of positive and negative impacts on the local population in order to develop appropriate strategies and plans to deal with the adverse impacts and ensure that benefits are widely distributed and socially inclusive. The essential tasks include:

(i) Review the socio-economic situation in Shaanxi Province, Project Prefectures and Project counties;
(ii) Conduct field surveys and multi levels stakeholder consultations and prepare socioeconomic and poverty profiles for project households;
(iii) Assess project impacts on the local residents, especially on minorities, poor, women and other vulnerable groups;
(iv) Assess potential social risks associated with the project such as land acquisition and people displacement, possible increased HIV/AIDS transmission or human trafficking;
(v) Explore possibilities to enhance positive impact and mitigate negative impact on the local community, particularly on the poor, ethnic minority, women and other vulnerable groups through a social and gender development action plan.

C. METHODOLOGY

4. The study methodology consisted of a series of data collection and analysis as defined below:

1. Secondary Data Collection

5. Literature study was used to review: (i) Twelfth Five-year (2011-2015)Development Plan of Shaanxi Province, Ankang and Shangluo Prefectures; (ii) official statistics books of Shaanxi, Ankang, Shangluo and three project counties (Hanbin, Xunyang and Shangnan); (iii) Poverty Reduction Strategies in Shaanxi Province, Ankang and Shangluo Prefectures, and three project counties; (iv) women development plan and evaluation reports in Shaanxi Province, Ankang and Shangluo Prefectures, and three project counties; (v) the feasibility study report (FSR) prepared by the design institute . FSR for trunk roads were available during ADB inception mission.

2. Primary Data Collection

6. Household survey and participatory appraisal approaches were used to gather primary data, which includes key informant interviews, focus group discussions, and field observations.

7. Household Survey: The household survey was designed to: (i) gather socio-economic and transport information at household level; and (ii) assess positive and negative impacts of the project on local people, particularly on women, the poor, minorities and other vulnerable groups. (iii) address the issue of road safety and mobility for local people. A total of 348 households in 17 administrative villages were sampled. All surveyed households were Han nationality. In Shaanxi Province, there were about 40 ethnic minorities in 2012 scattered and mixed living with Han population. Among minority population, Hui minority was the largest proportion, making up of 8.91% of total population. Minorities with more than 1000 population include: Man, Mongolia, Zhuang and Tibetan. Others had populations below 100 people. There are no pure and concentrated residence communities or villages or sub-villages of minority groups in the project areas. The ethnic minority population totaled less than 1% in the project areas. Of the households surveyed, 38.5% were female respondents, and 28.7% were poor households (according to Shaanxi Provincial Rural Poverty Line of per capita farmer net income CNY 2,785 per year). The provinces are allowed to define their own poverty line to fit their social and economic conditions. Shaanxi Province adjusted its poverty line higher than the national level in order to target more low-income groups. The families with 4-6 members comprised the majority of surveyed households, accounting for 71.8%, followed by families with less than 3 members (25.3%) and families with more than 6 members (2.9%). Table 1 shows the distribution of surveyed project roads and households. Among the 17 villages surveyed, 7 villages were still not accessed by rural public transport service.

Table 1: Distribution of Surveyed Roads and Households

Component	Road Name	County	Town /Township	Village committee	# of HH surveyed
Trunk Road Rehabilitation	S102 (Xiaohe-Xunyang)	Xunyang	Xiaohe	Qipan	20
			Zhaowan	Hujiazhuang	22
	G316 (Xunyang-Ankang)	Hanbin	Zaoyang	Dongwan	19
				Longquan	20
	S224 (Shangnan-Hubei)	Shangnan	Xianghe	Xianghe	22
			Weijiatai	Weijiatai	21
Subtotal	**3**	**3**	**5**	**6**	**124**
Rural Road Upgrades	Shuhe-Xiaohe Road	Xunyang	Hongjun	Shangma	20
			Xiaohe	Zhangjiagou	20
	Lijiaba-Baiguo Road	Xunyang	Duanjiahe	Baoguoshu	20
	Baigou-Luojia Road	Xunyang	Xiaohe	Luojia	20
	Yangpo-Liangheguan	Xunyang	Xiaohe	Liangheguan	20
	Zaobao-Youshengcun	Hanbin	Zaoyang	Yousheng	20
	Zaobao-Wujiashan	Hanbin	Zaoyang	Maliu	20
	Xianghe-Shuigou Road	Shangnan	Shuigou	Shuigou	20
				Taibai	20
Subtotal	**7**	**3**	**4**	**9**	**180**
Road Safety Improvements	Hongjunzhen-Dongchuancun	Xunyang	Hongjun	Dongchuan	22
	Longtangou-Gongjinxiang	Hanbin	Gongjin	Gongjin	22
Subtotal	**2**	**2**	**2**	**2**	**44**

8. Key Informant Interview: Leaders of surveyed villages were interviewed to collect information on population, poverty causes and poverty reduction programs implemented at the community level and views of community leaders on the project. A total 26 key informants were interviewed.

9. Focus Group Discussion: Various social groups in the Project areas with differences by gender, age, household economic level and occupation were organized to discuss their needs, opportunities and constraints brought by the Project. The focus group discussions also helped

identify positive and negative impacts of the Project on the local population as well as to discover social concerns and problems. A total 42 focus group discussions were held in project areas comprising 128 males and 122 females. The questionnaires of household survey and checklist of focus groups discussion and key informant interviews are attached.

10. Stakeholder Consultation Workshop: Consultation workshops with key project stakeholders were conducted at Ankang and Shangluo Prefectures, Xunyang County, Hanbin District and Shangnan County. The objectives of the consultation workshops were: (i) to assess stakeholders' capacity, interest and importance in and influence on project planning and implementation particularly in gender development and poverty reduction; (ii) to gather information on their views and expectations of the project; (iii) more importantly to assess vulnerable groups' needs, social impacts and social risks of the project in order to design effective measures to maximize the positive impacts and mitigate the negative impacts. The criteria for stakeholder selection included: (i) influence on the project like EA and IAs, namely Communication Bureaus at project prefectures and counties; (ii) affected local population; (iii) key organizations working for vulnerable groups like Women Federations working for women development and Poverty Alleviation Offices working to help the poor rise out of their poverty situation. The major stakeholders involving in these workshops included:

(i) Women's Federations at project prefectures and counties;
(ii) Poverty Alleviation Offices at project prefectures and counties:
(iii) Civil Affairs Bureaus at project prefectures and counties;
(iv) Communication Bureaus at project prefectures and counties;
(v) Local representatives of affected villages by the project.

D. PROJECT AREA IDENTIFICATION

11. The project is comprised of 3 components: (i) Component 1: 186.95 km of trunk road rehabilitation including improvements to the S102 between Xunyang County (located in Ankang Prefecture) and Xiaohe Town (located in Xunyang County), the G316 between Xunyang County and Hanbin District (located in Ankang Prefecture), and the S224 between Chengguanzhen township in Shangnan County (seated in Shangluo Prefecture) to Yunxian. (ii) Component 2: rural roads upgrades to eight roads totaling 139.66 km in Hanbin District, Xunyang County and Shangnan County; (iii) road safety improvements on component 1 and 2 roads and an additional 569.66 km of roads. Therefore the project area comprises Xunyang County and Hanbin District in Ankang Prefecture and Shangnan County in Shangluo Prefecture.

Figure 1: Maps of Project Area – Ankang City (S102, G316) and Rural Roads

Figure 2: Shangnan City Trunk Road (S224) and Rural Roads

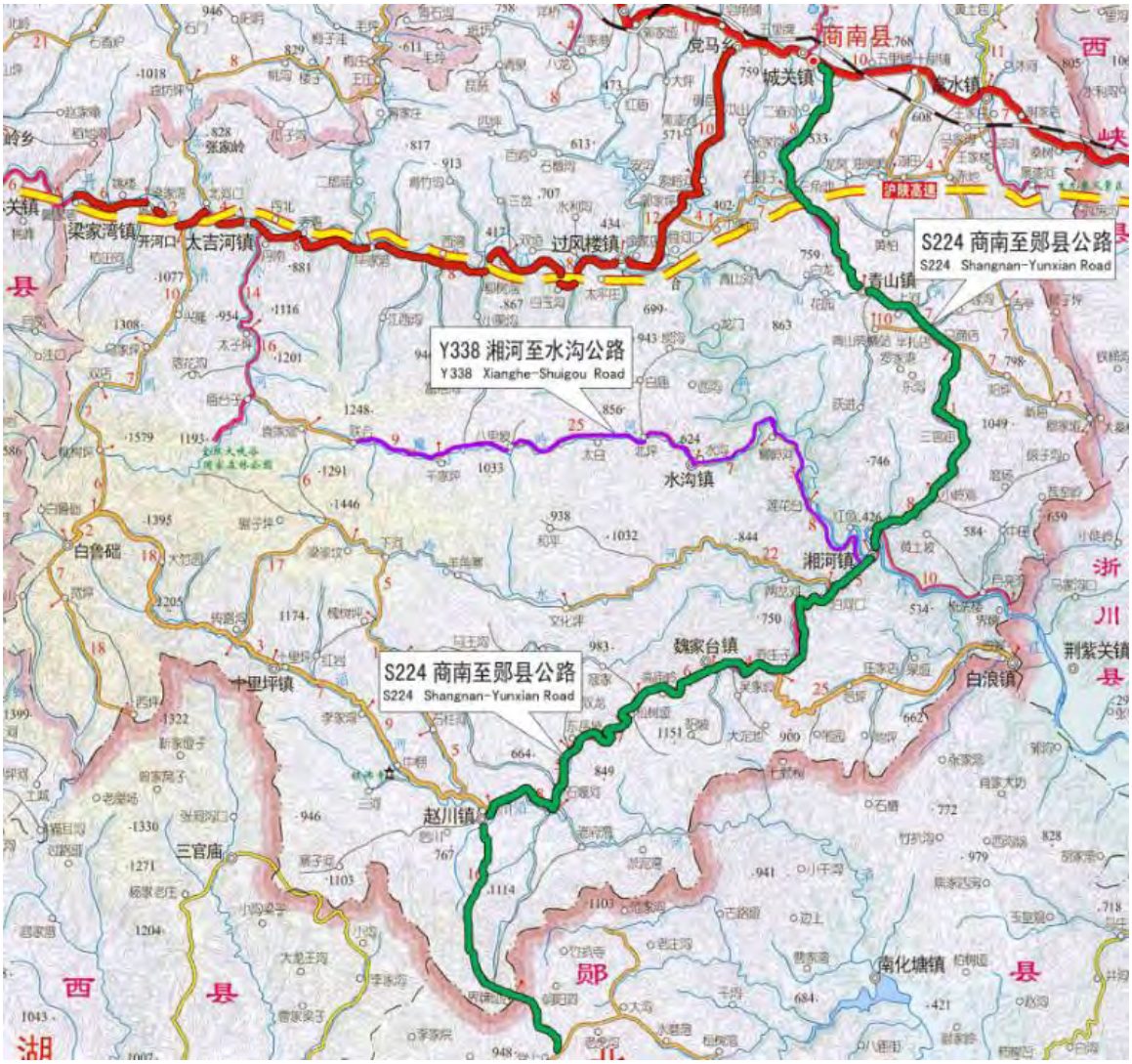
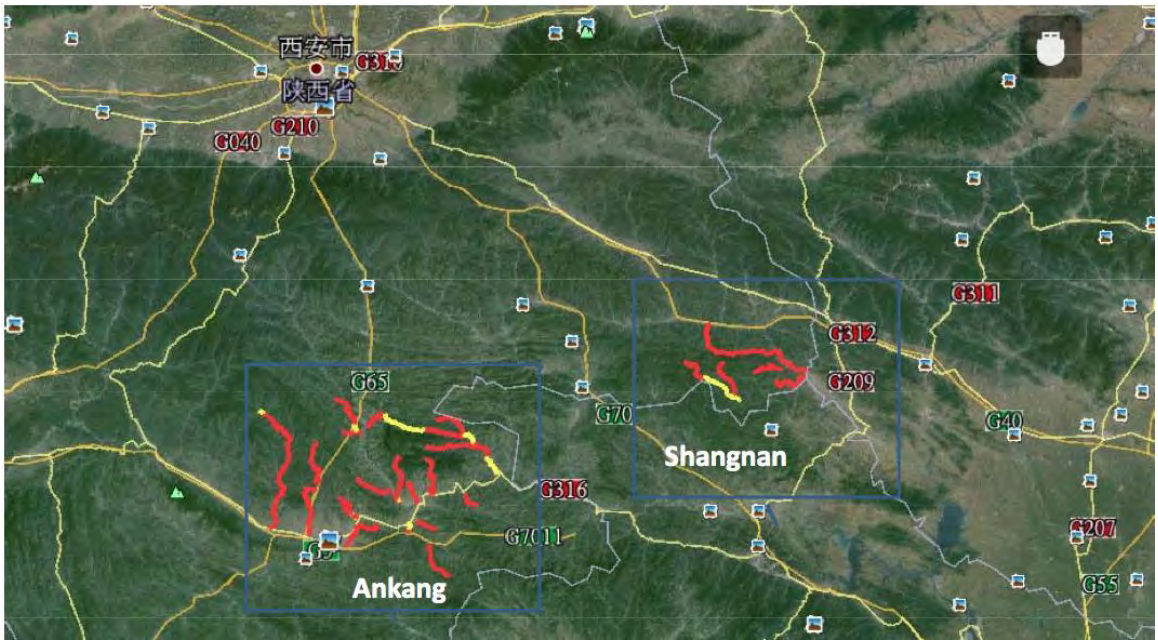


Figure 3: Road Safety Roads



II. SOCIO-ECONOMIC PROFILE

A. GEOGRAPHY AND HISTORY

12. Shaanxi Province is located in the north of China, covering a total area of 205,600 km^2. The terrain in Shaanxi is characterized by Loess Plateau in the north, Guanzhong Plain in the central of province and Qin-Ba Mountain in the south where the project area. Due to its large span in latitude, Shaanxi has a variety of climate. Its northern part is the semi-arid area with cold winters and hot summers, while the southern portion is much more humid with temperate winters and hot humid summers.

13. Shaanxi is known as one of the cradles of Chinese civilization. Thirteen feudal dynasties established their capitals in the province during a span of more than 1,100 years. Xi'an, the provincial capital city, is one of six great ancient cities of China and the start of the famous Northern Silk Road connecting the ancient China to the West.

B. ADMINISTRATIVE DIVISION

14. Shaanxi Province consists of 11 cities at prefecture level, 3 cities at county level, 80 counties, 24 districts under cities, 1136 towns, 80 townships，202 street communities and 27,530 village committees. The three project counties are Xunyang and Hanbin in Ankang Prefecture and Shangnan in Shangluo Prefecture. The administrative divisions in the project area are shown in Table 2.

Table 2: Administrative Division in Project Areas (2012)

Region	Cities at prefecture level	Cities at county level	Counties	Districts under cities	Towns/Townships	Street Communities	Village Committees
Shaanxi	11	3	80	24	1136/80	202	27530
Ankang	1	—	9	1	157/0	4	1634
Shangluo	1	—	6	1	122/0	4	912
Xunyang	—	—	—	—	16/12	—	282
Hanbin	—	—	—	—	30/0	4	876
Shangnan	—	—	—	—	13/0	—	164

Source: Shaanxi Statistic Yearbook 2013.

C. DEMOGRAPHY

15. In 2012, there were 1,708,778 people in the three project counties. Of these 1,328,771 people were rural population (77.8%), 799,032 people were women (46.8%) and 99.8% were Han nationality. The population density in Hanbin was significantly higher than the prefecture and provincial levels, reaching 277.9 persons per km^2, followed by Xunyang (135.4 persons per km^2) and Shangnan (104.9 persons per km^2). Per capita farming land area in three project counties was lower than the provincial average. Particularly per capita farming land area in Shangnan and Hanbin were 0.04 ha and 0.05 ha respectively. These are low as waste dry land also used by farmers is not included in the farming land figures.

Table 3: Population and Population Density (2012)

Province/Municipal/County	Total area (km^2)	Per Capita Farming Land Area (Ha)	Households	Population	Rural	Urban	Male	Female	Population density capita/km^2
Shanxi	205,600	0.10	12,249,020	39,086,765	25,180,912	13,905,853	20,217,274	18,869,491	190.1
Ankang	23,536	0.08	1,005,444	3,050,703	2,423,780	626,923	1,639,280	1,411,423	129.6
Shangluo	19,292	0.07	747,666	2,478,733	1,559,611	919,122	1,307,404	1,171,329	128.5

Xunyang	3,554	0.09	143,831	454,170	396,326	57,844	243,859	210,311	135.4
Hanbin	3,644	0.05	325,110	1,012,605	790,042	222,563	538,853	473,752	277.9
Shangnan	2,307	0.04	83,798	242,003	142,403	99,600	127,034	114,969	104.9

Source: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

D. ECONOMY

16. In 2012, the total GDP in Shaanxi Province reached CNY 1251.23 billion. GDP composition ratios for the primary, secondary, and tertiary sectors were 9.76%, 55.43%, and 34.81% respectively.

17. Xunyang County produced a total GDP of CNY 6.78 billion, or CNY 15879 per capita, which was lower than the Ankang Prefecture average of CNY 18,878. The proportion of the agriculture sector in the overall economy, which is an important indicator of the level of economic development, was 14.25% in Xunyang in 2012, which was lower than the prefecture average. The proportion of the secondary sector was 50.32% in Xunyang, which was higher than the prefecture average. The proportion of the tertiary sector was 35.42%, which was slightly lower than the prefecture average. The main secondary sector activities in Xunyang County include mining, tobacco, chemistry medicine, cement and construction materials. While real estate, catering and trading comprised the three major activities of the tertiary sector.

18. In the same year, the per capita GDP in Hanbin District and Shangnan County was CNY 15,735 and CNY 15,582 respectively, which were lower than the Xunyang County average. In 2012, GDP composition ratios for the primary, secondary, and tertiary sectors were 13.39%, 34.60%, and 52.01% respectively in Hanbin District. The percentage of primary industry in Shangnan was 23.46%, which has the biggest portion of GDP of the three project counties.

Table 4: GDP Composition in Project Areas（2012

Province/Municipal/ County	GDP (100 Million Yuan)	Primary Industry (%)	Secondary Industry (%)	Tertiary Industry (%)	Per Capita GDP (CNY)
China	471564	10.12	46.78	43.10	38,448
Shaanxi	12512.30	9.76	55.43	34.81	38,557
Ankang	407.17	17.69	44.98	37.33	18,878
Shangluo	362.95	19.45	44.92	35.63	18,097
Xunyang	67.77	14.26	50.32	35.42	15,879
Hanbin	136.95	13.39	34.60	52.01	15,735
Shangnan	47.39	23.46	42.84	33.70	15,582

Sources: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

19. The average annual disposal income of urban residents was CNY 17,697 per capita and CNY 18,710 in Xunyang and Hanbin respectively, which were higher than the Ankang Prefecture level but lower than the provincial average of CNY 18,245 Similarly, the average annual net income of farmers was CNY 5,096 per capita and CNY 5,099 per capita in Xunyang and Hanbin respectively, which were higher than the prefecture and provincial average. The resident income levels both for urban and rural people in Shangnan were lower than prefecture and provincial average. The annual increase of farmer income was lower (an increase of 18.2% over the previous year) compared to other two project counties where the increase was 26%).

Table 5: Resident Income Level (2011) (Yuan)

Province/Municipal/County	Per Capita Annual Disposal Income of Urban Resident	% increase over 2010	Per Capita Annual Net Income of Rural Resident	% increase over 2010
China	24,565	13.5	7,917	17.9
Shaanxi	18,245	16.2	5,028	22.5
Ankang	17,365	18.6	5,009	26.0
Shangluo	17,344	17.1	4,586	27.2
Xunyang	17,697	19.5	5,096	26.9
Hanbin	18,710	19.3	5,099	26.8

Shangnan	17,327	15.8	4,678	18.2

Sources: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

E. AGRICULTURE

20. Grain, oil bearing, cotton, vegetables and fruits formed the major agricultural crop products in the project area. The major fruit products are peach, apple, pear and plum. In 2012, Hanbin shared the largest yield of grain (217,363 ton) and vegetables (321,213 ton). Hanbin and Xunyang shared similar outputs of fruits, whereas Shangnan had the biggest harvest of oil bearing (61,733 ton, 5.3% of the while province) and cotton (11,732 ton, 17.5% of the whole province). But the production of vegetables and fruits in Shangnan was smaller compared to Xunyang and Hanbin.

Table 6: Main Agricultural Crop Products in Project Areas (2012) (ton)

Province/Municipal/ County	Grain	Oil Bearing	Cotton	Vegetables	Fruits
Shaanxi	12,451,000	603,300	67,202	15,256,183	14,377,449
Ankang	851,803	134,609	36	1,210,846	194,959
Shangluo	642,957	23,427	2	425,026	69,781
Xunyang	120,091	19,383	0	125,367	47,753
Hanbin	217,363	37,816	24	321,213	49,905
Shangnan	18,842	61,733	11,732	70,911	5,872

Sources: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

21. Farming and animal husbandry largely contributed to the agricultural output value in the project area. The gross agricultural output value in 2012 amounted to CNY 1,704.33 million in Xunyang, CNY 2776.29 million in Hanbin and CNY 2018.08 million in Shangnan where the farming accounted for 55.2%, 55.9% and 43.1% respectively, and animal husbandry accounted for 36.6%, 31.2% and 44.9% respectively. The main agricultural products of these counties included grain, oil bearing, cotton, vegetables and fruits. The main animal products included pigs, chicken, and fish.

Table 7: *Gross Output Value of Farming, Forestry, Animal Husbandry and Fishery in Project Areas (2012) (10000 Yuan)*

Province/Municipal/ County	Total	% increase over last year	Farming	Forestry	Animal Husbandry	Fishery
Shaanxi	23032043	6.0	15262805	584353	5987160	146109
Ankang	1403908	5.7	813006	80775	423245	48772
Shangluo	1395503	5.9	715915	80326	545743	3420
Xunyang	170433	6.9	94113	7158	62328	1802
Hanbin	277629	6.2	155243	14836	86610	11785
Shangnan	201807.83	5.6	86934.80	16174.66	90654.30	278.24

Sources: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

F. SOCIAL FACILITIES

22. Social facilities of health institutions and schools have been improving in the project area to meet fundamental needs of local population for medicine and education. There is one hospital in each town/township. Some towns with bigger population may have two hospitals, e.g. Hanbin. There is one clinic in each village committee with at least one doctor in each village clinic. Each county has one maternity and child center to serve women and infants at county cities.

23. In terms of education, primary schools can be fully accessed by children in the project area. Over 80% students can finish their nine education years and graduate from junior schools. However, the rate of student graduate both from junior and senior schools in the project area was lower than the prefecture and provincial average in 2012. Higher education over senior

school at the prefecture and county level is very limited as higher education is heavily concentrated in the provincial level.

Table 8: Number of Health Institutions and Persons Engaged in Project Areas (2012)

	Shaanxi	Ankang	Shangluo	Xunyang	Hanbin	Shangnan
Hospitals at Provincial/Prefecture/County	888	768	698	4	5	3
Medical Person Engaged	136,553	9,142	8,769	758	874	608
Township Hospitals	1,632	162	131	28	49	13
Medical Person Engaged	32,799	3,726	2,882	425	3634	117
Village Clinics	26,883	2,454	2,119	282	876	164
Medical Person Engaged	37,246	2,861	3,578	362	996	334
Maternity and Child Care Center	117	11	7	1	2	1
Medical Person Engaged	10,956	358	203	108	112	87

Sources: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

Table 9: Number of School and Students Enrolled in Project Areas (2012)

	Shaanxi	Ankang	Shangluo	Xunyang	Hanbin	Shangnan
Primary School	7,994	886	743	75	333	110
Students in Primary School	1,174,619	208,396	191,421	233,66	76,613	15,681
Enrollment Rate in Primary School	99%	99%	98.9%	100%	100%	100%
Junior Secondary School	1765	170	158	29	76	9
Students in Junior School	1,315,464	123,008	109,954	16,837	61,624	8,434
Graduate Rate from Junior School	90%	90%	87%	84%	83%	83%
Senior Secondary School	530	39	28	4	7	4
Students in Senior Secondary School	941,528	59,700	60,114	10,478	27,326	25,787
Graduate Rate from Senior Secondary school	90%	80%	75%	75%	72%	73%
Vocational Secondary School	287	2	2	1	2	1
Student in Vocational Secondary School	384,739	16,277	16,687	4,527	13,570	2,757

Source: Shaanxi, Ankang and Shangluo Statistic Yearbook 2013.

G. RURAL HOUSEHOLD LIVELIHOODS

24. There were four types of land in surveyed households including paddy land, dry land, orchard and forestland. The forestland shared the biggest proportion totaling 1347.3 mu or 47.2% of total land area, followed by the dry land totaling 1162.7 mu or 40.7%. The areas of paddy land within surveyed households were smaller, accounting for only 4.2% of total land area.

25. Average land area per household was 8.2 mu according to the household survey data, of which paddy land was 0.33 Mu per households. The paddy land was mainly cultivated with wheat, rice, vegetables and tobacco. The dry land was largely planted with ginger, oil bearing, corn, walnut, chestnut and some fruits. Orchards were planted with fruits or mushroom. In most forestland it is forbidden to fell trees but villagers are allowed to collect forest products like wild mushroom.

Table 10: Types and Sizes of HH Landholdings

Categories	Areas (mu)	Average areas per HH (mu)	% of total Areas
Paddy land	115.3	0.33	4.0
Dry land	1162.7	3.34	40.7
Orchard	64.4	0.19	2.3
Forestland	1347.3	3.87	47.2

Categories	Areas (mu)	Average areas per HH (mu)	% of total Areas
House site	119.15	0.34	4.2
Other	45.56	0.13	1.6
Total	**2854.41**	**8.20**	**100**

Source: Household Survey Data.

26. Agricultural and non-agricultural sources were the two primary income sources of rural households. Agricultural sources made up of 32.5% of total income including: grain (10.2%), cash crops (11.5%), livestock (5.1%), fruits and nuts (0.5%) and mushroom and herbal medicine (5.2%). Non-agricultural sources made up of 67.5% of total income, involving: small business (2.5%), restaurant (2.6%), providing transport service (0.8%), repair services (1.9%), migrant labor (55.1%), compensation of land acquisition (1.2%) and poverty reduction subsidy (2.1%).

27. It was estimated from village leader interviews and focus group discussions that 20% of households were fully dependent on agriculture for making their living, 60% of households relied mainly on non-agricultural activities with diversified grain and cash crops to develop their livelihoods, and the remaining 20% of ***households relied predominately on non-farm*** earnings. Few rural households can totally disconnect from agriculture production.

Table 11: Income Sources of Surveyed HHs (2013)

	Income sources	% of total income
Agricultural sources	Grain	10.2
	Cash crops (tobacco, vegetables, oil bearing， ginger)	11.5
	Livestock (pig, poultry, egg)	5.1
	Fruits and Nuts (apple, pear, plum, peach, walnut, chestnut)	0.5
	Mushroom and herbal medicine	5.2
	Others	0.6
Sub-total		32.5
Non-agricultural sources	Doing business	2.5
	Running restaurant	2.6
	Providing transport service	0.8
	Repairing service	1.9
	Migrant labor	55.1
	Compensation of land acquisition	1.2
	Poverty reduction subsidy	2.1
	Others	1.3
Sub-total		67.5

Source: Household Survey Data.

28. Education and living consumption (food, clothes, cooking oil, etc.) were major types of household expenditures, accounting for 22.5% and 25.7% of total expenditures respectively, followed by the transport cost (11.3%) and agricultural production investment (13.2%).

Table 12: Expenditure Patterns of Surveyed HHs (2013)

Expenditure categories	% of total expenditure
Living Consumption	22.5
Education	25.7
Health care	8.6
Transport cost	11.3
Communication	8.6

Social maintenance	6.3
Agricultural production investment	13.2
Others	2.8
Total expenditure	100

Source: Household Survey Data.

H. RURAL PUBLIC FACILITIES

29. Rural facilities of schools, clinics and electricity are sufficient to meet rural people's needs for their livelihood development in surveyed villages. However, accessibility to roads and potable water are inadequate. Half of rural households had access to earth-surfaced roads that are often not reliable in rainy season. The household survey reveals that only 70% of the villagers can access all-weather roads.

Table 13: Accessibility of Public Facilities in surveyed Villages (%) (2013)

Access to electricity	Access to tap water	Access to village clinic	Access to school within administrative village	Access to road	Access to all-weather road
100	90	94	70	100	70

Source: Village leader interview and focus group discussion.

III. PROFILE OF TRANSPORT SERVICE AND COST

A. EXISTING TRANSPORT NETWORKS AND PROBLEMS IN THE PROJECT AREA

1. Rural Roads

30. In Xunyang County, there are 27 township roads with a total length of 403 km, of which 50% are Class IV. There are 3,993 km village roads with 46.6% by length being paved. 100% village committees can be accessed by road. In Hanbin District, 93% village committees are covered by road and 70% by road length are paved. In Shangnan County, 95% village committees have road accessibility and around 70% roads are paved. In general, the major problems include: fewer village groups can be accessed by the road, existing road conditions are poor such as narrow surface, road deformation, many turns and 95% roads do not have security facilities.

31. Eight rural roads totaling 139.658 km in Hanbin District, Xunyang County and Shangnan County are proposed for upgrading to paved surface. Most of project rural roads are village roads except for one county road in Xunyang and one township road in Shangnan. The project rural roads pass 7 townships and 34 villages, serving over 50,000 local people, of which 36% are poor.

32. These rural roads provide rural isolated communities away from main road with access to markets, to collection or processing stations for a sale of cash crops, and to towns and cities for employment opportunities. They also provide important social services such as access to school, health facilities and administrative services. However, many rural roads become impassable during the rainy season due to landslides and poor road surface.

33. In general, the proposed project roads are in poor condition caused by multiple factors including increasing traffic volume with heavy transporting mineral materials and insufficient investments in road maintenance and rehabilitation. The poor condition of the roads is a major constraint to faster and easier mobility for local people to widen income-generating opportunities that are crucial to diversify household income sources for livelihood development. It was reported by focus group discussions with farmers that some of migrants have to stay in their working counties or cities due to longer travel on the road. If the road condition becomes better, they can return home daily or weekly to do other production activities. Some women said that

their land is suitable to grow vegetables. But they are scared of the decline of vegetable value due to product damage as a result of shipping over the roads in bad condition. Some women, who need to look after small children and want to have daily jobs in nearby private enterprises, cannot take up these job opportunities due to longer travel on the bad roads particularly in the rainy season. Bad road conditions have also obstructed the trade of agricultural products by hindering timely transportation of goods, which is becoming increasingly important for rural livelihoods under the changing situation of commercialized agriculture. Finally, the bad road condition is obstructive to accessibility of public transport services for local communities, particularly for the poor and women who are the major travelers using public transport.

34.The field survey selected 7 rural roads out of 8 proposed roads to study socio-economic features and to understand project benefits, impact and risks. Two villages out of surveyed 9 villages could not be accessed by the rural public transport due to poor road condition. For those villages, villagers can only use private modes of transport such as motorcycle, tractor-trailer and tractor-truck. Several villagers provide passenger transport services with their own transport modes. Transport fares vary from village to village and from dry to rainy season. According to interviews, the fare of these transport modes could be as much as double during the rainy season.

Table 14: Project Rural Roads Characteristics

Road Name	Administrative Class	County	Project Length (km)	Townships Passed	Villages Passed	Population Covered	Poor Population Covered
Shuhe-Xiaohe Road	County Road	Xunyang	38	2	13	19,806	2,445
Lijiaba-Baiguo Road	Village Road	Xunyang	7.2	1	1	1,046	360
Baigou-Luojia Road	Village Road	Xunyang	11	1	1	1,283	581
Yangpo-Liangheguan Road	Village Road	Xunyang	11.9	1	1	4,035	1,809
Yanba-Dongqiao Road	Township Road	Hanbin	12	1	4	3,401	1,205
Zaobao-Youshengcun Road	Village Road	Hanbin	6.3	1	1	1,153	492
Zaobao-Wujiashan Road	Village Road	Hanbin	5	1	1	803	285
Xianghe-Shuigou Road	Township Road	Shangnan	45	2	12	21,364	12,055

Source: Project County Communication Bureaus and village leader interviews.

2. Trunk Roads

35. In Shangnan County, there are two trunk roads (G312 and S224) serving the county transportation. G316 and S102 are main trunk roads passing Xunyang County and Hanbin District. These roads are lower Class roads that are failing to meet the increasing volume of vehicles, resulting in heavy traffic on the road, costly transport and dangerous travel.

36. This component comprises a mixture of upgrading of existing road and new construction of some sections of approximately 193km of trunk roads.

37. The project section of S102 starts from Xunyang County and ends at Xiaohe Town, connecting 9 town/townships (Chengguan Town, Bailiu Town, Ganxi Town, Zhaowan Town, Maping Township, Xiaohe Town, Tongmu Town, Gongguan Township, and Renhekou Township) and covering over 200 villages with a population of about 180,000. In these towns, rural households mainly rely on cash crops such as tobacco, ginger, oil bearing and vegetables and non-farm earnings to make their lives. They are fully dependent on the road for their livelihoods such as using the road to seek waged jobs, visiting health facilities and markets, accessing schools, buying agricultural inputs and selling their crops.

38. Current transport modes for farmers include motorcycle, tractor-trailer, small truck, bus and minivan. Availability of bus or minivan varies with routes connecting village to village, village to township, township to township, township to county and county to Ankang and Xi'an cities.

39. S102 is the major north-to-south trunk road in the south area of Shaanxi Province. Due to the regional economic development, the growing traffic has caused severe damage to pavements. Most portions of the existing road pavements have worn off and reduced to as gravel road and even become earth road. The current road condition of S102 cannot meet the increasing transportation demands. Some segments of road surface are badly destroyed with dense potholes and many deformations. The road surface is too narrow to meet the increasing transportation demand. The narrow road surface, increasing traffic volume, lack of effective measures of truck overloading control, and unclear safety signs at most intersections, are major factors contributing to unsafe travel on the road.

40. The project section of G316 is located in Ankang Prefecture, a southeast city of Shaanxi province, going through Xunyang County and Hanbin District along the north bank of Hanjiang River. Some sections have pavements defects such as crocodile cracks, potholes, cave-ins, cement concrete slab slackening, and subgrade depressions.

41. The project section of G316 passes 6 town/townships of Guanmiao Town, Shiti Township, Zaoyang Town, Duanjiahe Town, Lvhe Town and Guihua Township, covering over 130 villages with a population of about 140,000.

42. S224 （Shangnan-Weijiatai）Highway is the only north-to-south corridor in project areas. and links Shangnan County and Yunxian County of Hubei Province, playing a very important role in the regional economy development. The Project's route starts in Shangnan County linking S312 Highway, goes through Qingshan Town, Xianghe Town, and ends in Weijiatai Town.

43. Due to mountainous terrains, the route has many tight curves, and goes along the riverside in low elevations, which is prone to flood inundations in summer. Its capacity got improved considerably after the whole section upgraded to Class III highway between October 2002 and October 2003. Unfortunately, the flood in 2010 again washed away some roadbeds, protection works, bridges and culverts. Some sections of pavements were destroyed seriously. They have not yet recovered.

Table 15: Surveyed Villages Characteristics in Trunk Roads

Road Code	Villages	Population	Per capita Farming Land (Mu)	Per Capita Annual Income (Yuan)	Income Sources	Distance to the Main Road (km)	Distance to the Town (km)	Distance to the Nearest market (km)	Distance to Primary School (km)
S102	Qipan	1,059	1.1	9,065	Wheat 10% Ginger 30% Migrant labor 60%	10	10	10	5
	Hujiazhuang	1,216	1.2	6,484	Migrant labor 50% Tobacco 20% Ginger + Herb 25% Livestock 5%	15	15	15	4
G316	Dongwan	1,229	0.8	6,835	Migrant labor 50% Livestock 20% Ginger 35%	1	1	1	5
	Longquan	968	1.3	6,710	Oil bearing 20% Migrant labor 40% Ginger 10% Grain+ Livestock 30%	0	10	10	10
S224	Xianghe	950	0.8	4,800	Mining work 20% Migrant labor 30% Mushroom 30% Livestock 20%	2	10	2	0

	Weijiatai	1,147	0.7	4,200	Mining work 35% Migrant labor 35% Transport 30%	0	0	0	0

Source: village leaders interviews

3. Road Safety Improvements

44.The total 660 km with 25 proposed rural roads will be improving road safety facilities in order to reduce travel accidents as well as increase travel safety. Five (5) proposed roads are located in Hanbin, 14 roads are in Xunyang and 6 roads are in Shangnan. These roads are seated in the mountainous area, stretching along either steep climbs or deep rivers. Narrow and unpaved road surface with lots of steep hills and sharp turns lead to the high ratio of transport accidents on these roads. The motorized and non-motorized travel becomes more dangerous during the raining season due to landslides, sharp turns and muddy mixed slippery road surfaces. There are few road safety facilities on these roads.

B. TRANSPORT PATTERNS OF LOCAL POPULATION IN THE PA

45. There are four major travel destinations of local people, namely; township, county, prefecture city and province town. The main purposes of travel include: seeking job opportunities; selling and buying products; buying household commodities; visiting health center; sending children to school and maintaining social networks. The township is a common destination of travel for local people. 27.9% respondents said they had travel to townships in the previous month. 42.5% people travelled to the prefecture cities, followed by county destination with 18.4% people. The prefecture city is an important destination for local population as they hold bigger markets, more job opportunities and more qualified health and education services. This explains the higher frequency of prefecture city travel as compared to county travel. All respondents reported they made few trips to the province towns. According to the focus group discussions with local farmers, the main reason why the people travel less to province towns was that the province town is far away and costly although they want to visit there to find a wider variety of job and business opportunities.

Table 16: Different Travel Destinations for Local People

Destinations	Total	
	No. of HH	%
Township	97	27.9
County	64	18.4
Prefecture	148	42.5
Province town	9	2.6

Source: Household Survey Data.

46. Overall, the frequency of township travel was ranked highest as the local people went there not only for business activities but also for administrative matters such as marriage register, obtaining certificates, etc. The travel time within township, county or prefecture city was similar but going to the province town took far longer. There is an obvious difference in travel cost among various destinations. Return travel to township was the cheapest, with the travel cost to the province town was the highest, at CNY 48.89 return.

Table 17: Travel Frequency, Time and Cost for Local People

		Total (N=348)
Travel frequency	Township	5.0

(No. of travels per month)	County	4.2
	Prefecture	4.4
	Province town	2.8
	Total	16.4
Travel time(Minutes/one return)	Township	34.23
	County	41.09
	Prefecture	52.37
	Province town	204.29
	Total	332.07
Cost of travel (Yuan/one return and back)	Township	14.79
	County	39.53
	Prefecture	43.86
	Province town	48.89
	Total	147.07

Source: Household Survey Data.

47. Among the surveyed 17 villages, there are 10 villages (59%) that have public transport services. The household survey revealed that the motorcycle was the most popular transport mode possessed by surveyed households. Particularly in those villages without public transport service, the motorcycle is quite important for villagers to transport people and products and other goods. The percentage of private transport modes possessed by surveyed households was 63.5%. The percentage of tractor, small trunk, car, and minivan possessed by surveyed households was 42%, 38%, 28% and 8% respectively. Almost all households have their own motorcycles (60%).

C. TRANSPORT NEEDS OF LOCAL COMMUNITIES IN THE PROJECT AREA

48. Road improvement is a fundamental need of livelihood development and living condition improvement. The local transport needs have been identified during focus group discussions with villagers in terms of: improving connections from main road to village road; improving connections from village road to town centers and paving roads connecting village groups.

49. The field survey discovered the following four aspects of transport needs are the most important for local farmers.

50. Agricultural goods transport: Since 1990, the transport for agricultural products has increased greatly in the project area. From 2010 to 2012, the annual fruits and nuts production increased 96.5% and vegetable production increased 13.5%. The scaling up of the commercial agricultural products calls for the road accessibility improvement, and also fuels further needs of road improvement. The field surveys and observations found that the most profitable cash crops (ginger and vegetables) were planted in the fields located along the main road or those with better rural road access. Most newly planted cash crops are located in the area with new road constructed or newly improved roads. Road improvement is the precondition of expansion of cash crops. Focus group discussions confirmed that the road accessibility is one of the major factors affecting cash crop production. The other factors include large areas of land availability, financing availability, irrigation condition, and technology and marketing capacity. Out of the 17 surveyed administrative villages, 13 viewed cash crop plantation increase as one of the major changes and all 17 villages are looking forward to planting more or improve the productivity of the cash crops.

51. Faster travel for non-farm jobs: all 17 surveyed villages have large income sources from migrant labor representing over 55% of the total income. More than 60% of the surveyed households have members that are long-term or seasonal migrant labors. In general, the frequency of returning home for seasonal migrant labors varied from one week to two months depending on the distance and road condition. However, the long-term migrant labors often come back home once per year since most of them worked in prefecture or provincial towns. Better road conditions would benefit both seasonal and long-term migrant laborers. For the long-term migrants, better road conditions would save them travel time. For seasonal workers, good road connectivity can provide them with more time to come back home to help agricultural activities as well as address domestic concerns. They have strong need for faster transportation. It was reported by interviewed villagers there is a trend to increase non-farm earnings to meet the increasing demand of cash income for rural households. More job opportunities are outside villages and beyond townships. Often the county town can provide more jobs but longer travel is needed. Villagers nearby the city or along the main road can easily obtain more jobs or create some small businesses.

52. Safer travel to school: Within the 17 administrative villages surveyed, there are a total of about 3000 primary students and 800 middle school or high school students. Motorcycle and walking are the two major transport modes for primary school students. Motorcycle and bus/minibus are the major transport modes for middle school students. Bus/minibus is the main transport mode for high school and vocational school. The poor road condition makes it difficult for students to go to school, particularly for small children in primary school.

53. Easier travel to township hospital: Traveling to township hospitals is a basic need of local farmers as village clinics have limited capacities. The distance to township hospital averaged 8-10 km in the surveyed villages. The existing poor road condition increases the travel time to the hospital.

54. Safer travel on the road: The safety related issues are central concerns of local people, particularly parents with school-aged children. Over 95% of household survey respondents think there are road safety problems in the project area, of which about 70% consider the road safety problems are serious. All interviewed people from FGDs with different road users viewed that there are problems with road safety, of which about 60% of interviewees considering that road safety problems faced by them are very serious. The common issues of road safety raised by local people interviews include: (i) unsafe intersections connecting villages and markets due to lack of clear and easy-identified safe signs; (ii) unsafe travel due to lack of markings on the road; (iii) dangerous roads, particularly at bends, due to lack of effective regulation of speed and truck loading controls; (iv) roads have become more unsafe because of being narrow and poorer condition with increasing speeds as well as overloaded trunks, and (v) there are no speed-barriers on the road passing towns with large populations.

Meanwhile, eight aspects of road safety problems have been identified by the household survey in terms of: (i) sharp curves and steep slopes (92%); (ii) speeding (25%); (iii) lack of safety facilities in dangerous sections (57.4%); (iv) many overloaded trunks (25.2%); (v) illegal parking on the road (23.5%); (vi) severe over loading (28.9%); (vii) vehicles passing through towns at high speed (22.6%); (viii) difficult for people walking on the road to clearly see approaching vehicles (38.3%). Based on focus group discussions, villagers thought it would be very important to widen the road as the major cause of dangerous travel is that the existing road cannot meet the increasing volume of vehicles and trucks and the increasing transport demand. Besides widening the roads, people also considered that the establishment of safety signs and speed barriers along the road passing villages or towns or markets would be necessary.

IV. POVERTY PROFILE ANALYSIS

A. POVERTY PROFILE IN CHINA AND THE PROVINCE

55. The definition of rural poverty in the PRC focuses on income with some consideration of infrastructure factors (e.g., limited access to transportation, drinking water, and electricity) and health and education factors (e.g., low level of women's health and deprivation of education for girls). At present the Chinese government continues to use income as the primary indicator of poverty.

56. The poverty line of income is adjusted regularly depending on the cost of a basic minimum subsistence package of food plus a certain amount of essential nonfood items. Between 2000 and 2010, the national poverty line had been adjusted from annual income per capita CNY 865 up to CNY 1,274 and the total rural poverty population in the PRC has been reduced by 26.68 million during the same period.

57. The Chinese government has adjusted the national rural poverty line up to CNY 2,300 (per capita annual net income) since 2011 in order to target more population with low-income levels. In 2012, there were 99,976,378 rural poor in the PRC, which accounted for 14.9% of the total rural population. The majority of rural poor are concentrated in the western region of China.

58. There were 77 poverty counties in Shaanxi Province in 2012, of which 50 were also designated as national poverty counties. In 2012, Shaanxi provincial government revised the provincial rural poverty line from annual net income CNY 2,700 per capita up to CNY 2,785, which was higher than the national rural poverty line (annual farmer net income CNY 2,300 per capita). According to official statistics, 7,561,937 rural people in Shaanxi were poor in 2012, which was 30% of the total rural population in Shaanxi. The majority of poor people are concentrated in Qinba Mountain Region in the south and Loess Plateau in the north where poor infrastructure, high frequency of natural disaster and undeveloped industries form the major barriers of living condition improvement and well-being development.

B. POVERTY PROFILE IN THE PROJECT AREA

1. Incidence of Poverty

59. In 2012, there were 795,609 rural poor in Ankang Prefecture, about 32.8% of total rural population in Ankang, and 483,479 rural people in Shangluo Prefecture (31% of the prefecture).

60. Three project counties of Xunyang, Hanbin and Shangnan are national poverty counties. By the end of 2012, total rural poverty population was 158,530 in Xunyang, 304,956 in Hanbin and 48,804 in Shangnan. The rural poverty ratio was 40% in Xunyang, 38.6% in Hanbin and 34.3% in Shangnan were higher than the prefecture and provincial average.

Table 18: Poverty Population in Project Areas (2012)

Region	Total rural population	Rural poverty population	As % of rural population
Nation-wide	674,149,546	99,976,378	14.9
Shaanxi Province	25,180,912	7,561,937	30.0
Ankang Prefecture	2,423,780	795,609	32.8
Shangluo Prefecture	1,559,611	483,479	31.0
Xunyang County	396,326	158,530	40.0

Hanbin District	790,042	304,956	38.6
Shangnan County	142,403	48,804	34.3

Source: Poverty Reduction Offices in Project Areas.

2. Characteristics of Poor Households in the Project Area

61. According to the Shaanxi Provincial rural poverty line (annual net income CNY 2,785 per capita), 28.7% surveyed households were poor (annual net income below CNY 2,785 per capita in 2012), 32.8% of surveyed households were in the middle income level (CNY 2,786-4,000), 23.6% were in the upper middle income level (CNY 4001-6000) and 14.9% were classified as better-off (> CNY 6,000) households.

Table 19: Economic Status of Surveyed HHs

HH economic status		No. of surveyed HHs	% of surveyed HHs
Annual net income per capita (Yuan)	< 2785	100	28.7
	2786-4000	114	32.8
	4001-6000	82	23.6
	>6000	52	14.9
	Total	348	100

Source: Household Survey Data.

Land holding

62. The pattern of distribution of land holdings is similar between poor households and non-poor households. There are no cases where a substantial proportion of holdings is possessed by a few households since the majority of households are small landholders. Although poor households have a bit bigger land area on average, they still lack capacity or means to earn more cash income compared to non-poor households.

Table 20: Landholding between Poor and Non-poor (2013)(mu)

Average Area Per HH	Poor (N=100)	Non-Poor (N=248)	Average Total N=348
Paddy land	0.34	0.31	0.33
Dry land	3.61	3.32	3.34
Orchard	0.14	0.20	0.19
Forestland	3.95	3.81	3.87
House site	0.35	0.38	0.34
Other	0.1	0.16	0.13
Total	8.49	8.18	8.2

Source: Household Survey Data.

63. The survey showed that there is difference of planting areas for major cash crops between the poor and non-poor households. Total planting areas averaged 14.4 mu per HH for the poor, lower than the average surveyed households. Meanwhile the non-poor households have 21.67 mu per HH on average, higher than that of total surveyed households.

Table 21: Planting Areas of Cash Crops/Fruits between Poor and Non-poor (2013)(mu)

Average Area Per HH	Poor (N=100)	Non-Poor (N=248)	Average Total N=348
Walnut, Chestnut	1	3	2
Tea	4.7	4.8	4.8

Apple, Peach, Plum, Pear	1.5	2.1	1.8
Tobacco	6	8	6.8
Vegetable	0.4	0.42	0.41
Ginger	0.1	0.3	0.16
Other	1	3	2
Total	14.7	21.62	17.97

Source: Household Survey Data.

Private Transport Possession

64. The survey revealed that the percentage of private transport modes possessed by poor and non-poor households is similar. 63% of poor and 63.7% of non-poor households have their own transport means. However, the gap between poor and non-poor households possessing various types of transport modes is obvious. Poor people use motorcycles mostly, 65% poor households have motorcycles, higher than the non-poor households where 60% of non-poor households have motorcycle. There are no costly transport means such as tractor, car, small trunk and minivan possessed by poor households since most of poor household income is heavily derived from migrant labor (60%) so that they need to use more public transport services.

Table 22: Transport Possession by Poor and Non-poor

Do your family have transport Vehicle?	Poor (N=100)		Non-Poor (N=248)		Total (N=348)	
	No.	%	No.	%	No.	%
Yes	63	63	158	63.7	221	63.5
No	37	37	90	36.3	127	36.5
Total	100	100	248	100	348	100

Source: Household Survey Data

Table 23: Transport Modes Possessed by Poor and Non-poor (unit)

Transport Modes	Poor (N=100)		Non-Poor (N=248)		Total (N=348)	
	HHs	Amount	HHs	Amount	HHs	Amount
Bicycle	14	14	15	15	29	29
Motorcycle	65	74	150	162	215	236
Motor tricycle	0	0	8	8	8	8
Tractor	0	0	5	5	5	5
Car/jeep	0	0	8	8	8	8
Small trunk	0	0	7	7	7	7
Minivan	0	0	2	2	2	2
Others	0	0	0	0	0	0

Source: Household Survey Data

Income Structures and Expenditure Patterns

65. The survey showed that household income sources both for poor and non-poor people is mainly derive from agricultural (average 30%) and non-agricultural sources (average 60%). The percentage of agricultural and non-agricultural income source between the poor and non-poor was similar. However, the income gap between the poor and non-poor occurred in non-agricultural sources. Obviously the non-poor had more means to generate income. For example, the poor has less percentage from doing business and running restaurant compared to the non-poor where 0.6% and 0.7% income derived from doing business and running restaurant within poor households. In comparison, doing business and running restaurant accounted for 5.2% and 4.3% respectively within non-poor households. Focus group discussions with poor people further revealed that lack of available capital and capacity for investment are the major two obstacles for the poor to develop business profits. They have to use their own labor to generate cash income. Therefore, the percentage of income from migrant labor was a bit higher within poor households.

Table 24: Income Structures Between Poor and Non-poor (%)

	Income Sources	Poor	Non-Poor
Agricultural sources	Grain	10.6	9.3
	Cash crops (tobacco, vegetables, oil bearing , ginger)	12.8	10.4
	Livestock (pig, poultry, egg)	6.3	3.9
	Fruits and Nuts (apple, pear, plum, peach, walnut, chestnut)	0.3	1.0
	Mushroom and herbal medicine	6.2	5.7
	Others	0.1	1.2
Sub-total		36.3	31.5
Non-agricultural sources	Doing business	0.6	5.2
	Running restaurant	0.7	4.3
	Providing transport service	0	0.8
	Repairing service	0	1.9
	Migrant labor	58.3	52.1
	Compensation of land acquisition	1.5	1.0
	Poverty reduction subsidy	2.1	0
	Others	0.5	3.2
Sub-total		63.7	68.5

Source: Household Survey Data, total 348 households

66.Focus group discussions with poor people also revealed that the poor kept more traditional crop plantation with low profits like grain and oil bearing but developed less new cash crops like ginger with high values. This was attributed to three major factors; i) lack of capital investment for developing high value added crops, ii) lack of techniques in developing newly cash crops, and iii) the poor are often located in remote villages with poor road condition or climate condition for cash crop growing.

67.The comparison of household living expenditures between the poor and non-poor indicated that the percentage of living consumption (food, cloth, fuel, and electricity, etc.) within poor households was higher than that of the non-poor which meant that poor people have less capital to invest in livelihood improvement. The poor households had higher health care costs (9.9% of total expenditures) than the non-poor (6.9%). The cost of education was a large portion of household expenditures of both groups. However, the poor spent less on education, travel and communication compared to the non-poor. The poor households also have less capacity to invest in the agricultural productions due to heavier cost of education and medicine.

Table 25: Expenditure Patterns between Poor and Non-poor (%)

As % of HH expenditure	Poor	Non-Poor
Living Consumption	24.2	18.5
Education	24.2	30.1
Health care	9.9	6.9
Transport cost	10.8	13.2
Communication	8.0	9.8
Social maintenance	6.3	6.4
Agricultural production investment	12.6	13.7
Others	4.0	1.4
Total expenditure	100	100

Source: Household Survey Data.

C. CAUSE OF POVERTY IN THE PROJECT AREA

68. From group discussions with poor people as well as interviews with village leaders, it was found that poverty households were mainly comprised of children in high school or university, the elderly without children and pension, disable people and members with illness. They are usually vulnerable. Specifically, the major causes of poverty include:

(i) Lack of professional skills place the poor in a disadvantaged position in labor markets where work opportunities vary according to skills. The poor population tends to occupy insecure jobs with unstable wages. Most interviewed poor people are working in temporary or part-time job positions. They are earning less or have unstable positions.
(ii) Disability and illness are two major causes of poverty, which have resulted in i) high level of health care costs and ii) loss of working capacity. Disability and illness constrain poor people in accessing employment opportunities that could increase income and develop better lifestyles.
(iii) Lack of capital reduces the capacity of the poor to improve their living standard. The survey data indicates that the poor were involved less in business operation than the non-poor, and there was less investment for agricultural production to develop their livelihoods.
(iv) Some households are expense-driven poverty households such as higher education cost for children and more medicine expense.
(v) Poor villages tend to be located in the mountainous areas where the harsh geography and undeveloped transport infrastructure are huge obstacles to obtaining economic benefits for rural inhabitants as they have limited access to better road networks and wider marketing networks and more employment opportunities.
(vi) The poor road condition commonly restricts development opportunities for poor people. First, the poor road condition limits benefits of the high value cash crop plantation as the poor road is a key limitation to faster transport goods as well as to attract more buyers coming in, particularly the high value-added perishable products. Second, poor road condition also results in higher costs for transporting goods to the local market. Thirdly, it limits the ability of villagers to seek employment opportunities that are an important source of increasing income. Fourthly, it is a constraint to villagers' access to services such as extension service workers and traders who are more willing to visit villages when a road is in good condition. Lastly, lack of regular and cheap public transport services is a key factor in increasing vulnerability for the poorest who are without transport means.

D. POVERTY ALLEVIATION PROGRAM

69. The problems of subsistence, food and clothing for rural residents have been basically solved through the extensive efforts of poverty reduction. Over the past ten years (2001-2010), the central and local governments have been constantly adjusting their structures of financial expenditure and gradually increasing the financial input into poverty reduction programs. The financial input increased from CNY 12.75 billion in 2001 to CNY 34.93 billion in 2010, with an average annual growth rate of 11.9 percent, and the accumulative input totaled CNY 204.38 billion during that time.

70. In order to promote overall economic and social development in the poverty areas, the central government launched the comprehensive development-oriented poverty reduction initiative with three aspects of development. First, increasing income of poor people that includes: (i) improving agriculture productivity; (ii) providing agricultural technology training; (iii) assisting the farmers in moving to urban areas to find work.

71. Secondly, improving living condition of poor people that includes accessibility and availability of roads, safe water supply and electricity as well as social infrastructures such as school and health care facilities.

72. Thirdly, developing social service system in rural poor areas that involves: (i) funding for the rural compulsory education system, and reduction or exemption of tuition fees for poor students pursuing higher education. By 2010, 90% poor students obtained the compulsory education (9 years school education); and, (ii) funding for the rural health care security system. By 2010, over 80% poor people had been covered by the rural health care security system.

73. In terms of Shaanxi Province, the provincial poverty alleviation program is focusing on three aspects during the Twelfth Five-year (2011-2015) Overall Provincial Development Plan: improving road conditions in poverty areas, improving housing conditions, agricultural technology training and providing safe water supply particular for poor people living in northern Loess Plateau where water scarcity is a key issue for poor households. By 2012, the accumulative financial input totaled CNY 5.14 billion to be used for 0.85 million square meters of housing upgrades, benefiting 0.43 million poor people. CNY 0.32 billion accumulatively financed agricultural technology training by which one million farmers have been trained. At that time the percentage of paved township roads in poverty areas increased from 70% to 90%, and all county roads have also been paved.

V. SOCIAL IMPACT ASSESSMENT

A. PROJECT BENEFITS

74. The benefits brought by the project are widely perceived by respondents. According to the surveys, 100% of households in the rural road upgrades component, 98.8% of households in the trunk road rehabilitations component, and 100% of households in the road safety improvements component view that the project would bring either significant or some benefits for them.

Table 26: Villagers' Perspective of Project Benefits

Components		Rural Road Upgrades		Trunk Road Rehabilitations		Road Safety Improvements	
Surveyed HHs		No.	%	No.	%	No.	%
Social benefits perceived	Significant	76	61.7	117	65	30	68.2
	Some benefit	48	38.7	61	33.9	14	31.8
	Not at all	0	0	2	1.1	0	0
	Total	124	100	180	100	44	100

Source: Household Survey Data.

75. Over 50% of respondents believe that the project would bring improved mobility in terms of shorter travel time, faster and wider mobility, good road accessibility for all seasons and smoother ride comfort, and reliable access to social services. 65% respondents think the improved road conditions can promote cash crop production that would be helpful to increase their income. About 60% respondents deem the better road would attract more buyers coming so that they can plan to develop more livestock. 56% respondents expect the project construction could provide job opportunities for local people. 39.7% people think the pavement improvement on rural roads will contribute to reduce the dust that would provide a better travel environment. While about 30% people think the project could promote employment opportunities in the urban area. Whereas surveyed households think the project benefits of adding the value of land and property as well as creating new business along the road will be limited because the project will focus on existing road rehabilitation rather than new road construction. 18% people deem the project will add to the value of land and property and 10% people indicated the project would create some new businesses such as restaurants or hotels. For example, many freight

trunks have to choose the express highway due to the poor road condition in S102 that has resulted in the apparent decline of service sector such as restaurants or hotels. More trunks will come back to use S102 without toll fare after the road improvement that could encourage more small businesses.

76. Lack of road safety facilities is a key concern for local road users. Over 65% people consider they will enjoy a safer travel as a result of road safety facilities improvements. However, interviewed villagers said that road safety facilities improvements are not enough to guarantee a totally safe travel as other factors also can cause unsafe travel like driver's dangerous behavior and ineffective enforcement of regulations regarding speed limitation, overloading control, slowing down while passing through towns or villages, etc.

Table 27: Project Benefits Perceived by Surveyed Households

Project benefits	No. of HHs	%
Shorten travel time	179	50.4
All season accessibility	175	51.3
Provision of job opportunities for local people	198	56.9
Promotion of cash crops plantation	227	65.2
Promotion of livestock development	206	59.2
Faster and wider mobility	174	50.0
Provision of urban/industrial employment opportunities	104	29.9
Adding value for land and property	63	18.1
Creating new businesses along road	37	10.6
Reducing dust	138	39.7
Improving road safety facilities	274	78.7
Improving travel safety and reducing accident	133	38.2

Source: Household survey Data.

77. In order to take advantages of benefits from the road improvement, the households presented their desires to "plant more cash crops, raise more livestock, buy vehicles, and select better schools for children".

78. About 60% surveyed households want to take advantages of better road condition and safer travel environment to produce more cash crops like ginger, tobacco, mushroom and herbal medicine and 65% people want to increase the amount of livestock like cattle and goat. They said that more buyers would come to the field to collect their agricultural and animal products after the road improvement. 50% people prefer to select better schools for their children because travel time will be reduce. 47% families are planning to buy private transports. For example, in Maliu village, farmers' income averaged annual CNY 6,380 in 2012. But only a one-third of households possess private transport means, as the earth road with big bends and steep slopes is very dangerous particularly in the rainy season. They are expecting to have their private vehicles or motorcycles after the road condition becomes better.

79. 47% households desire to go outside to seek waged jobs in order to increase cash income for their families after road conditions improve. 46% people express they can increase the frequency of coming back home to be together with their family members when the travel becomes more faster. 49% people plan to run small businesses along the road and 33% people prefer travel more for entertainment and other social activities.

Table 28: Strategies to Take Advantages of Project Benefits

Strategies	No. of HHs	%
Buy vehicles	165	47.4
Produce more cash crops/fruits	202	58

Increase number of livestock	228	65.5
Run small business along road	171	49.1
Go outside to seek waged jobs	166	47.7
Increase frequency of coming back home from work place	160	46
Chose better school for children	172	49.4
Travel more for entertainment	116	33.3

Source: Field Household surveys. Total 380 households

80. With respect to the desirable interventions in order to grasp the opportunities posed by the Project, the surveyed villagers prioritized technology training/extension of growing cash crops (61.8%), provision of timely market information (69.9%), and provision of better bus services particularly on the rural roads (74.4%). Provision of loans is also desired priority actions. Farmers' professional associations can be an effective ways to deliver the training and market information of the cash crop plantation. Therefore, 50% people expect to have support in establishing farmers' cooperatives.

Table 29: Supports Needed for Enhancing Project Benefits

Supporting Interventions	No. of HHs	%
Provide credit supports	169	48.6
Better public transport service	259	74.4
Technology extension service and training for cash crops	215	61.8
Market information support	243	69.9
Support in establishing farmer's cooperatives	178	51.1
Improve irrigation	141	40.5
More job available stimulated by local enterprise development	186	53.4

Source: Field Household Survey, total 380 households

81. Based on the current livelihood patterns of the villages in the Project area, the project positive impacts will be most likely be to:

(i) stimulate local farmers to increase cash income through expanding their cash crops plantation or amount of animal products;
(ii) provide better access to market for villagers who grow or are going to grow cash crops along project roads;
(iii) benefit villages who need to diversify their income sources through non-farming activities;
(iv) promote villages near the urban areas or towns for sustaining their current trends in non-farming income; and
(v) realize easier access to social services.

B. NEGATIVE IMPACTS

82. Land acquisition and house demolition caused by trunk road rehabilitations are the main negative impact of the project. No land acquisition and resettlement would occur in both components of rural road upgrades and road safety improvement.

83. Household survey and focus group discussions reveal that most villagers were not seriously worried about potential negative impacts of the Project on their livelihoods. For the rural road upgrades component, 54.4% of the respondents did not have any concern on the project, 40.1% admitted a little bit of worry and only 5.5% were concerned. The major concern was "land loss" or "house demolition" because they did not have clear information that "the rural road is for pavement upgrading only". Other major concerns were related to disturbance during construction, noise and dust caused by the construction and road safety that might potentially encourage speeding vehicles after the road improvement.

Table 30: Potential Negative Impacts of the Project

	Rural Road Upgrades		Trunk Road Rehabilitations		Road Safety Improvements	
	No.	%	No.	%	No.	%
Degree of worry about negative impacts of the project						
Worried	10	5.5	38	30.6	1	2.2
A little worried	72	40.1	66	53.2	13	29.5
None	98	54.4	20	16.2	32	68.3
Total	180	100	124	100	44	100
Negative impacts perceived						
Land acquisition	22	12.2	54	43.5	1	2.2
House demolition	8	4.4	56	45.2	3	6.8
Disturbance during construction	64	35.6	37	29.8	4	9
Noise and dust	72	40	41	30.1	12	27.3
Safety issues caused by high speed of vehicle	36	20	27	21.8	15	34.1
Inconvenience caused by road crossing villages	15	8.3	11	8.8	0	0

Sources: Household Survey Data

84. In the case of trunk road rehabilitations, the project will involve amounts of land acquisition and house demolition along the re-alignment sections. Over 80% of the villagers were worried about impacts of the project, and only 16% said that there is no concern about possible negative impacts. The compensation rate ranks as the major negative impact perceived, the inconvenience caused by road cutting through the village as the second, and house demolition as the third. Further group discussions discovered that the villagers also worried whether the road re-alignment would come to their village and strongly expected that the road could pass through their village area.

85. In terms of road safety facilities improvements, almost interviewees and respondents considered there is no impact of the project on them. Some people (30%) were worried about noise and dust maybe caused by the project construction as well as potential dangers caused by faster vehicles after road safety facilities improvements.

86. Stakeholder consultations were conducted to understand social benefits and potential issues perceived by villagers, local government, communication bureaus, road safety management offices, businessmen, roadside shop owners, technical service agencies, urban residents in project county towns, and the general road users.

Table 31: Benefits and Issues Perceived by Stakeholders

Stakeholders	Expecting Benefits	Concerns or Potential Issues
Villagers in rural road upgrades	• Shortening travel time up to school, market place, clinic/hospital and other social services • Less damage to vehicles such as motorcycles, tractors, cars, pickup, minivan, and trucks etc. • Benefit to perishable goods transport brought by better roads • Stimulating cash crop growth, particularly perishable goods • Easier access to job place • Easier back from job place to have more time staying with family members • More comfortable travel, e.g. less bumping and dust • Ensuring all day accessibility, particularly during raining season	• When to start the project • Landslide • Damages of road again by heavy trucks • Disturbance during construction but it is tolerable if the road get improved and the construction period is not too long • Safety issues if the transport vehicles speed up • Land acquisition and house demolition

	• Safer travel	
Villagers in trunk road rehabilitations	• Reduce traffic jams affected travel and roadside business • Potential job opportunities through attracting investors • Potentials to increase value of the land and property along the road • More business opportunities along road. • Potentials for expanding vegetable growth for the city. • Benefits from potential urban and industrial park expansion • Job opportunities of construction • Safer travel	• Reasonable compensation for land • Road safety issues • Inconvenience caused by construction • Future land development by owners
Roadside business people	• Faster and easier transport • Extending business to more areas • Saving transport cost • Reduction of goods damages, particularly perishable goods. • Stimulating economic development • Increase of business opportunities during construction • More business with traffic increase after the construction	• Construction disturbance • When the project will be started • Any additional fee charges • Safety issues • Compensation for potential resettlement
Project County Communication Bureaus	• Improvement road network that can stimulate local economic growth • Better road coverage	• Approval of the project follow the procedures of PRC and ADB • Balance of investment among different counties/district • Optimizing the options technically, economically and socially.
Poverty Reduction Offices in Project Counties	• Faster and easier transport • Saving the costs • Safety • More business opportunities • Poverty reduction through road improvement	• Pro-poor project design • Project targeting poor people • Additional supports needed for the poor such as small loan and technology extension service
Women Federations in Project Counties	• Faster and easier transport for women • Provide more job opportunities for women during the project construction. • Safer travel for women and children	• Earlier start of the project • Project targeting women • Additional supports for women like introducing new agricultural products, regular market information and technology training
Urban Residents	• Saving transport costs • More comfortable travel • Quick information • Potentials to stimulate tourism development • Faster mobility • Safer travel	• Cost effectiveness of the project • Inconvenience caused by construction • Safety issues if the transport vehicles speed up

Sources: Project Stakeholder Consultations and Focus Group Discussions with Local People

C. SAFEGUARD AND OTHER SOCIAL RISKS

1. Involuntary resettlement

87. The project will involve a total land acquisition amounting to 3259.76 mu with 7,405 affected people in 2,509 households.

88. The resettlement reports have been developed to address adequately the resettlement issues. The report has also formulated the plan of livelihood restoration to mitigate the impact of project for affected people.

2. Ethnic Minority

89. The Project is located in the Han nationality concentrated area with 99% being Han. There are no issues of ethnic minorities related to land acquisition, house demolition, disturbance during the project construction. The review of feasibility studies suggested that there is no ethnic minority population living in the project area. The field survey further indicated that 100% of respondents from household surveys and 100% of interviewees from focus group discussions were Han population.

3. HIV/AIDS and Anti-Drug Use

90. The past experiences in road projects show that road improvement has less health negative impacts compared with new road construction in terms of HIV/AIDS. Currently, local governments have put a system in place to deal with HIV/AIDS and anti-drug use after years of implementing various health programs.

91. There is Disease Control Center in each project prefecture and county responsible for HIV/AIDS protection. Local Disease Control Centers have established a system responsible for education, monitoring and treatment of HIV/AIDS and anti-drug use. One or two seminars are held to disseminate HIV/AIDS preventive knowledge each year by local Disease Control Centers. Free testing and treatment system has been established.

92. As of results of these activities, knowledge on HIV/AIDS protection is widely spread among the public. The households' survey shows that around 70% of respondents have heard of HIV/AIDS and their preventive measures. However, there is still a comparative large proportion of local population with limited knowledge on HIV/AIDS prevention measures). Particularly women have less knowledge compared to men, regarding use of condoms and needles and syringes. Although local governments have mechanisms and capacity to deal with HIV/ADS spread, the proposed Project has to put specific measures on HIV/AIDS and anti-drug in its project action plans.

Table 32: Knowledge on HIV/AIDS by Gender

HIV/AIDS knowledge		Male		Female	
		No.	%	No.	%
Have you ever heard of HIV	Yes	154	72.0	95	70.9
	No	60	28.0	39	29.1
	Total	214	100	134	100
Knowledge about preventive measures	Using condoms	63	29.4	30	22.1
	Needles and syringes	98	45.8	57	22.4
	Preventing mother to child transmission	26	12.1	24	17.9
	Have no idea	32	15.0	24	17.9

Sources: Household Survey Data

4. Human Trafficking

93. Human trafficking became an issue as the population interaction increases and people's travel distance increases. However, villagers surveyed admitted there was seldom any human trafficking cases heard of. In the 1990s Chinese government created a special office in department of public security from central level to county level. Special funds and human resources are put in place to address this issue. The other agencies involved include education bureau and women's federation at various levels who regularly conduct awareness building training for women and girls. At surveyed villages, women are organized as a group to share related information, particularly new tricks of tramps. However, village leaders and

representatives from women's federation still think it is necessary to enhance human trafficking awareness building further, particularly to incorporate it into school training.

VI. POVERTY IMPACT ANALYSIS

A. PROJECT CONTRIBUTION TO POVERTY REDUCTION IN THE PROJECT AREA

94. In general, the project will contribute to poverty alleviation in Qinba Mountain Region, poverty-striken areas in Shaanxi Province, through three components of trunk road rehabilitation, rural road upgrading and road safety improvement that would directly provide the poor people with faster mobility, more convenient and safer travel. The transport access improvement would be complementary to the availability of other basic services such as health care and education for the poor. Furthermore, the improved road condition would also facility poor households pursuing cash crop income and non-farm employment opportunities.

95. The transport development is an important driver in a comprehensive poverty reduction program. The trunk road rehabilitation of G316, S102 and S224 were included in the transport sector component of the Shaanxi Twelfth Five-year (2011-2015) Provincial Development Plan. Thus, the project would also enhance the existing provincial poverty reduction program through financing the road network improvement in poverty areas with trunk road rehabilitation, rural road upgrading and road safety improvement.

B. TRAVEL NEEDS OF THE POOR

96. The township is a common destination both for poor and non-poor people. They shared the similar percentage of travelling to townships. But the poor have less travel to county and prefecture towns compared to the non-poor. According to the results of focus group discussions with poor and non-poor villagers, the main reason why the poor people travel less than the non-poor within county and prefecture towns is that the scope of migration for poor people is largely concentrated in their living townships. Whereas non-poor people travel widely to seek more job opportunities. Both poor and non-poor groups reported they make few trips to the province towns

Table 33: Travel Destinations by Poor and Non-poor

Destinations	Poor HH (N=100)		Non-poor HH (N=248)		Total	
	No. of HH	%	No. of HH	%	No. of HH	%
Township	28	28	69	27.8	97	27.9
County	14	14	50	20.2	64	18.4
Prefecture	37	37	111	44.7	148	42.5
Province town	0	0	9	3.6	9	2.6

Source: Household Survey Data.

97. Overall, the poor have less travel frequency to township, county, prefecture and province towns compared to the non-poor but they have longer travel time. Focus group discussions revealed that the poor often chose a trip associated with longer time and less costs. Three factors that caused more time for poor travel than for non-poor travel are: 1) the poor are located more often in remote villages while the non-poor are more in the villages along main roads, 2) the poor use more motorcycles while non-poor use more bus/minibus and cars/pick ups, and 3) the road condition is poorer for most of poor and remote villages.

Table 34: Travel Frequency, Time and Cost by Poor and Non-poor

	Poor (N=100)	**Non-poor (N=248)**	**Total (N=348)**

Travel frequency (No. of travels per month)	Township	4.7	5.3	5.0
	County	3.6	5.3	4.2
	Prefecture	3.4	4.5	4.4
	Province town	0.0	3.8	2.8
	Total	11.7	18.9	16.4
Travel time(Minutes/one return)	Township	35.54	33.70	34.23
	County	41.80	38.57	41.09
	Prefecture	55.47	45.33	52.37
	Province town	0	204.29	204.29
	Total	136.69	321.89	332.07
Cost of travel (Yuan/one return and back)	Township	14.11	15.07	14.79
	County	32.14	41.60	39.53
	Prefecture	39.44	45.54	43.86
	Province town	0	48.89	48.89
	Total	85.69	151.1	147.07

Source: Household Survey Data.

98. Compared to the non-poor, the poor have a higher percentage of travel to township (17.6%) to visit doctors than the non-poor (8.6%). In comparison, more non-poor households go to county and prefecture towns for health care. Focus group discussions indicated that the poor people want to solve their health problems within their townships that could save not only the travel cost but also medicine expenses. They also indicated that the road improvement therefore will benefit them in providing easier access to the health care facilities.

Table 35: Travel purpose and tools by poor and non-poor

Destination	Poor (N=100)	Non-poor (N=248)
Township	***Purposes***: • Seeking job opportunities (36.3%) • sending and picking up children to and from school (5.8%) • Buy or sell products (20.3%) • Buy HH commodities (21%) • Maintain social network (14.8%) • Visiting health center (17.6%) ***Patterns:*** • On feet (17.9%) • Motorcycle/motor-tricycle (39.5%) • Track-trailer (3.7%) •Car (1.2%) • Bus or minivan (63.8%)	***Purposes:*** • Seeking job opportunities (25%) • Sending and picking up children to and from school (17.9%) • Buy or sell products (17.9%) • Buy HH commodities (26.5%) • Maintain social network (5.4%) • Visiting health center (8.6%) ***Patterns:*** • On feet (4.3%) • Motorcycle/motor-tricycle (20.3%) • Track-trailer (4.3%) •Car (2.2%) • Bus or minivan (58.5%)
County town	***Purposes***: • Seeking job opportunities (21.3%) • sending and picking up children to and from school (0%) • Buy or sell products (28.6%) • Buy HH commodities (7.1%) • Maintain social network (5.5%) • Visiting health center (0%) ***Patterns:*** • On feet (0%) • Motorcycle/motor-tricycle (36.1%) • Track-trailer/small truck (0%) •Car (1.6%) • Bus or minivan (68.8%)	***Purposes:*** • Seeking job opportunities (20.5%) • Sending and picking up children to and from school (2.4%) • Buy or sell products (14%) • Buy HH commodities (16.8%) • Maintain social network (14.3%) • Visiting health center (10.2%) ***Patterns:*** • On feet (0%) • Motorcycle/motor-tricycle (28.8%) • Track-trailer/small truck (8.6%) •Car (18.5%) • Bus or minivan (53.9%)

Prefecture town	***Purposes***: • Seeking job opportunities (34.2%) • sending and picking up children to and from school (0%) • Buy or sell products (10.6%) • Buy HH commodities (17.3%) • Maintain social network (2.1%) • Visiting health center (8.9%) ***Patterns:*** • Motorcycle/motor-tricycle (16.4%) • Track-trailer/truck/small truck (5.9%) • Bus or minivan (64.7%) • Car (5.9%)	***Purposes:*** • Seeking job opportunities (50.4%) • Sending and picking up children to and from school (1.1%) • Buy or sell products (22.2%) • Buy HH commodities (19.7%) • Maintain social network (3.2%) • Visiting health center (11.7%) ***Patterns:*** • Motorcycle/motor-tricycle (21.6%) • Track-trailer/truck/small truck (3.3%) • Bus or minivan (60%) • Car (8.5%)

Source: Household Survey Data

99. For selling the products and maintaining their social network, the poor travel more within townships, while the non-poor travel more to townships and county towns. The poor appear to have a narrower traveling scope.

100. More poor people travel to township and county town for buying household commodities than the non-poor did. This suggested the improvement of rural road would bring more benefits to poor in terms of purchase of cheaper household commodities at centers of township and county town. Group discussions further proved that the price of commodities is cheaper at county towns than at township centers and similarly cheaper at township center than at village small shops. It was reported that most townships have 3-4 representatives from different express companies. Villagers can also pick up at township center. The youth are the pioneer users of this shopping model. Improving rural road conditions will bring convenience of modern online purchase to local people both for the poor and non-poor.

101. To transport agricultural produce, both poor and non-poor families mainly rely on buyers coming to them e.g. tobacco, oil bearing an ginger are main cash crops in surveyed villages, and these products tend to be collected by buyers in the crop fields. The poor families use their own motorcycles much than the non-poor families to transport their field products. The non-poor use more rented vehicles and minibuses to transport their produce. It was reported by the group discussions that the non-poor people have more money to use rented vehicles in order to speed up the harvesting process.

Table 36: Transport Modes for Agricultural Products by Poor and Non-poor HHs

Transport mode (as % of HH agriculture products)	Poor (N=100)	Non-Poor (N=248)	Total (N=348)
Walking/carrying	10.5	6.8	8.5
Own vehicles	16.7	8.1	10.57
Rented vehicles	4.6	5.6	5.29
Buyer coming	62.3	62.6	62.4
Bus/minibus	5.9	6.5	5.7

Source: Household Survey Data.

C. PROJECT BENEFITS FROM A PERSPECTIVE OF THE POOR

102. In general, the project will have positive impact on poverty reduction. First, it will reduce the difficulties of the poorest to access the health care because the poorest are often haunted with illness. Secondly, the project will promote the transition of the poor from traditional agriculture production to cash crop plantation. Thirdly, the project will create local waged farming jobs for the poor particularly in the villages where villagers rely on multiple income sources. Fourthly, the project will indirectly benefit the poor by creating non-farming jobs or business opportunities through stimulating overall economic development, particularly urbanization and industrialization.

The project will be a pro-poor intervention mechanism by connecting township/county center or main road to remote villages where most of the poor live. Last, the project will facilitate the rural public transport services in the isolated area where most of the poor live.

103. Major project benefits are similarly perceived by both poor and non-poor, with the most common being i) shortened travel distance or time, ii) improving all season access or reduced traffic jam, iii) smoother ride particularly beneficial for perishable fruit and vegetable transport, and iv) promoting cash crops plantation.

Table 37: Project Benefits Perceived by Poor and Non-poor

Benefits Perceived	Non-poor Households		Poor Households	
Shorten travel time	125	50.4	54	54.0
All season accessibility	126	51.8	49	49.0
Provision of job opportunities for local people	142	57.3	56	56.0
Promotion of cash crops plantation	160	64.5	67	67.0
Promotion of livestock development	148	59.7	58	58.0
Faster and wider mobility	123	49.6	51	51.0
Provision of urban/industrial employment opportunities	74	29.8	30	30.0
Adding value for land and property	46	18.5	17	17.0
Creating new businesses along road	26	10.5	11	11.0
Reducing dust	87	35.1	51	51.0
Improving road safety facilities	201	81.0	73	73.0
Improving travel safety and reducing accident	100	40.3	33	33.0

Source: Household Survey Data.

104. From the survey data, most poor households want to take advantages of better road condition and safer travel environment to produce more cash crops like ginger, tobacco, mushroom and herbal medicine and 65% poor people want to increase the amount of livestock such as cattle and goats. They said that more buyers would come to the field to collect their agricultural and animal products after the road improvement. 50% people prefer to select better schools for their children because travel time will be shorter. Most poor households also desire to go outside for seeking waged jobs in order to increase cash income for their families after they can enjoy good road conditions. However, unlike non-poor households, poor households expressed that they have few chances to run small businesses along the road although the road condition would be improved because i) they lack enough capital to do that, and ii) they lack related experiences to manage the business. Therefore, they are expecting that the local government can provide training regarding business management, non-farm job skills, and new agricultural technology for them.

D. NEGATIVE IMPACTS AND MITIGATION

105. Major negative impacts perceived by the poor households include land acquisition and house demolition in the trunk road rehabilitations component. In addition, construction disturbance for all roads and safety issues caused by high speed of vehicles are concerned by the poor people.

106. The main mitigation measures include: (i) full compensation for land acquisition and house demolition for affected poor households would be addressed in the resettlement plans; (ii) social assistance programs such as the government social security subsidy for land-loss farmers would fully cover land-loss of poor farmers: (iii) an action-oriented livelihood restoration plan for affected poor people should be formulated separately in the resettlement report.

VII. GENDER IMPACT ANALYSIS

A. RURAL WOMEN PROFILE IN THE PROJECT AREA

107. The proportion of female population was 46.3% in Xunyang, 46.8% in Hanbin and 47.5% in Shangnan respectively in 2012, of which the majority were rural women accounting for about 65% of total female population. Women are playing important roles both in agricultural sector as well as rural household development.

1. Education

108. Based on the PPTA survey, there are differences of education levels between women and men. Specifically, 20.9% of female respondents are in the no-schooling category, higher than male respondents (11.7%). Similarly, female respondents with 7-9 years of education (24.6%), is lower than for males (38.8%), and female respondents with 10-12 years of education (3.7%), is lower than for males (7.0%). However, 43.3% female obtained primary education, higher than that of men (38.3%).

Table 38: Education Level by Gender

Education Level	Male		Female		Total	
	No. of respondents	% of respondents	No. of respondents	% of respondents	No. of respondents	% of respondents
No school	25	11.7	28	20.9	53	15.2
Primary education (1-6 years)	82	38.3	58	43.3	140	40.2
Junior middle school (7-9 years)	83	38.8	33	24.6	116	33.3
Senior middle school (10-12 years)	15	7.0	5	3.7	20	5.8
Higher education (>12 years)	9	4.2	10	7.5	19	5.5
Total	214	100	134	100	348	100

Source: Household Survey Data

2. Occupation

109. The majority of respondents were farmers with 63.4% female and 59.3% male being fully engaged in agriculture on their farmland. Both long-term and seasonal migrant labors were largely men. 8.9% male were engaged in the long-term migrant labor against 4.5 % women. 18.2% men were seasonal migrant labors against only 5.2% women. Women were often left at home both for cultivating family land and taking care of household members.

110. Women were fully responsible for household work with 10% for women and 0% for men. The survey indicated that there were slightly more females running small businesses than men. However of the respondents, only 1.5% of females were village cadre compared to males (4.7%), indicating that women's participation in decision-making at village level was lower than for men.

Table 39: Occupation by Gender

Occupation	Male		Female		Total	
	No. of respondents	% of respondents	No. of respondents	% of respondents	No. of respondents	% of respondents
Farmer	127	59.3	85	63.4	212	60.9
Businessmen	10	4.7	11	8.2	21	6.0
Government employee	1	0.5	5	3.7	6	1.7
Enterprise employee	0	0	1	0.7	1	0.3
Responsible for housework	0	0	10	7.5	10	2.9
Retired, pensioner	2	0.9	1	0.7	3	0.9

Village cadre	10	4.7	2	1.5	12	3.4
Long-term migrant labor (over one year)	19	8.9	6	4.5	25	7.2
Seasonal migrant labor (within half year)	39	18.2	7	5.2	46	13.2
Other	6	2.8	6	4.5	12	3.4
Total	214	100	134	100	348	99.9

Source: Household Survey Data

3. Women's Roles in Household Livelihoods

111. Among surveyed villages, women and men are major labor forces in their households. They are involved in not only agricultural activities but also non-agricultural practices. Women and men have different roles in agricultural production practices. Males usually dominate ploughing and clearing activities, while females are more engaged in transplanting and weeding. Both women and men take part in activities such as fertilizing, harvesting and raising pigs. Tending poultry feeding is solely a woman's activity.

112. It is very common for both females and males to be involved in income-generating activities. Among middle-aged groups, more males are long-term as well as seasonal migrant labors compared to women. Whereas more women are left at home to undertake agricultural practices as well as to look after their household members such as children and elderly.

113. Women exclusively perform household work in addition to their agricultural work. Their roles are cooking, washing and care of small children and elders in their households.

114. It is obvious that men contribute more cash income generation in the household, and women's roles tend to be in household maintenance like growing corn and grain, raising animals for household consumption rather than for selling purpose. Looking after children is women's domain.

115. Some interviewed women (36 females) reported that they are living in rented houses in the town to look after their school children and are no longer cultivating their land in the village. The household income is fully derived from their husbands' non-farm earnings.

4. Decision Making at Household and Community Levels

116. Females headed less than 10% of surveyed households. Men dominated decision-making at household level. Couples jointly discuss agriculture production activities such as planting, crop selections, seed purchases, fertilizer and equipment/tools. In many cases, women's voices are heard during the discussion process but men make final decisions.

117. Men dominate decision making on household investments such as buying vehicles, running small shops or building new houses. The interviewed villagers indicated that men have more opportunities to go outside than women and therefore have more experience and knowledge with which to make decisions.

118. Men also dominated with respect to decision making on renting out land and on borrowing and lending money. These are very important household decisions and are definitely the responsibility of household heads.

119. Men and women equally share decision-making on household saving and buying durable consumables such as TVs, furniture, washing machines and electronic cookers. Women dominate decisions on purchase of daily consumables.

Table 40: Decision Making Intra Household by Gender (%)

Activities	Male	Female	Total

Crop Variety and size of areas for cultivation	50	50	100
Purchase of seed, fertilizer, equipment for production	50	50	100
Education cost for children	50	50	100
Purchase of HH daily consumables	20	80	100
Purchase of HH durable consumables	50	50	100
Household investment	80	20	100
Household saving	50	50	100
Rental land out and in	60	40	100
Borrowing money out and in	70	30	100

Source: Estimates from male and female FGDs.

120. The participation of women in community decision-making is still much less than for men because there are the fewer women members in decision-making bodies of communities. Among 17 surveyed villages, only 7 villages have female members in village committees. Women's participation in community management include organizing traditional festivals, special occasions like marriage ceremonies and funeral activities, attending community meetings in the absence of men, and contributing labor for public works such as village road routine maintenance and irrigation repair.

B. GOVERNMENT RURAL WOMEN DEVELOPMENT STRATEGIES

121. In the project area, Women Federation is responsible for rural women development. Specific measures for promoting rural women development have been made by Women Federations in project counties, as follows.

1. Women Participation in Community Decision Bodies

122. Women participation in decision-making and management at the community level has been addressed by Women Federations at project counties. Gender percentage of leadership at township and village committee levels has been regulated with support of wide range of training on women leadership capacity building. Local Women Federation reported that women leaders at township and village committee levels had increased by 1.8% in 2012 compared to 2010. The total number of female cadres at township and village committee levels has increased steadily over the years particularly at village committee level where the percentage oemale members had increased 2.3% in 2012 over the 2011 figure.

2. Women Health Improvement

123. Women's health, in particular reproductive health, has been addressed through a variety of programs. The quality of births has improved a lot by implementing the program "Safe Mother and New-Born Baby". The rate of maternal hospital delivery in project rural areas has substantially increased, with consequent reductions in maternal and infant mortality. In 2012, the rate of hospital delivery reached 95% and the rate of regularly premarital examination for rural pregnant women increased up to 90%.

3. Enabling Nine-year Compulsory Education for Rural Girls

124. Assistance to rural girls to enter the schooling system has been prioritized through provision of a governmental boarding subsidy. In 2012, the enrollment rate of primary school for rural girls was 99.7% (an increase of 1.2% over the 2010 figure) while the percentage of rural girls enrolling in middle school in 2012 was 89% (an increase of 3.4%).

4. Promotion of Women Income-Generating Activities

125. The program provides rural women with technology training of crops cultivation and animal raising in collaborating with other resource institutions of agricultural extension, education, health, finance, poverty alleviation office, and etc. Training has usually been conducted in

township and village levels. In 2012, around 20,000 women were trained throughout the project rural areas.

C. GENDER-DIFFERENTIATED TRANSPORT NEEDS

126. The women's role in the household shapes their transport patterns, frequency of women's mobility and travel costs. Women's transport activities are different from men's since women often have the primary responsibility for transporting goods to and from market, and for accompanying children and elders to hospital, and for seeking job opportunities to meet increasing cash demand of households.

1. Travel Patterns and Destinations

127. The survey showed a variety of women travel destinations: township, county town, prefecture town and province town. Rural village, township and county towns are the major travel destinations for both women and men. There is a few travelling by both men and women to provincial towns. The percentage of female and male travel to township is 30.6% and 26.2% respectively with the purpose to buy or sell products, visit health center and seek local job opportunities. The percentage of female travel to county town is lower than that of men because men generally go there for seeking jobs or buying or selling big volume of products within bigger markets of the county town. Women travel more to county towns for the purpose of accompanying their family members to hospital.

Table 41: Travel Destinations by Gender

		Male		Female		Total	
		No. of respondents	% of respondents	No. of respondents	% of respondents	No. of respondents	% of respondents
Destination	Township	56	26.2	41	30.6	97	27.9
	County town	35	16.4	29	21.6	64	18.4
	Prefecture town	93	43.5	46	34.3	148	42.5
	Province town	8	3.7	7	3.3	9	2.6
	Total	214	100	134	100	348	100

Source: Household Survey Data

128. Women's transport purposes and modes differ to men's. 14.6% of female respondents traveled towards townships by walking compared to 3.6% of men. The motorcycle is more commonly used by men, accounting for 28.6% of total males, against 12.2% of females. The main purpose of women's travel includes; seeking paid jobs, buying and selling products at nearby market and fetching small children from school. The main purpose of village travel for men is to look for job opportunities and is usually by motorcycle.

129. Women also travel to the county town markets where they can sell and buy with more options. Public transport and private motorcycles are the main transport means for local communities to the county town. Women prefer using public transport such as buses or vans rather than motorcycles. Travel to the county town for men is mostly on motorcycles, for the purpose of visiting markets or seeking paid jobs. 51.2% of male and 62.1% of female respondents still use public transport (bus or minivan) to travel to the county town.

130. County travel is quite important for both women and men to visit bigger market centers have a better access to social facilities and to maintain family relationships and social networks. Women are more likely to accompany family members to hospital as role of primary family care. Public transport and private motorcycles are commonly used by both genders.

131. Long distance travel beyond county is not common for local people. Very few respondents travel to the provincial town.

Table 42: Transport Purposes and Patterns by Gender

Destination	Male	Female
Township	***Purposes***: • Seeking job opportunities (19.6%) • sending and picking up children to and from school (8.9%) • Buy or sell products (19.6%) • Buy HH commodities (19.6%) • Maintain social network (10.7%) • Visiting health center (14.3%) ***Patterns:*** • On feet (3.6%) • Motorcycle (28.6%) • Track-trailer (5%) • Bus or minivan (62.4%)	***Purposes:*** • Seeking job opportunities (19.5%) • Sending and picking up children to and from school (9.8%) • Buy or sell products (19.5%) • Buy HH commodities (26.8%) • Maintain social network (4.9%) • Visiting health center (12.2%) ***Patterns:*** • On feet (14.6%) • Motorcycle (12.2%) • Track-trailer (3%) • Bus or minivan (55.9%)
County town	***Purposes***: • Seeking job opportunities (34.5%) • sending and picking up children to and from school (2.9%) • Buy or sell products (27.3%) • Buy HH commodities (16.7%) • Maintain social network (20%) • Visiting health center (2.9%) ***Patterns:*** • On feet (0%) • Motorcycle (25.7%) • Track-trailer (8.6%) • Bus or minivan (51.2%)	***Purposes:*** • Seeking job opportunities (31.4%) • Sending and picking up children to and from school (6.9%) • Buy or sell products (23.8%) • Buy HH commodities (18.4%) • Maintain social network (13.8%) • Visiting health center (6.9%) ***Patterns:*** • On feet (0%) • Motorcycl0 (27.6%) • Track-trailer (0%) • Bus or minivan (62.1%)
Prefecture town	***Purposes***: • Seeking job opportunities (28.3%) • sending and picking up children to and from school (0%) • Buy or sell products (38.1%) • Buy HH commodities (20.4%) • Maintain social network (4.3%) • Visiting health center (9.7%) ***Patterns:*** • Motorcycle (17.2%) • Track-trailer (3%) • Bus or minivan (66%) • Car (16%)	***Purposes:*** • Seeking job opportunities (25.8%) • Sending and picking up children to and from school (0%) • Buy or sell products (34.7%) • Buy HH commodities (15.2%) • Maintain social network (2.2%) • Visiting health center (13%) ***Patterns:*** • Motorcycle (14%) • Track-trailer (0%) • Bus or minivan (78%) • Car (17%)

Source: Summary from HH Survey Data

2. Frequency and Cost of Transport

132. Women group discussions indicated that they have less time to travel than men, due to their heavy involvement in household and agricultural activities. The frequency level of transport for women was less than that of men. Travel by men to the three destinations totaled 16 times a month compared to 13.3 for women. Women had lower travel costs than men because they tended to walk within townships or take public transports that took more time on the road for women.

Table 43: Frequency and Cost of Transport by Gender

		Male	Female
Travel frequency (## of travels per month)	Township	4.7	4.2
	County	5.1	4.2
	Prefecture town	3.4	2.9
	Province town	2.8	2.0
	Total	16	13.3
Travel time (Minutes/one return)	Township	17.0	23.9
	County	42.0	42.3

	Prefecture town	72.1	69.0
	Province town	0.0	0.0
	Total	131.1	135.2
Cost of travel (Yuan/one return)	Township	15.63	13.66
	County	18.8	16.5
	Prefecture town	39.1	31.9
	Province town	0.0	0.0
	Total	73.5	62.1

Source: Household Survey Data

133. Women have similar transport needs to other social groups. Due to their higher level of domestic responsibility, women assign greater importance to transport that is easier, faster, and safer and provides more mobility, as this in turn provides more home time for productive work. Women also expect more buyers to come to the village, which would in turn further reduce travel time and thus save more time. Specifically, women are more reliant on public transport and prefer safe and regular public transports with fixed fares.

D. PROJECT BENEFITS FOR WOMEN

134. The Project will bring benefits equally to women and other social groups through improvement of road safety facilities, rural road surface upgrading and three trunk road rehabilitations. Shorter travel time on rural roads is beneficial to them, as it increases mobility, and allows more productive use of time.

135. Women are primary local travelers for buying home consumption goods and selling produce, sending and picking up small children to and from school, traveling for health purposes, more frequently accompanying family members to hospital. Accessing better roads, thereby, will provide them easier, faster and safer travel.

136. Public or private transport operators will be more willing to provide services when the road condition and road safety is improved. This could increase the potential for young women to travel outside the village to seek employment. Specifically, availability of public transport services, which are their primary means of travel, is important to women.

E. NEGATIVE IMPACTS AND MITIGATION

137. The trunk road rehabilitations would bring negative impacts on women in terms of land acquisition and resettlement due to housing demolition. Several vulnerabilities of women resulting from land acquisition or relocation should be addressed. First, women are often in a disadvantaged position at labor markets due to lower education levels or (traditional) gender bias, that might lead to less income or fewer job opportunities for them after land loss, compared to men. For example, at local labor markets, a skilled man can earn CNY 150-200 per day against CNY 100-120 for a skilled woman for the same work. The wage for an unskilled man is CNY 100-120 per day versus CNY 80-100 per day for an unskilled woman. Second, women's needs or interests tend to be ignored during public consultation and participation since few women can voice their opinions in public and/or fewer women are invited to attend consultation meetings, for example, consultation on selection of resettlement sites. Third, a woman's burden might be increased because the resettlement site might be far away from farmland that might keep her busier between household work and land related activities. Relocation may also increase the distance between school and hospital and home, which would increase her travel time.

138. To facilitate livelihood restoration for affected women, various skill-training programs should be provided through a number of ongoing government initiatives. According to women's needs, relevant training courses such as housekeeping and handicrafts should be introduced to women

through Women Federation, or the Human Resources and Social Security Bureau with close cooperation with the Project sponsor. Provision of jobs to women should be prioritized during project construction.

139. All the above measures have been included in the Social and Gender Action Plan (SGAP), which has been extensively discussed with project sponsor. The SGAP addresses women's needs and ensures women will be benefited equally by the Project and to mitigate negative impacts for women that might arise from the Project.

VIII. PUBLIC PARTICIPATION AND CONSULTATION

A. CONSULTATION METHODS AND PROCESS

140. Various consultations have been conducted during the preparation of the project feasibility study reports, social and poverty impact assessment and resettlement plans. These consultations were conducted with governmental agencies, villagers living in the project area, and affected people to discuss transport concerns and needs, land acquisition and resettlement issues, and economic development potentials through the road development.

141. Methods and tools used include (i) participatory observation: to learn generally about transport problems faced by local residents; (ii) household questionnaire: to survey socio-economic profiles of project beneficiaries, to understand family situations, life status and living conditions; (iii) focus group discussion: to know expectation and requirements of affected people; local residents' opinions and suggestions on the project; (iv) interview with representatives of households, villages or communities to find potential impacts, coping strategies and support needed; (iv) interview with government agencies to identify existing programs helping the poor and women take advantages of the project benefits; and (v) workshops have been held to discuss enhancing project benefits and mitigating negative impacts of project on local people particularly women and poor people.

B. CONSULTATION DURING PROJECT PREPARATION

142. At the preparation stage, free, prior and informed public participation and consultation have been conducted. Then, in the social and poverty assessment and resettlement preparation, a socio-economic survey was undertaken in May 2014. A total of 348 households from 17 villages were surveyed. In addition, a total of 42 FGDs have been held with total 250 interviewees, involving local representatives of women, poor, elder, men and community leaders to discuss in an open ended manner topics related to the project. Furthermore, a number of key informant interviews and stakeholders workshops also have been held with various bureaus to inform of and consult with this project design and management.

143. During the project preparation, extensive consultations and participation were carried out by EA and IA in the project affected communities in order to ensure all of them are fully aware of compensation policies and rehabilitation measures. Further consultation and participation will be carried out during the implementation of land acquisition and resettlement. Consultation and participation will be conducted in order to optimize the project design, selection of labor for construction, education on environment awareness, integration of opinions and advice of residents, and monitoring of implementation of gender action plan.

C. PARTICIPATION PLAN DURING PROJECT IMPLEMENTATION

144. During project implementation, consultations with and participation by people affected by the project will be encouraged. This will be particularly during the land acquisition and resettlement phase. First, all affected people and villages will be provided the opportunity to review and consult the final compensation packages before signing compensation agreements. The agreed compensation rates and rehabilitation measures will be disclosed in the area affected by the project and be supervised by the affected people. Relocated households will have a choice of cash or an in-kind rehabilitation option. For landless farmers, a training needs assessment will be carried by the local government.

145. In order to ensure that people affected by the project, particularly the poor, will benefit during project implementation, the contractors will be asked to provide opportunities to use both local construction materials and local labor. To facilitate such employment and reduce poverty, the IA and the local poverty alleviation office along with the human resource and labor security bureau will be asked to provide various kinds of non-farm skill training to the affected people, particularly the rural poor in the area affected by the project. Such training should be provided to both male and female labors.

146. For who are not satisfied with the compensation and rehabilitation offered, or have issues and difficulties during resettlement implementation, a grievance procedure will be established, which will be disclosed in the resettlement information booklet to be distributed to people affected by the project six months prior to project implementation. Related government agencies and the IA will be the primary managers of the grievance procedure.

D. MONITORING AND EVALUATION PLAN

147. The purpose of this section is to present the participatory monitoring and evaluation plan for the project. It is expected that the monitoring and evaluation plan will generate data and information required to assess and quantify the potential social and poverty benefits of the project; as implementation progresses, it will also monitor the processes for implementation of GAP.

148. The objectives of the monitoring and evaluation plan are to set out a method to assess changes in the social and economic conditions of the project area during implementation of the project. It will generate:

(i) Data and information to identify effects and project impact including qualitative information to describe social changes;
(ii) Analyze and document the results of GAP implementation;
(iii) Focus on key actions and processes learned from the project for replication in other areas.

149. The Plan consists of 3 sections; Section one: executive summary of the monitoring and evaluation. This section concisely describes the critical facts, significant findings, and recommended actions. Section two: description of the project. This section provides a general description of the project; discusses project components and activities that may bring impacts on local residents and identify project area. Section three: social Impact assessment. This section will:

. (i) Provide baseline information on the demographic, social, and economic characteristics of the project area

. (iii) Based on meaningful consultation with the local residents and communities, assess the potential adverse and positive effects of the project.

. (v) Include GAP monitoring and women impact assessment of the project in terms of women's perceptions about the project and its impact on their social and economic status.

. (vi) Identify and recommend, based on meaningful consultation with the local residents and communities, the measures necessary to avoid adverse effects or, if such measures are not possible, identify measures to minimize, mitigate, and/or compensate for such effects and to ensure that the local population benefit from the project.

150. The monitoring and evaluation will cover the process of land acquisition and resettlement, which will be included in the resettlement plan to be carried out by resettlement monitoring and evaluation agency.

APPENDIX L - SUMMARY POVERTY REDUCTION AND SOCIAL STRATEGY

SUMMARY POVERTY REDUCTION AND SOCIAL STRATEGY

Country:	People's Republic of China	Project Title:	Shaanxi Mountain Road Safety Demonstration Project
Lending/Financing Modality:	Project loan	Department/ Division:	

I. POVERTY AND SOCIAL ANALYSIS AND STRATEGY

Targeting classification: general intervention

A. Links to the National Poverty Reduction and Inclusive Growth Strategy and Country Partnership Strategy:

In 2012, 7.5 million rural people or about 30% of the rural population in Shaanxi were poor. Qinba Mountain Region in the south is one of the two poor population concentrated areas in Shaanxi where poor infrastructure, high frequency of natural disaster and undeveloped industries form the major barriers of living condition improvement and well-being development. The project target Hanbin, Xunyang and Shangnan district/county in Ankang and Shangluo, two prefecture-level cities in the Qinba Mountains, a poverty-stricken area with potential for shifting conventional agriculture to intensive cultivation of high valued added agriculture and related processing, development of mineral, chemical medicine, construction materials, hydropower industries, and the development of tourism with road and road safety improvement. The Project will reduce poverty by improving rural road access, introducing alternative road safety design and maintenance approaches, networking regional roads in Ankang and Shangluo to facilitate regional integration and trade. As envisaged in the Twelfth Five Year Plan of the PRC, the project will contribute to inclusive and balanced regional development and reducing income disparity. The project is in line with the PRC rural poverty reduction strategy for 2011-2020 which recognizes regional road network and road safety as an important poverty reduction intervention. The Project aligns with the Shaanxi Government poverty reduction strategy of improving road condition in poverty areas, improving housing condition, agricultural technology training and providing safe water supply particular for poor people living in Qinba mountain and northern Loess Plateau where water scarcity is a key issue for poor households. The project is also consistent with ADB's assistance to the PRC under the 2011–2015 country partnership strategy (CPS) in the area of: (i) Inclusive growth and balanced development; and (ii) regional cooperation and integration as well as ADB's Sustainable Transport Initiative (STI), which identifies road safety and social sustainability as key developmental opportunities.

B. Results from the Poverty and Social Analysis during PPTA or Due Diligence

1. **Key poverty and social issues.** All three project counties and district, Xunyang and Hanbin of Ankang and Shangnan County of Shangluo are poverty-stricken areas in Shaanxi Province. In 2012, the per capita GDP is CNY 15,879, CNY 15,735 and CNY 15,582 in Xunyang, Hanbin and Shangnan respectively, about 14-17% lower than its prefecture average of CNY 18,878 of Ankang and CNY 18,097 of Shangluo, accounting for about 40%-41% of the provincial average of CNY 38,557 and national average of CNY 38,447. The rural poverty ratio was 40% in Xunyang, 38.6% in Hanbin and 34.3% in Shangnan, which are higher than Ankang (32.8%), Shangluo (31%) and Shaanxi (30%). Low profit margin of local product due to remote location with under-developed transport infrastructure and harsh geographical and climate conditions with frequent natural disasters are the main causes of poverty at the village level while lack of professional skills, illness and credit are often the main causes for poverty at the household level.

2. **Beneficiaries.** The project will potentially benefit a total population of about 1.7 million people, of which 38.4% are poor. In particular, the 6 village road and 1 township road

improvements will benefit around 33,085 people of 21 village of 8 townships. Out of them, 16,787 rural poor or 50.7% of its beneficiaries are directly benefited by the Project.

3. **Impact channels**. **Direct**: Social and Poverty Assessment (SPA) surveys indicate 63.5% of the households have transport vehicles that play important role in both of income generation and everyday life requirements of the people. (i) Improved roads including rural and village roads will benefit people by ensuring safer, time- and cost-saving transport and comfortable travel; (ii) The implementation of the Social and Gender Development Action Plan (SGDAP) will target and benefit the poor. (iii) It will also provide employment opportunities for the poor as unskilled labors during project construction. (iv) improved access to social services, particularly school and healthcare services; (v) The proposed project will also help timely delivery and distribution of relief materials in case of severe natural disasters of flooding and snowing.

4. **Indirect**: (i) creating easy mobility for the poor particularly in the remote villages to seek non-farm jobs; (ii) creating non-farming jobs or business opportunities through stimulating overall local economic development, particularly mineral, transport related business, construction and decoration, hydropower and tourist sectors; (iii) promoting more cash crop growth such as horticulture seedlings, fresh vegetables, green house crops, herb medicine, and others by intensified cultivations.

5. The project will create 2,700 jobs during project implementation and 100 follow-on jobs. Targets of 40% women and poor during construction and 50% women and poor during operation women are in the design and monitoring framework as well as loan assurances.

6. **Other social and poverty issues.** The SPA indicates land acquisition and resettlement, construction such as construction noise, small business along roads and safety during construction.

7. **Design features.** The project design features that will further enhance the poverty alleviation impact of the project include (i) improvements of village road and road safety into the project component to enhance the project benefits to the poor, women and vulnerable group, (ii) minimizing impacts on land acquisition and resettlement, (iii) targeting employment opportunities for poor and women, and (iv) community awareness raising on road safety, anti-communicable diseases, drug use and human trafficking.

C. Poverty Impact Analysis for Policy-Based Lending NA

II. PARTICIPATION AND EMPOWERING THE POOR

1. **Summarize the participatory approaches and the proposed project activities that strengthen inclusiveness and empowerment of the poor and vulnerable in project implementation.**

At the pre-feasibility and feasibility study phase, stakeholder participation and intensive consultation have been conducted with focus on project scope, initial alignment of the trunk road and rural road and its design standard, potential affected villages, alternatives of reducing affected populations. During the PPTA, RP, and SGDAP preparation, surveys have been undertaken in May-December 2014. A total of 1,424 households including 804 AHs from 49 villages were surveyed. In addition, a total of 108 FGDs were held with total 800 interviewees, involving local representatives of women, poor, elder, men and community leaders to discuss in an open ended manner topics related to the project. Extensive consultations and participation were also carried out by EA and IA in the project affected communities in order to ensure all of them are fully aware of compensation policies and rehabilitation measures. Participation processes have been built into the SGDAP and RP plans to ensure appropriate levels of participation by local communities during the implementation phase. These will be monitored through loan assurances and the DMF.

2. **If civil society has a specific role in the project, summarize the actions taken to**

ensure their participation.

The All China Women's Federation (ACWF) will assist in organizing several consultative, advocacy, and training activities for farming and non-farming training, women led community awareness of road safety and anti-communicable diseases.

3. **Explain how the project ensures adequate participation of civil society organizations in project implementation.**

The ACWF will be involved in implementation. In addition, all primary and middle schools in the project area will participate in the project implementation for awareness raising on road safety and anti-communicable disease. The external monitors and social safeguard and gender capacity specialists will be sourced from the research institutes or universities

4. **What forms of civil society organization participation is envisaged during project implementation?**

☒ Information gathering and sharing H ☒Consultation H ☐Collaboration ☐ Partnership

5. **Will a project level participation plan be prepared to strengthen participation of civil society as interest holders for affected persons particularly the poor and vulnerable?**

☐ Yes. ☒ No.

No separate plan is prepared. A number of measures on participation are included in the RP and SGDAP and to ensure appropriate information dissemination, consultation and public participation throughout all stages of the project cycle

III. GENDER AND DEVELOPMENT

Gender mainstreaming category: EGM

A. Key issues. The project is categorized as effective gender mainstreaming (EGM). Based on FGDs and interviews, most women support the project components. The Project will bring benefits equally to women and other social groups through improvement of road safety facilities, rural road surface upgrading and three trunk road rehabilitations. Shorter travel time on rural roads is beneficial to them, as it increases mobility, and allows more productive use of time. Women are primary local travelers for buying home consumption goods and selling produce, sending and picking up small children to and from school, traveling for health purposes, and more frequently accompanying family members to hospital. Accessing better roads, thereby, will provide them easier, faster and safer travel.

B. Key actions. Measures to address gender issues in both project design and implementation have been incorporated in the SGDAP. (i) Traffic safety facilities will be incorporated into the project design. (ii) Public participation meetings at all stages of the project will involve women at a proportion of not less than 50%, (iii) 40% local women in unskilled construction jobs, (iv) 75% of the total 46,000 days of employment generated to go to women. Rural Road maintenance for two years post-operation. Project publicity, training and other activities will be conducted in times and at places convenient to women with respect to their schedule and in a manner that women can easily understand. In addition, women will be informed about the compensation for land acquisition and house demolition, and sign a receipt when they receive the compensation.

☒ Gender action plan ☐ Other actions or measures ☐ No action or measure

IV. ADDRESSING SOCIAL SAFEGUARD ISSUES

A. Involuntary Resettlement | **Safeguard Category:** ☒ A ☐ B ☐ C ☐ FI

1. **Key impacts**. The total permanent land acquisition is 3,428.76 mu, including 841.59 mu of farming land, 1,045.82 mu of forest/garden land, 190.44 mu of homestead and 1,350.91 mu barren land. Total house/building demolition area is 62,964 m^2, including 43,222 m^2 of brick and concrete, 8,248 m^2 of brick and wood houses, 9,516 m^2 of earth wood, and 1,948 m^2 of wood, tile and other simple structures. A total of 13,238 persons in 3,515 households from 62 villages are affected, including 3,225 households affected by land acquisition, 307 households by both land acquisition and demolition.

2. **Strategy to address the impacts**. All acquired and occupied lands, and demolished houses and structures will be compensated at full replacement cost, including young crops and ground attachments. In addition to compensation, EA and IAs will take others measures including (i) provision of skill trainings to the APs to improve cash crop productivity and husbandry raising, (ii) provision of credit to poor and women APs in promoting cash crop plantation, transport and other small business, (iii) provision of employment related to the Project, and (iv) non-monetary support.

3. **Plan or other Actions.**

☒ Resettlement plan
☐ Resettlement framework
☐ Environmental and social management system arrangement
☐ No action
☐ Combined resettlement and indigenous peoples plan
☐ Combined resettlement framework and indigenous peoples planning framework
☐ Social impact matrix

B. Indigenous Peoples | **Safeguard Category:** ☐A ☐ B ☒ C ☐ FI

1. **Key impacts**. No ethnic minority groups will be affected by the project.
Is broad community support triggered? ☐Yes ☒ No

2. **Strategy to address the impacts**. No special supports needed.

3. **Plan or other actions.**

☐ Indigenous peoples plan
☐ Indigenous peoples planning framework
☐ Environmental and social management system arrangement
☐ Social impact matrix
☒ No action
☐ Combined resettlement plan and indigenous peoples plan
☐ Combined resettlement framework and indigenous peoples planning framework
☐ Indigenous peoples plan elements integrated in project with a summary

V. ADDRESSING OTHER SOCIAL RISKS

A. Risks in the Labor Market

1. Relevance of the project for the country's or region's or sector's labor market. National regulations will be obeyed by contractors. ☐ unemployment ☐ underemployment ☐ retrenchment ☒ core labor standards

2. **Labor market impact.** The project will promote local employment directly and no risks in unemployment and retrenchment. The project is estimated to directly create about 2,700 jobs during the construction period, out of which 1200 would be unskilled jobs and 1,500 would be skilled jobs. The operational maintenance activities will generate 46,000 days of employment for two years post-operation.

B. Affordability

The project consists of three trunk highways and 8 section of rural road improvement with integration of road safety and another 25 section rural roads of road safety improvement. All of them are open access and toll free.

C. Communicable Diseases and Other Social Risks

1. Indicate the respective risks, if any, and rate the impact as high (H), medium (M), low (L), or not applicable (NA): L

☒ Communicable diseases L ☒ Human trafficking L
☐ Others (please specify) _____

2. Describe the related risks of the project on people in project area.

The project is a rehabilitation/reconstruction/upgrading/road safety improvement which will have limited risks compared to new road construction: (i) involve migration of construction workers which may increase the risk of communicable diseases. HIV/AIDS and other communicable disease prevention, anti-drug use and human trafficking knowledge and education will be

provided to the workers and villagers to reduce risks. This has been addressed in the SGDAP.
VI. MONITORING AND EVALUATION
1. **Targets and indicators**. 40% poor and 40% of female for unskilled labors during the implementation and operation; 40% poor, and 50% of female participants in farming and non-farming skill training. 2. **Required human resources**. EA and IAs shall appoint staff as focal point of gender and RP to manage and report the implementation progress of these plans, and an independent monitoring agency or specialists shall be recruited for external monitoring of RPs and SGDAP. The budgets for the M&E are included in each plan. 3. **Information in PAM**. Requirements for quarterly monitoring reports of RPs, and semi-annual monitoring reports of SGDAP are included in the PAM. 4. **Monitoring tools**. Internal monitoring results shall be included in the project progress reports, while external M&E reports shall be submitted to ADB in separated reports semi-annually or annually.

Appendix M: Social and Gender Development Action Plan

（budget and sources to be finalized）

Proposed Actions	Target Group(s)	Agencies Involved	Timing	Funding Needs & Source (CNY)	Monitoring Indicators & Source
A. PROJECT BENEFITS AND ENHANCEMENT MEASURES					
1. Design Features: Shaanxi mountain Roads Safety Demonstration a. Rural road safety improvement for 25 sections rural road totaling 570 km b. Rehabilitation of three trunk highways (186.95 km) and 8 rural road upgrading with road safety improvement (139.7 km)	Communities along the road. Around 62,718 populations including 33.8% of poor or low income population and about 50% of female.	SPPMO and County/District PMOs in Transport Bureau	2015-2018	US$ 322.1 M in Project budget	• 36 sections totalling 896.3 km of roads with condition and safety improved and maintained • Number of rural people served by improved roads, % of poor benefitted • Number of village roads spots fixed; number & km of village roads maintained
2.Improved Road Safety[1] a. Installation of road safety measures such as signage, traffic calming strips, pedestrian crossings b. Law enforcement b. Establishing Accident database established	Communities along the roads	SPPMO and County/District PMOs in Transport Bureau, Local Police, Village communities and educational institutions along the project roads	2015-2017	US$49.33 in Project budget	• % reduction in traffic accident • No. of easy-identifiable roads safety signs installed • No. of effective measures taken for speed limitation. • No. of local communities covered by road safety training. • No. of awareness building material prepared and distributed.
3. Project Economic Benefits: • 50% of unskilled jobs (estimated number of jobs 2,700 in total) for women, poor, project affected, and local people • Use of local resources and local construction materials	Villages along road, priorities given to poor, women, and project affected people	SPPMO and County/District TB and Contractors	2015–2017	Project budget	• Provisions included in the bidding documents • Number of unskilled jobs provided to local people (ethnicity and sex disaggregated data) • Average purchase of local

[1] A program of road safety improvements will be implemented targeting: i) education and community programs, ii) enforcement, iii) capacity building, iv) accident database establishment and v) a program of equipment procurement. The Project county/district government will provide the necessary guidance and oversight.

Proposed Actions	Target Group(s)	Agencies Involved	Timing	Funding Needs & Source (CNY)	Monitoring Indicators & Source
					products and other resources (contractor camps details) in Yuan • Number of establishments (houses/space) rented • Source of construction materials – money spent and % of total procurement (interviews with contractors)
4. Capacity development measures (poor, women) • Technical training for cash crop growing • Non-farming job skill training	All 59 villages with APs, Priorities give to poor women and poor villages, total target trainees 3000 person	SPPMO and County/district TB and Human resources bureau	2017-2018	Project budget In RP (CNY 599,940)	• No. of training sessions held • No. of EM people trained (training report)
B. MITIGATION MEASURES TO ADDRESS SOCIAL RISKS					
1. Minimizing risk of communicable diseases: ***i. HIV/AIDs and STI awareness*** • Contractors provide training to all workers and managers in accordance with the provision under bid contracts 2015. ***Malaria Prevention and control – construction workers*** • Ensure site sanitation and improved drainages • Use of mosquito nets and spraying of camps • Treatment of affected workers 2015. ***Tuberculosis prevention and control among construction workers*** • Annual health screening for all workers • Quarantine and treatment of affected	Contractor staff, construction workers, villagers	SPPMO and County/district TB, contractors and County CDC	2015–2016	CNY 50,000 included in project management	• Contractors bids include provision for HIV/AIDS awareness training to all workers • Number of workers trained • Number of training programs conducted for workers • Number of awareness raising material produced & distributed • Number of condoms distributed • Number of mosquito nets provided • Number of times camps sprayed • Number of workers screened for TB • Number of workers quarantined and treated for TB

Proposed Actions	Target Group(s)	Agencies Involved	Timing	Funding Needs & Source (CNY)	Monitoring Indicators & Source
workers • Communities (CDC)					
2015. **Minimizing risk of Trafficking of human and drugs** • A multi-sector approach in coordination with various agencies • Awareness building and information sharing in coordination with local women's federation • Awareness building and education on anti-drug trafficking especially targeting youths • improved law enforcement including setting up check points and surveillance equipment • Posters and pamphlets in bus stations, border points	Villages and towns along port areas	SPPMO and County/district TB, Police station, Customs Offices, and women's federation	2015-2016	CNY 50,000 included in project budget for awareness building and information sharing. Law enforcement costs will from government regular budget.	• No. of posters • Number of training program and trainees • Number of check points and surveillance equipment installed • Number of youths provided training
4. Minimization of disturbances during construction • Avoidance of water sources contamination. • Avoidance of construction work at night nearby residential areas. • Minimization of dusts caused by construction. • Site cleaning up on work completion • Provide temporary service during construction and reconstruction of irrigation, drainage systems and approach roads	Villages close to the alignment corridor	SPPMO and County/district TB and contractors	2015–2016	Included in project budget (refer to EMP)	• Number of complaints received and resolved • Length of irrigation and drainage canals, percentage of recover ratio • Clearance from village committees upon completion

Proposed Actions	Target Group(s)	Agencies Involved	Timing	Funding Needs & Source (CNY)	Monitoring Indicators & Source
5. Minimization of road safety risk along road community • Organizing educational programs in school • Organizing community awareness programs lead by women	Villages along the roads	SPMO, local PMO and WF in county and village	2017-2018	CNY 100,000 in project road safety budget	• No. of schools conduct road safety education program • No. of villages conduct road safety awareness building program • No. of women participated the activities
C. LOCAL GOVERNMENT COMPLEMENTARY POVERTY REDUCTION MEASURES					
1. Promote non-farming employment in transport and tourism service sectors. • Promote skill training on transport and tourism, • Provide micro-credit assistance to help establish non-farming establishments	Minority Household and individuals	SPPMO and County/district TB, Local PRADO and LSSB	2015-2016 onwards	On-going government project	• No of trainees, particularly women and poor trained • Amount of credit disbursed, • number of women and poor borrowers, and type of activities
6. Tourism promotion • Promoting villages ecotourism with scenery resources • Advertising of tourism sites through varies approaches.	Villages with scenery resources	LG and its tourism bureaus	2016 onwards	Government and tourism sector	• Number of advertisements • No. of home stay tourism site in villages • Income from tourism • Jobs created, particularly for poor
D. Monitoring and Evaluation					
1. Monitoring and Evaluation	All project counties and district with project components	SPPMO and County/district TB	2016-2018	CNY 200,000 as part of project consultancy budget	• Report to ADB semi-annually

Source: Shaanxi provincial project management office in Communication Department, Ankang and Xunyang City Government, Hanbin, Xunyang and Shangnan county level PMO, County level of bureaus/office of transport, poverty alleviation, civil affairs, labor and social insurance, ethnic minority affairs and women's federation.

Note: CDC = Center of Disease Control, DRB = Development and Reform Bureau, EMP = environmental management plan, HH = household, IPMC = Industrial Park Management Committee, LSSB = Labor and Social Security Bureau, M=Million PRADO = Poverty Reduction and Development Office, PMO = Project Management Office, RP = resettlement plan, TB = Tourism Bureau, LG =Local Government, and WF = Women's Federation.