



**Policy Instruments for Chinese Sustainable Future:
Environmental Policy Integration and
Strategic Environmental Assessment
for the Energy and Transport Sectors**

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SWOT-Analysis – Provincial Transport Plan

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Project outline

Policy Instruments for Chinese Sustainable Future focuses on the integration of the environment into transport and energy planning in China, both at the policy level and in terms of concrete measures for the two administrative levels of provinces and municipalities. The implementation of this project will help to build transportation and energy-use systems that are environmentally sound and capable of achieving sustainable development in China. As part of the Asia Pro Eco II Programme the project contributes to the programme's main themes for China: energy savings, improved air quality and reduced emissions of GHGs.

At the heart of this project are two closely related mechanisms that are central to the EU efforts to promote sustainability: Environmental Policy Integration (EPI) and Strategic Environmental Assessment (SEA).

The action targets the inadequate reflection on environmental policy objectives and the weakness of the environment as a cross-sectoral priority and the need for information and knowledge of technical/practical solutions that can lead to immediate improvements in the development of sectoral plans. The 30 months Action consists of four work packages and multiple activities.

For further information please look at:

http://www.epi-in-china.com/project_information/summary.html

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Contents

1) ABOUT THIS REPORT	4
2) INTRODUCING THE EXPRESSWAY PLAN	5
ORIGINS OF THE PROPOSED THE SHAANXI PROVINCE HIGHWAY PLAN	5
BASIC INFORMATION	6
LAYOUT OF THE SHAANXI PROVINCE HIGHWAY PLAN	8
LINKS WITH THE INSTITUTIONAL AND POLICY CONTEXT	11
PROPOSED PLAN OBJECTIVES	16
CONSISTENCY ANALYSIS	16
3) PLANNING TIMELINE AND WINDOWS OF OPPORTUNITY	18
4) ACTORS AND RESPONSIBILITIES	20
KEY ACTORS	20
CONSULTATION, COLLABORATION AND PUBLIC PARTICIPATION	20
CONTACTS	22
5) BASELINE INFORMATION	23
INTRODUCTION - THE USE OF INDICATORS AND TARGETS	23
BASELINE FOR SHAANXI	24
6) ENVIRONMENTAL AND SUSTAINABILITY ISSUES	26
7) ENVIRONMENTAL AND SUSTAINABILITY OBJECTIVES AND TARGETS	29
PROPOSED ENVIRONMENTAL AND SUSTAINABILITY OBJECTIVES	29
8) SCOPE OF THE SEA	30
PROPOSED REVIEW APPROACH AND PURPOSE	30
PROPOSED REVIEW METHODOLOGY: METHODS, TOOLS, STRENGTHS AND WEAKNESSES	31
CONSULTATION ON THE SCOPE OF THE SEA	33
9) IDENTIFICATION OF ALTERNATIVES	35
10) ASSESSMENT	36
ASSESSMENT METHODS	36
ASSESSMENT CONTENT	37
11) ENVIRONMENTAL REPORT	41
12) INTEGRATION INTO DECISION-MAKING PROCESS	43
13) PRELIMINARY RECOMMENDATIONS	44
REFERENCES	45

1) About this report

EU Asia Pro Eco programme is one of the four Asian programmes of EU, and is a supplement to bilateral cooperative programme of EU. The program is intended to conduct the dialogues on environmental issues, improve environmental conditions in the field of economy, strengthen technical cooperative relation through introducing EU into financing, and to promote mutual benefits and understanding between EU member countries and Asia through encouraging persistent investment. The focus of the programme is to strengthen the capacity of managing environment of Asia, promote market-oriented outlook of environmental protection, develop, promote and support environmental research and network relations between Europe and Asia.

The project “Policy Instruments for Chinese Sustainable Future: Environmental Policy Integration and Strategic Environmental Assessment for the Energy and Transport Sectors” is aimed to provide the technical support for environmental polices and strategic environment assessments in the energy and transport sectors of China.

The report describes the case of environmental impact assessment of transport sector planning. Since the environmental assessment report has been completed before the project started, a SWOT analysis has been conducted for the “Environmental Impact Assessment Report of the Expressway Network Plan in Shaanxi Province”. The European experts proposed to develop capacity of the Chinese transport sector experts by providing overview of the EU experience, especially on the current situation of planning environment in highway traffic, such as the contents of assessment, technical assessment methods, assessment indicators, environmental protection objectives which should be taken into consideration during the assessment, the contents and ways of public participation

2) Introducing the Expressway Plan

Origins of the proposed the Shaanxi Province Highway Plan

Shaanxi Provincial Department of Communications prepared the plan for provincial type highway network in 1991.

With an aim to get adapted to the implementation of the strategy for developing western regions, the Ministry of Communication has planned eight inter-provincial highway passages for western development, three of which run across Shaanxi Province. Shaanxi provincial party committee and the provincial government approved the document named “Speeding up Highway Development Plan to Get Adapted to Western Development and Implementation Options” made out by Shaanxi Provincial Department of Communications to speed up construction of highway network inside Shaanxi Province. The plan prepared the forth plan for expressway network composed of 6 expressways with a total mileage of 2,943 km and secondary highway network of a “one vertical highway, three horizontal highways and two ring roads” with a total length of about 3,600 km. The aforesaid plan plays an important guiding role for the construction and development of the expressway in the whole province.

The construction of the expressway in the province has realized a historical development step through the 15 years of rapid development. Expressways in modern central Shaanxi have basically formed a network. Six cities and 42% of the counties (cities and districts) have been connected by the expressways. In addition, Yulin, Yan’an and Hanzhong have bid farewell to the history without expressway. And the distance in time and space between Xi’an and surrounding cities, three economic regions in the whole province, and surrounding provinces and regions has been greatly shortened.

The State Council considered and approved “Plan of State Expressway Network” including 7 radiating routes from the capital of the Province, 9 south-north vertical routes and 18 east-west horizontal routes. Altogether 8 highways in Shaanxi have been incorporated into state expressway network, and Qingdao-Lanzhou route and Shiyao-Tianshui route have been newly added to the network, which cover the original provincial type framework.

The 7th plenary meeting of the 10th Shaanxi Provincial Party Committee thought that traffic was still one of the bottlenecks restricting provincial economic development when studying development prospect of the whole province during “the 11th Five-Year Planning” in August 2005, and required relevant parties to further speed up the construction of expressways and break through restriction of bottleneck in traffic. Shaanxi Provincial Department of Communications then developed the objectives of “three staged development”, and the length of expressway was planned to increase by 2,000 km, 3,000km and 3,800 km in 2007, 2009 and 2012 respectively, and the state expressway network inside the province would be basically constructed. Confronted with the new development trends, the original main expressway framework in Shaanxi Province can not meet the requirements of the rapid economic and social development in Shaanxi Province in the future, and there is an urgent need to make state expressway network inside the province denser, and to improve expressways and to form a network thereof, and revise the original planning objectives and construction programs for main framework highway to optimize connection between state expressway and provincial expressways. It is necessary to systematically compile the long-term development planning for provincial expressway network to instruct construction of provincial expressway better, promote process of traffic

modernization in Shaanxi Province, improve the scientific justification of decisions on construction of expressway and serve provincial economy more efficiently.

According to requirements of “Notice on Printing and Issuing Guiding Opinions for Planning of Expressways in Provinces (Autonomous Regions, Municipalities Directly under Central Committee” of Ministry of Communications [(2005) No.41 Document on Traffic Planning and Development], Shaanxi Highway Survey & Design Institute undertook a development of the “Plan for Expressway Network in Shaanxi Province” under the entrustment by the Shaanxi Department of Communications.

Basic information

a) Transport statistics

1. Highway

By the end of 2006, the total mileage of highways in the whole province had reached 113,303 km, ranking the 14th nationwide (by the end of 2006, the total road mileage of national had amounted to 3.46 million kms) . The density of highway network was 55.06 km per 100 square kilometers, which was about 1.53 times the figure of the average density nationwide (36.0 km per 100 square kilometers) . The road include 4,846 kms of national road, 5,977 kms provincial road, 17,108 kms county highways, 23,843 kms of township roads , 1,833 special-purpose highways and 59,696 kms village road, if divided according to administrative levels; 1,646 kms of expressway, ranking the 13th nationwide, 526 kms of class I ,6,177 kms of class II ,13,875 kms of class III, 38,572 kms of class IV, 52,507 kms of sub-standard road; 22,282 km of highway with paved road surface, and 23,082 km of highway simple paved road surface and 67,939 km of highway without paved road surface.

Update the last numbers

2. Railway

At present, railway network is formed of “two vertical routes, three horizontal routes and three hubs”. There is Zhongwei-Baoji-Yangpingguan, Baotou-Yulin-Yan’an-Ankang-Chongqing form the two vertical routes; Shenmu-Shuozhou, Baoji-Xi’an-Tongguan (Longhai Route), and Yangpingguan-Ankang-Xiangfan comprise the north, central and south horizontal routes and form three hubs of Xi’an, Baoji and Ankang. The extending mileage of formal routes inside the province, the operating mileage and electrified mileage thereof were 4,461 km, 3,266 km and 2,382 km respectively in 2006 with a density of 1.7 km per 100 square kilometers. Xi’an was connected with all of the other cities and regions with railway. The construction of Zhengzhou-Xi’an section of the dedicated passenger transport railway line from Xuzhou to Lanzhou which is one of the “four vertical and four horizontal railway lines” in state medium and long-term planning for railway network has started.

3. Civil Aviation

There are Xi’an Xianyang International Airport and 4 branch airports in Yan’an, Yulin, Hanzhong and Ankang for civil aviation inside Shaanxi at present, which form a network reaching inland areas and extending to overseas areas. The mileage of provincial civil airlines in 2006 was 550,856 km, including 53,459 km of international airlines and 5,315km of Hong Kong and Macau airlines, and 352 airlines were opened, including 27

SWOT

international airlines and 3 Hong Kong and Macau airlines; The province established direct aviation to 132 cities, including 19 foreign cities.

4. Waterway Transport

The navigable rivers in Shaanxi Province only include the Hanjiang River and its tributaries, the Yellow River and its tributaries and the Jialingjiang River. Shaanxi Province conducted the harness of river valleys and the construction of water conservancy facilities for the major rivers inside the province to meet the requirements for developing resources and carrying out construction, and waterway transport development in a steady and upward way. The navigable mileage of waterway in the province was 1,066 km in 2006(Class V waterway 9 kms, class VI waterway 300 kms, class VII waterway 248kms, sub-standard waterway 508kms).

Total freight traffic by waterway in Shaanxi was 1.17 million tons, with 3,001 million ton-kms in 2006; total passenger traffic by waterway was 3.55 million passengers, with 5968 passenger-kms.

b) Estimation of future demand

The regression analysis method, index smoothing method and elastic coefficient method were selected to conduct prediction and analysis of the comprehensive transport demand according to the characteristics of transport development in Shaanxi Province. A Binary linear function was adopted for regression analysis, and population and GDP were taken to be independent variables of transport volume of passenger car, and population and GDP of industry and agriculture are taken to be independent variables of transport volume of trucks. The predicted results are shown below.

Table 2-1: The Prediction of Passenger Transport Volume in Shaanxi Province (ten thousand persons)

Method	Elastic Coefficient	Regression Analysis	Index Smoothing	Comprehensive Prediction	Growth Rate
2004 Actual	35682	35682	35682	35682	
2010	54966	51205	53391	53200	6.88%
2020	88311	93582	82907	88300	5.20%
2030	121026	159099	112422	130800	4.01%

Table 2-2: The Prediction of Freight Transport Volume in Shaanxi Province (ten thousand tons)

Method	Elastic Coefficient	Regression Analysis	Index Smoothing	Comprehensive Prediction	Growth Rate
2004 Actual	41139	41139	41139	41139	
2010	59169	50403	60386	56700	5.49%
2020	91315	71830	92465	85200	4.16%

Method	Elastic Coefficient	Regression Analysis	Index Smoothing	Comprehensive Prediction	Growth Rate
2030	119553	101368	124543	115200	3.06%

Table 2-3: The Prediction of Passenger Transport Turnover Volume in Shaanxi Province (million person kilometre)

Method	Elastic Coefficient	Regression Analysis	Index Smoothing	Comprehensive Prediction	Growth Rate
2004 Actual	51713	51713	51713	51713	
2010	85023	78529	93629	85700	8.78%
2020	145278	150334	163489	153000	5.97%
2030	202420	258401	233349	231400	4.22%

Table 2-4: The Prediction of Freight Transport Turnover Volume in Shaanxi Province (million ton kilometre)

Method	Elastic Coefficient	Regression Analysis	Index Smoothing	Comprehensive Prediction	Growth Rate
2004 Actual	103183	103183	103183	103183	
2010	157565	137581	158852	151300	6.59%
2020	263498	230399	251635	248500	5.09%
2030	367092	370658	344417	360700	3.80%

c) The main features of the Transport Plan

According to the static investment estimation and the newly-designed projects after 2006, about 143.9 billionRMB are needed in total, including 69.7 billion RMB for state expressway, and 74.2 billionRMB for provincial expressway.

Layout of the ShaanXi Province Highway Plan

1) Layout of the Shaanxi Province Highway Plan

The layout integrating vertical-horizontal network and radiating routes is adopted for expressway network in Shaanxi Province. The plan can be summarized as “three vertical routes, four horizontal routes and five radiating routes”, that is “345” network for short. The expressway network is composed of 3 south-north vertical routes, 4 east-west horizontal routes and 5 radiating routes with Xi’an being the center, and the total length of the expressway network is about 5,002 km, including 369 km of 5

SWOT

liaison routes. There is 3,541 km of state expressway and 1,461 km of provincial expressway in the total scale of the network. See the following form for details.

Table 2 – 5: The layout of Expressway Network in Shaanxi Province

South-North Vertical Routes			East-West Horizontal Routes			Radiating Routes			Liaison Routes		
No.	Title	Mileage (km)	No.	Title	Mileage (km)	No.	Title	Mileage (km)	No.	Title	Mileage (km)
1	Yushang Route	736	1	Wuding Route	321	1	Xiyu Route	239	1	Yujia Route	88
2	Yukang Route	938	2	Yifu Route	190	2	Xishang Route	240	2	Yanyan Route	100
3	Longhan Route	356	3	Tongbao Route	375	3	Ximan Route	159	3	Weipu Route	52
			4	Bailue Route	484	4	Xihan Route	385	4	New Airport Route	20
						5	Xichang Route	182	5	Xi'xian North Ring Road	109
Sum		2030	Sum		1370	Sum		1233	Sum		369

Note: The total length of the radiating routes include 28 km of the road section from Shangzhou to Machi.

2) Implementation Programme

The traffic mileage in 2007 has reached 2,018 km and 3 state highway arteries in the province have been connected. 59% of the counties (cities and districts) are connected with expressways. The traffic mileage in 2009 will reach 3,019 km, and 3 provincial highway passages for western development inside the province will be constructed ahead of schedule, and the original planned radial - type main highway network will be completely constructed. In addition, 10 urban areas in the province will be connected with expressways, and 71% of the counties (cities and districts) will be connected with expressways.

By 2010, the traffic mileage of expressway will reach 3,132 km, accounting for 62.7% of the planned mileage, and 72% of the counties (cities and districts) in the province will be linked with expressway and will be connected with expressways in adjacent provinces and regions, thus forming “one day traffic circle” with Xi’an being the centre leading to over 10 major surrounding cities.

By 2015, the traffic mileage of expressway will reach 4,115 km, accounting for 80.5% of the planned mileage. 82% of the counties (cities and districts) in the province will be connected with expressways, and the functions of expressway network will be further perfected. And the traffic mileage in 2012 will reach 3,807 km, and the state expressway inside the province will be basically constructed, and the expressway network will be basically formed. 80% of the counties (cities and districts) in the province will be connected with expressways.

Links with the institutional and policy context

Table 2-6: The list of relevant policies, plans, programmes, strategies and initiatives that are directly or indirectly relevant to the Plan

Note: See link with the Questionnaire – section 3A

Source (e.g. Author/ Department)	Date	Level I, N, P, M*	Title
The State Council	2004	N	Planning for State Expressway Network
Ministry of Communications	2005	N	<i>Notice on Printing and Issuing Guiding Opinions for the Planning of Expressways in Provinces (Autonomous Regions, Municipalities Directly under Central Committee</i>
Shaanxi Provincial People's Government	2006	P	Outline of the 11 th Five-Year Planning for National Economy and Social Development in Shaanxi Province
Shaanxi Provincial Department of Construction	2006	P	Planning for Urban System Development in Shaanxi Province (2006-2020)
Shaanxi Provincial Department of Land and Resources	1999	P	Over Planning for Land Utilization in Shaanxi Province
Shaanxi Provincial Department of Communications	2004	P	Planning for Environmental Protection of Main Highways in Shaanxi Province
Shaanxi Provincial Department of Land and Resources	2005	P	Overall Planning for Mineral Resources in Shaanxi Province
Shaanxi Provincial Department of Land and Resources	2005	P	Planning for Preventing and Controlling Geological Disasters in Shaanxi Province (2005-2015)
Shaanxi Provincial People's Government	2007	P	Special Planning for Environmental Protection during “the 11th Five-Year Planning” in Shaanxi Province

SWOT

Source (e.g. Author/ Department)	Date	Level I, N, P, M*	Title
SEPA	2006	N	<i>The 11th Five-Year National Eco-protection Plan</i>
SEPA	2007	N	<i>Suggestion on Further Strengthening Eco-protection Work</i>

*= Governance level of each source:

I – International

N – National

P – Provincial

M – Municipal, local

Table 2-7: The list of relevant legislation that is directly or indirectly relevant to the proposed Plan

Note: See link with Questionnaire – section 3A

Source (e.g. Author/ Department)	Date	Level I, N, P, M*	Title
UNESCO	1972	I	Convention Concerning the Protection of the World Cultural and Natural Heritage
The State Council	2004	N	Highway Law of the People's Republic of China. (amended for the second time)
The State Council	2003	N	Law of the People's Republic of China on Appraising of Environmental Impact
MEP	2004	N	Notice on Printing and Issuing “The Specific Scope of Plan for Compiling Environmental Impact Report (Probationary) and The Specific Scope of the Plan for Compiling Chapters or Explanation on Environmental Impact (Probationary)
Ministry of Communications	2004	N	Notice on Relevant Issues on Implementing Planning Environmental Impact Assessments in Transport Sector
National environment administration	2006	N	Provisional Methods for Public Participation in Environmental Impact Assessment
The State Council	1994	N	Regulations for Management of Nature Reserves of PRC
The State Council	1989	N	Law for Protection of Wild Animals of PRC
The State Council	1996	N	The National Law on Prevention and Control of Water Pollution of PRC

SWOT

Source (e.g. Author/ Department)	Date	Level I, N, P, M*	Title
The State Council	1998	N	The National Law on Land Administration of PRC
The State Council	1998	N	Regulations on Protection of Basic Farmland
The State Council	1996	N	The National Law of Water and Soil Conservation of PRC
The State Council	1985	N	The Forest Law of PRC
The State Council	1996	N	The Mineral Resources Law of PRC
The State Council	2002	N	Law on the Protection of Cultural Heritage of PRC
The State Council	2006	N	Regulations for Scenic Spots and Places of Interest
Shaanxi provincial people's government	2006	P	The Guidance for Implementing of the "Law on Appraising of Environmental Impact of the PRC" in Shaanxi Province

*= Governance level of each source:

I – International

N – National

P – Provincial

M – Municipal, local

Table 2-8: The Summary of Key findings from the institutional and policy context analysis

Theme	Comment
Traffic mode	In 2010, the expressway should reach to 3,100km in Shaanxi Province <i>(approved by the Fourth Session of the Tenth Shaanxi Provincial People's Congress on Jan.22, 2006)</i>
Ecological environment	<p>It is regulated in the third clause of the PRC Highway Law <i>(approved by the Tenth Session of the Eleventh National People's Congress in 2004.8.28, second revision)</i> that, the development of highway should follow the principle of comprehensive planning, reasonable layout, good quality, unblocked, environment friendly, and equal attention to construction, reconstruction and maintenance.</p> <p>In environmental protection special planning during the “Fifteenth Five Year Plan” <i>(approved by the Fourth Session of the Tenth Shaanxi Provincial People's Congress on Jan.22,2006)</i> of ShaanXi Province, they will start and implement the management ability for the protection of Qinling ecological protection region, the conservation of biodiversity, the protection of water conservation forest, the conservation of water and soil, mine investigation and treatment at areas with serious hidden problem of geological disaster, highway construction and ecology protection, pollution control, tourism ecological environment protection, the construction of ecological demonstration district (garden), and will strengthen the self-recovery ability of Qinling ecological region.</p>
Conduct planning and environment assessment	It is regulated in the eighth clause of the PRC Environment Assessment Law <i>(approved by the 13th Session of the 9th National People's Congress on Oct.28 , 2002)</i> that, relevant departments of State Council, local people's government and its relevant departments of municipal level or above with districts should organize the environment impaction assessment (for special planning related to industry, agriculture, stockbreeding, forestry, energy, water conservancy, traffic, city construction, tourism, and development of natural resources which are organized and made by them) before submitting of special planning protocol and submit the environment impaction assessment report to department which examines and approves this special planning.
Cultural heritage protection	It is regulated in the seventeenth clause of the PRC Cultural Heritage Protection Law <i>(approved by the 13th Session of the 9th National People's Congress on Oct.28, 2002)</i> that, within the protection range of cultural heritage protection unit, other constructions, demolishing, drilling, excavating and other works are not allowed.
Mineral resources protection	It is regulated in the 33 rd clause of the PRC Mineral Resources Protection Law <i>(Revised by the 21st Session of the 9th National People's Congress on Oct.28, 2002)</i> that, before the construction of railways, factories, reservoirs, oil pipelines, power transmission lines, various large buildings or building complex, development organization should consult with administrative departments of geology and mineral industry of the province, autonomous region or municipality directly

Theme	Comment
	under the central government of China for the mineral resources distribution and exploitation of that area. Without the approval of departments authorized by the State Council, important mineral deposit should not be covered.
Farmland protection	<p>It is regulated in the PRC Land Management Law (<i>promulgated by Order No. 8 of the President of the People's Republic of China on Aug. 9,1998</i>) that, our country will implement the basic farmland protection system. The farmland protection region should be strictly managed.</p> <p>It is regulated in the fifteenth clause of basic farmland land protection ordinance that, after officially delimitation, no unit or individual can change or occupy the basic farmland protection region.If national energy, traffic, water conservancy, military facilities, and other important projects can not avoid the basic farmland protection region, farmland conversion and land expropriation must be approved by the State Council.</p>
Natural reserve protection	It is regulated in the eighth, 27 th and 28 th clauses of Regulations of the PRC on Natural Reserves (<i>promulgated by Order No. 167 of the President of the People's Republic of China on Oct. 9,1994</i>) that, natural reserve can be divided into core zone, buffer zone and experimental zone. No one is allowed to go into the core zone. No tourism or production and operation activities is allowed in the buffer zone of natural reserve.
Water resources protection	Clause 20 of Law of the People's Republic of China on Prevention and Control of Water Pollution (<i>Revised by the 19th Session of the 8th National People's Congress on May 15, 1996, Now was update by Order of the President of the People's Republic of China(No.87), Feb.28,2008</i>) point Peoples' government of provincial or above level can delimit the surface water resource protection region for potable water. The surface water resource protection region for potable water can be divided into first level protection region and protection regions with other levels. Construction and expansion of projects which are irrelevant with water supply facilities and the protection of water resources are not allowed in the first level protection region of surface water resources for potable water.
Conservation of scenic beauty spots	It is regulated in the scenic beauty spots ordinance that, development organization and construction unit should make pollution control and water and soil conservation plan, and take effective measures for protecting surrounding scenery, water body, forest and grass vegetation, wild life resources and topography and landform for construction in scenic spots.

Proposed Plan objectives**Table 2-9: List of proposed Plan objectives for Shaanxi Province Transport Plan**

Theme	Detail	The sources of the objective/target (e.g. expert opinion, policy, law etc.)
Highway construction	Vertical and horizontal grid and radiation lines layout is adopted to expressway network of the province, which can be summarized as “three vertical, for horizontal and five radiation lines” (“345 in brief”). It is composed by three north-south vertical lines, four east-west horizontal lines and five radiation lines. The total length of the network is 5,002km, including five connecting lines with the length of 369km. National expressway is 3541km and provincial expressway is 1461km.	It is specified in the 15 th five year plan outline of national economic and social development of ShaanXi Province, till 2010, total length of highway in the province will be more than 1,800km, and the mileage open to traffic will reach to 3,100km.
		State Expressway Network Plan
		In ShaanXi Province urban system: take Xian as the centre, accelerate the construction and reconstruction of “mm” shape main frame and “one vertical, three horizontal and two circles” secondary highway, perfect the supporting facilities of rural highways and improve the layout. National main highways and provincial western main passages will become expressway; provincial the secondary roads (roads of cities and counties) will adopt secondary standard; counties and town roads will adopt the third level standard; rural roads will be adopted with hard surface. Till 2010, the length of highway in the province will reach to 60,000km, in which newly constructed expressway is more than 1800km and the mileage open to traffic is 3,800km; till the end of the planning period, the length of highway in the province will reach to 165,000km, in which expressway is 3,800km, secondary or above highway will reach to 30,000km which accounts for 18.2% of the total length, the highway network density will be 80.3km/hundred sq. km. 80 % of counties (cities and districts)of the province will be connected by expressway, and the rest 20% have access to the expressway network within 2 hours.

Consistency analysis

ShaanXi highway network plan and traffic transport, especially the national expressway network plan and ShaanXi national economy and the 15th five year social development plan outline are well coordinated, which realize the traffic development goal in ShaanXi urban system planning.

There is no environmental target in the Shaanxi provincial road network planning.

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The Highway Network Plan of ShaanXi Province has no specific guidelines for environmental protection, tourism development, water resources protection, land resources protection, and so on.

Due to the traffic management system, traffic planning of various transport modes are managed by many different departments. Comprehensive traffic planning is rare in China. In order to coordinate with other traffic plans, a comprehensive traffic plan is required.

3) Planning timeline and windows of opportunity

The following table represents the stages of implementation of the ShaanXi Province Highway Plan and the Environmental Impact Assessment for the Plan.

Table 3-1: The main stages in planning and assessment of the ShaanXi Province Highway Plan

Date	Planning tasks	Lead organisation	Inputs required	Analysis proposed	Outputs expected
Aug. 2005		Shaanxi Provincial People's Government	Planning for State Expressway Network	Investigation and research	Require further accelerating the construction of expressway
Aug. 2005		Shaanxi Provincial Department of Communications			Scale of highway network
Nov. 2005	Highway network planning scheme	ShaanXi Highway Survey and Design Institute			Highway network planning scheme
Jan 2006	Solicit opinions	Shaanxi Provincial Department of Communications	Highway network planning scheme	Consult relevant departments	Adjustment opinions of highway network planning by all departments
June 2006	Final draft	Shaanxi Provincial Department of Communications	Opinions put forward by all departments; planning protocol	Adjustment of planning scheme	Plan report
Sep 2006	Environmental Impact Assessment	CATS	Demand models Routes Etc.	Indicators based evaluation....	Constraint maps SEA Report
Nov. 2006	Analysis of results from assessments	ShaanXi Environmental Protection Agency	SEA Report	Revision of the report by CATS	Memo explaining how the results were considered?
Feb 2007	Plan Approval	Prov. Gov (with DRC)	Final Draft Plan	Council Debate??	Final Plan

Evaluation of the Environmental Impact Assessment based on the IAIA criteria

Environmental Impact Assessment started late, when the highway Network plan was almost completed.

The work of SEA for Shaanxi Province network planning is relatively late, and the main reason is that according to the China EIA Law, SEA shall be carried out during the process of planning, but the word "during the process" is an unclear description of time, and does not give an exact definition that when the SEA shall be done.

Without enough communication between Environment Impact Assessment personnel and scheme framer, there is no chance for them to put forward adjustment suggestions for the planning.

Highway plan determines the traffic route only, and the environment impact assessment report can find out the important environmental sensitive points of the route. EIA also can put forward specific requirements for further planning and the environment impact assessment of all projects planned within the plan and to be carried out after it's approval.

4) Actors and responsibilities

Key actors

Table 4-1: The key actors of the development of the ShaanXi Province Highway Plan and EIA

Phase	Role	Participants
Highway network planning	Leader	ShaanXi Traffic Department, ShaanXi Highway Survey and Design Institute
	involved	ShaanXi Environmental Protection Agency, ShaanXi Forestry Department, ShaanXi Land Resources Department, ShaanXi Development and Reform Commission, ShaanXi Water and Soil Conservation Department, ShaanXi Culture Department
Environment impact assessment	Leader	Traffic Ministry Science Research Institute
	indirectly involved	ShaanXi Traffic Department, ShaanXi Highway Survey and Design Institute, ShaanXi Environmental Protection Agency, ShaanXi Forestry Department, ShaanXi Land Resources Department, ShaanXi Development and Reform Commission, ShaanXi Water and Soil Conservation Department, ShaanXi Culture Department, Chang'an University, Northwest University

Consultation, collaboration and public participation

Table 4-2: Key actors of development of the ShaanXi Province Highway Plan and EIA

Form	Stakeholders consulted
Small-size meetings (10-20 peoples)	<ul style="list-style-type: none"> • ShaanXi Environmental Protection Agency (information about provincial environmental law, environmental protection planning, ecology function regionalization, water environmental function regionalization) , • ShaanXi Forestry Department (information about nature reserve, forest park, wetland and related law, policy and planning) , • ShaanXi Land Resources Department (information about land use planning, resources planning, geologic hazard planning, geology relic and related law and policy) , • ShaanXi Development and Reform Commission

SWOT

	<p>(information about socioeconomic development planning、 comprehensive transportation planning and related law and policy) ,</p> <ul style="list-style-type: none">• ShaanXi Water and Soil Conservation Department (information about water function regionalization、 water conservancy、 water and Soil loss and related law, policy and planning) ,• ShaanXi Culture Department (information about cultural relic distribution and local law) ,• Changan University (information about technology for SEA) ,• Northwest University (information about Qinling ecological zone)
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Contacts

The section contains the contact points for the planning and assessment (names, telephone no., emails etc)

Stakeholders consulted	Name	Telephone number
ShaanXi Environmental Protection Agency	Nature & Ecology Protection Division EIA Management Division Pollution Controlling Division Planning & Investment Division	029-87292064 029-87291994 029-87292248 029-87291440
ShaanXi Forestry Department	Wildlife Protection Division Forest Inventory Management Division	029-88652038 029-88652036
ShaanXi Land Resources Department	Development & Planning Division Plantation Protection Division Land Use Management Division Geology & Environment Division Mineral Exploitation Management Division	029-84333017 029-84333020 029-84333026 029-84333033 029-84333042
ShanXi Development and Reform Commission	Transport Division Society Development Division Environment & Resources Comprehensive Utilization Division	029-87294564 029-87294226 029-87291050
ShaanXi Water and Soil Conservation Department	Planning & Fund Management Division Water Resources & Technology Division Fishery Management Division Hydro Project Building & Management Division	029-87463117 029-87463136 029-87463166 029-87463120
ShanXi Culture Department	Cultural Relic Protection Division	029-85360089
Chang'an University	Liu Shan	029-82334882
Northwest University	Ma Naixi	029-88363092

5) Baseline Information

Introduction - the use of indicators and targets

The description of the indicator typology

The environment impact assessment indexes system of expressway network planning should be able to scientifically and comprehensively reflect the environmental conditions of the region of the expressway network, has high operability and has corresponding standards for comparison and analysis. According to the characteristics and requirements of environment impact assessment of expressway network planning, its assessing indexes system should satisfy the following principles:

- Comparability

Comparability exhibits in three aspects, which are quantity comparison, longitudinal comparison and horizontal comparison.

- Feasibility

Feasibility means data required by the indexes system can be accurately obtained in time, and be easily used in calculation, analysis and assessment. Due to the uncertainty of traffic volume, roadbed height and shape, vehicle type ratio and other factors, sewage drainage concentration can not be used as assessment index for the planning.

- Comprehensiveness

The environment impact assessment of expressway network planning involves many aspects and has lots of assessment factors, including land resources, tourism development, traffic safety, social economy, atmosphere environment, acoustic environment, aquatic environment, and so on. Therefore, the assessment indexes system must be more comprehensive to reflect all environment conditions of the region of expressway.

- Objectivity

The environment impact assessment of expressway network planning should truly reflect the influence of expressway network to the regional environmental quality, that is of certain objectivity. This requires practical and realistic working attitude, rigorous working style, and operating strictly according to corresponding codes and requirements.

Data gaps and availability

Considering the availability of assessment indexes, the indexes we use are designed according to collected data. Therefore, all aspects can be obtained from the above data.

In China, the following difficulties existed in data collection:

- 1) Data are not shared by all departments;
- 2) Data are not provided without payment, especially the electronic books which are expensive;

3) Due to the short time of environment assessment planning in China, some departments are unwilling to cooperate and provide data.

Baseline for ShaanXi

List of indicators used

Table 5-1: Environmental Goals and Indexes System

Environment type	Environmental goals	Assessment indexes
Ecological environment	Reduce the adverse influence to natural reserve, wetland, forest, animal and plant habitat, and other ecological sensitive regions and other regions with special environment values, and controls the water and soil loss.	<ul style="list-style-type: none"> • Length of road sections in the natural reserve, • Numbers of forest parks and geological relic reserves, • Number of landscape patterns, • Length of highway sections with different corrosion strength and prevention sub-areas.
Aquatic environment	Avoid causing the changing of watercourse changing and water function of lakes; reduce the pollution to potable water sources, and other sensitive water bodies.	Types and quantities of affected water body functions
Acoustic environment	Reduce highway traffic noise pollution, and guarantee the acoustic environment standard of residential area and other noise sensitive areas.	Number of acoustic environment sensitive points within 200m.
Resources environment	Control the land occupation, and reduce the influence to important land type; reduce the consumption of energy by highway traffic.	Land and farmland occupation area of newly constructed highway network;
	Avoid occupy or cover the mineral resources.	Length of road section within the mining area.
	Reduce the conflict between the constructions of highway and water conservancy facilities.	Number of affected water conservancy facilities;
Social environment	Reduce land expropriation and relocation, and guarantee the residents quality of life; Optimize industrial layout, promote tourism development and guarantee the traffic safety; reduce the damage to cultural relics	Number of jobs provided

Future trends under ‘business as usual’

Zero scheme analysis is not considered in this report.

Basic plan implementation scheme analysis mainly exhibits in the following two aspects: general trend is favorable after taken action in environment pollution aspect. For example, after the implementation of planning scheme, traffic volume of existed roads will be reduced. Road level will be improved, the exhaust of air pollutants and greenhouse gas will be reduced, and the probability of accidents while vehicles with dangerous goods passing sensitive water bodies.

However, in highway network planning stage, quantitative analysis is impossible due to lack of data, and only qualitative analysis can be used to analyze its development trend. Quantitative analysis can be realized in the environment impact assessment of single construction project.

Relative to basic plan implementation scheme, the influence to ecological environment by the implementation of the planning is adverse. However, several measures can be suggested and implemented to control that within an acceptance scope.

6) Environmental and sustainability issues

The table below represents the map of the problems and issues covered by the EIA.

Table 6-1: Map of the problems and issues covered by the EIA

Issue / problem	Background data / indicators from baseline review	Possible causes
Land Resources Occupation	Quantity of arable land resources per capita Land areas of different types	Take up a great number of arable land; Reduction of forest area Reduction of grassland;
Ecological reserve	Level, area, protection type and geographical location of reserve	Land (reserve) uptake by the road; Habitat fragmentation
Water and soil loss	Type of water and soil loss (area)	water and soil loss aggravates infertile land
Exploitation of mineral resources	Type, quantity, exploited quantity and storage quantity of mineral region	Need for mineral resources for construction Road passing through mineral region
Cultural heritage and historic sites protection	Level and geographical location of cultural relics and historic sites	Heritage destruction by the road construction
World heritage Protection	Level and geographical location	World heritage destruction
Biodiversity	Ecological system Cherish threatened animals and plants	Threat and damage to animals and plants, which are rare and at the verge of extinction Habitat fragmentation
Water resources	Water function type	Polluted water Damage drinking water source sites Damage rare aquatic animals and plants habitat
Tourism development	Level and geographical location of tourist resources	Damage scenic spots

Table below lists the problems and issues which are not covered by EIA, but which otherwise must be covered due to the relevance and EIA role.

Table 6-2: Mapping of the problems/issues which are not covered by EIA of a Highway Plan

Issue / problem	Background data / indicators from baseline review	Possible causes
Atmosphere pollution	SO ₂ , NO _x and Pb emissions	Air pollution
Greenhouse gas emissions	Cox emissions in kilograms or grams per tone kilometre and per passenger kilometre	Climate warming
Traffic safety	Number of accidents per 1000 inhabitants \$\$ of lost generated by the accidents per 100,000 inhabitants	Traffic accidents
Human health	Mortality of people due to accidents per year per 1000 Mortality of people due to air pollution (other than smoking)	Mortality due to traffic accidents Mortality due to air pollution born diseases
Landscape	SHDI,AWMPFD,LPI,PSCV	Need elaboration

Reasons for the issues not covered by EIA:

1) Atmosphere pollution & Greenhouse Gas Emissions

According to the method to calculate the emissions, we must have the speed and traffic volume of large-size vehicle, medium-size vehicle and small-size vehicles. But there is only traffic volume of some routeway in the Shaanxi road network planning report, no information about each size vehicle and speed, so we can not calculate.

2) Traffic Safety & Human Health

In SEA report for Jiangxi Provincial Expressway planning, we used nether method to r estimate number of accidents and economic loss roughly, but we can only give a number, cannot provide appropriate measure to reduce them, so we didn't estimate them in the Shaanxi's report.

Table 6-3: Method for Rough Estimating Number of accidents and economic loss

Road class	Number of accidents per year		Economic loss (RMB per accident) ^②
	Number of accidents per 100,000,000 vehicle-km	Recommended normal value	
Expressway	$-40 + 0.005AADT$ ^①	20-50	21000~28000
Class I	$37 + 0.003AADT$	55-70	15750~19250
Class II	$133 + 0.007AADT$	150-160	10500~12250
Class III	$140 + 0.03AADT$	> 160	7000~8750

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Notes: ①AADT——Annual Average Daily Traffic (Medium size vehicle) ; ②price in 2002, not including casualty cost

3) Landscape

We tried to analyze fragmentation to landscape by road network at one time. The method based on GIS is put forward in Jiangxi provincial Expressway planning, including 4 steps, namely drawing landscape picture, classing landscape, calculating landscape index and analyzing the impact to the road network.

In Shaanxi SEA we didn't do it for lack of detail digital map.

7) Environmental and sustainability objectives and targets

Proposed Environmental and sustainability objectives

The table below presented the proposed environmental objectives identified during the process of SWOT and linkages with relevant legislation.

Table 7-1: Proposed Environmental and Sustainability Objectives for the Environmental Assessment of the Plan

	Issue problem /	Assessment indexes	Legislation
1	Land Resources Occupation	Floor areas of different types of land	It accords to the stipulations of the Law of Land Administration of PRC, recognizes road sections occupying many arable land resources and put forward measures to control it.
2	Ecological reserve	the levels of natural reserve that may be influenced inside traffic corridor	In planning stage it is to recognize the reserves that may be influenced y road construction in future, to offer reference for planning staff on the feasible research stage of certain road sections, avoid passing through natural reserve in accordance with the stipulations of the Regulations of PRC on Natural Reserves
3	Water and soil loss	The length of road sections inside water and soil loss intensity area	In accordance with the law of PRC on Water and Soil Conservation, it can recognizes road sections with severe water and soil loss and can put forward measure to control it
4	Exploitation of mineral resources	Levels of the mineral region that may be influenced inside traffic corridor	Avoid that roads pass through mineral regions as much as possible or occupying mineral deposits in accordance with the Law of PRC on Mineral Resources
5	Cultural relics and historic sites protection	Levels of the cultural relics and historic sites that may be influenced inside traffic corridor	It can recognizes the cultural relics that many be influenced and put forward protection measures in accordance with the Law of PRC on Cultural Relics Protection
6	World heritage Protection	Levels of the world heritage that may be influenced inside traffic corridor	To avoid damaging world heritage in accordance with the Convention Concerning the Protection of the World Cultural and Natural Heritage
7	water resources	Water function types that may be influenced	It can recognizes the water that many be influenced and put forward protection measures in accordance with the Law of PRC on Prevention and Control of Water Pollution
8	Tourism development	Levels of the tourist resources that may be influenced inside traffic corridor	It can recognize the tourist resources that may be influenced and put forward protection measures in accordance with the Regulation on Scenic and Historic Areas

8) Scope of the SEA

Proposed Review Approach and Purpose

- Objectives of SEA of the Shaanxi Province Highway Plan and its Environmental Impact Assessment are:
 1. To analyze the impacts based on the sustainable development principle, making linkages with other planning, assessing the environmental impacts that may be caused by road network construction and proposing the measures for prevention, control and remedy as well as other suggestions;
 2. Based on the Shaanxi province's natural environment and social situation, according to the scientific development concept from the point of view of the environment feasibility, analyze the shortcomings of highway network planning, improve the layout of Shaanxi province's highway network and put forward the replacement plan and controlling measures.
 3. Recognize the environmentally sensitive spots (regions) of Shaanxi province's natural reserve, forest parks and geological parks to offer reference for the planning and implementation of projects in the future;
 4. Analyze the coordination between the planning on Shaanxi province's highway network and the different national traffic planning on the earlier stage, to make highway network planning in accordance with the national traffic planning, as well as to complete, complement and perform it;
 5. Analyze the coordination between the planning on Shaanxi province's highway network and the planning of Shaanxi province's other industries, to avoid the influence of highway network planning on other industries' planning, as well as to offer convenient traffic environment for the successful performance of the other planning;
 6. Analyze the stipulations on road construction by different relevant laws, rules and regulations to avoid the conflict with the working laws, rules and regulations during complementation of projects in the future;
 7. Explore the method on evaluation of traffic industry's environmental influence to offer reference for the succeeding similar research;
 8. Offer reference for Shaanxi province to work out traffic development planning and have daily environmental administration.
- Scope and limitations of the Review Report

The scope of analysis includes the entire planning scope, namely the entire area of Shaanxi province, and it shall be extended to the neighbouring provinces at the exits of traffic passages.

The limitation mainly means as the Environmental Impact Assessment work was conducted comparatively late in the planning process and adjustment opinions on the Plan have failed to be laid out.

To solve this problem, we suggest that for future planning, we should carry out SEA and planning at the same time.

Proposed Review Methodology: Methods, Tools, Strengths and Weaknesses

- **Checklist Method**

Checklist method is to put the elements that may be influenced by traffic planning and the influence that may happen together in a list and make qualitative or quantitative evaluation on the checked environmental influence.

Checklist method is convenient and easy to be accepted by the professionals and the public. It can guarantee that severe environmental influence won't be neglected if used at the early stage of the evaluation on traffic planning's environmental influence. However, it's a tedious and time-requiring job to establish a systematic and comprehensive checklist; meanwhile as the checklist doesn't integrate the "receptor" with "source" as well as fails to clearly show the influential process, degree and comprehensive effects of traffic planning on environment, economy and society.

- **Analogy Method**

On the insufficiency of data, partial investigation can be adopted, and then take it as basis to analogize the different situations in the province. Its disadvantage is its requirement on a lot of detailed investigation data.

- **Experts Consultation Method**

On the process of information collection, the relevant departments and authorities such as Shaanxi Environmental Protection Bureau, Communication Department, Construction Department, Forestry Department, Water Resources Department, Land Resources Department and Tourism Bureau etc have been consulted to put forward environmental protection measures suitable to the local actuality based on the existing local environmental problems and during the process of report making, senior experts on environmental protection and planning have been consulted for many times to complete the making of the report. Its defects are work load is too much, and the cost is too high; the advantage is that some accidental discovery can be acquired.

- **Map Overlay Method**

Map Overlay Method is to overlay the specific maps concerning natural conditions, social background and economic conditions etc that evaluate regional characteristics to form a map that can reflect comprehensively the space characteristics of environmental influence.

Map Overlay Method is suitable for the comprehensive analysis, environmental influence recognition (to judge influential scope, nature and degree) and accumulated influence evaluation. Map Overlay Method can directly, vividly and briefly show the space distribution of different single influence and compound influence. But it can't reflect the casual relationship between source and receptor directly on map, so it can't comprehensively evaluate the degree of environmental influence or the importance of environmental factor.

The disadvantage is its requirement on enough electronic maps, professional geographical information system software, which will inevitably increase the project cost; its advantage is the quantitative analysis can be made to some extent.

- **Mathematics Model Method**

Environmental mathematics model means to show spatial temporal change process and change rules of environmental system or environmental factors with mathematics form quantization.

Environmental mathematics model has the following features:

- it can quantitatively describe the interactive effects and casual relationship between the multiple environmental factors and environmental influence;
- it has great flexibility.

Its defects mainly include:

- high requirement on basic data;
- application limited to environmental system that has been known well by people;
- high cost and influence analysis limited to single environmental factor.

- **Space Analyzing Technology Symbolized with GIS (Geographic Information System)**

Space analyzing technology symbolized with GIS (Geographic Information System) mainly means 3G technologies, namely GIS (Geographic Information System), GPS (Global Positioning System) and RS (Remote Sensing). Currently the research and application on “3G” technology in the world develop at the direction of integration.

In traffic planning’s environmental influence evaluation, as the traffic planning’s environmental influence evaluation is regional, and what it is to analysis and evaluate is the environmental influence of traffic infrastructure construction in a larger region scope, it must be closely connected with the space distribution of environmental factors and their interactive relationship. Therefore geographic information system technology will be an important technical tool and measure for traffic planning’s environmental influence evaluation and traffic planning, environmental background and status quo can all be visualized in GIS and be checked and inquired; GIS’s space analyzing function and its combination with model technology (environmental forecast model or decision analyzing model) can play important roles in the environment influence forecast of different plans.

- **Analytic Hierarchy Process**

Analytic hierarchy process (AHP) is to analyze the factors contained in complicated problems and their mutual relationship to decompose the problem to different factors and classify the factors to different levels to form a multi-level structure and on every level make paired-comparison on the factors of this level and establish judgment matrix according to certain stipulated rule. It can get the weight of the factors of this level on the rule by calculating the maximum eigenvalue of the judgment matrix and its corresponding orthogonalizational eigenvector.

AHP applies to the determination of the weights of different environmental factors of the evaluation on road network planning’s comprehensive environmental influence.

Consultation on the scope of the SEA

The consultation of the project has two stages.

After being entrusted to conduct SEA of the planning, we have visited Shaanxi Environmental Protection Bureau, Forestry Bureau, Communication Department, Construction Department, Land Resources Department, Water Resources Department, Cultural Heritage Bureau, Tourism Bureau and Water and Soil Conservation Bureau to make the investigation. The main consultation contents with the concerned departments are as follows:

Table 8-1: The Main Contents of consultations with the concerned Departments

No.	Department	Consultations' Content
1	Communication Department	<ul style="list-style-type: none"> - the traffic planning of other levels, - the experiences on environmental protection gained from the past road construction
2	Environmental Protection Bureau	<ul style="list-style-type: none"> - Water environmental function regionalization, - natural reserve regionalization, - wet land situation, - desertification, - ecological exemplary region planning, environmental protection planning
3	Forestry Bureau	<ul style="list-style-type: none"> - Name list of wild fauna and flora, - forest park, - threatened animals and plants habitats distribution, - forest planning, - natural forest protection
4	Construction Department	<ul style="list-style-type: none"> - Scenic and historic areas, - urban system planning
5	Land Resources Department	<ul style="list-style-type: none"> - General planning on land utilization, - basic farmland protection planning, - general planning on mineral resources, - general planning on geological environment - prevention and control on geological disasters such as landslide, landslip, debris flow, land subsidence etc, - planning on geological remains protection, - geological park distribution
6	Water Resources Department	<ul style="list-style-type: none"> - Water and soil conservation planning, - water and soil loss status quo, - information concerning flood
7	Agriculture Department	Agricultural planning

SWOT

No.	Department	Consultations' Content
8	Cultural Heritage Bureau	Distribution of Cultural Heritage
9	Tourism Bureau	- Distribution of Scenic spots, - tourist planning
10	Development and Reform Commission	- Regional economy development planning, - comprehensive traffic system planning, - railway planning

Information about public participation can be found in the Public participation section of the TPRR.

9) Identification of Alternatives

In China, the transportation planning of different transportation models are supervised by different departments. Shaanxi province communication department only takes charge of the road and water transportation planning while the railway transportation planning is charged by The National Ministry of Railway and the aviation planning by General Administration of the Civil Aviation of China, so the comparison selection can not be done among different transportation models.

During the highway network planning, it needs to consult with several departments and experience demonstration many times. The planning process itself is a selection process and compares the proposed traffic corridor strips. There is only one road network in the draft of planning scheme, which was reviewed by the project team. It has no alternative schemes to be compared with. Because the works of environmental impact assessment was carried out later than the planning works, and EIA has not been started until the planning draft had been issued, the project team found out that the *Environmental Impact Assessment of Highway Network Planning of Shaanxi Province* does not include the comparing selection section of planning.

10) Assessment

Assessment methods

The assessment methods included analytic hierarchy process (AHP), expert consultations and mathematical model method.

(1) Expert Consultations

There are 8 kinds of assessment factors in the environmental impact assessment of highway network planning of Shaanxi province. To assess the impact of the highway construction on each assessment factor, we invited experts from different industries to score for it, and following table was used.

Table 10-1: Scoring table suggested used by the experts to identify effects of the highway network construction for 8 environmental assessment factors.

Expert name	Land resource	Protective land	Aquatic environment	Acoustic environment	Mineral resources	water and soil loss	Tourist resource	Water conservancy facility
Expert 1	10	10	5	2	5	5	2	2
Expert 2								
.....								

(2) Analytic Hierarchy Process

The analytic hierarchy process is an effective tool to determine the weight of each environmental factor during comprehensive assessment process.

(3) Mathematical Model Method

The mathematical model is the main approach of quantitative analysis which is mainly used to determine the sensitive index of all section's environment.

The following formula is used to assess the impact of highway construction on the land resources, mainly on the cultivated land.

$$R_t = \frac{\sum_{i=1}^n l_i \alpha_i}{\sum_{i=1}^n l_i}$$

Where: R_t - the sensitive index of land resource of highway section;

l_i - Highway section strength in the cultivated land of i -th county, in km;

n - The number of the counties the highway section passing through;

α_i - The sensitive index of cultivated land resource of the i -th county, referring to the indications of table 0-1;

After determining the sensitivity of all highway sections with the formula, the sensitivity of cultivated land resource of all highway sections was determined and the assessment is presented the Table 10-2.

Table 10-2 Sensitive Index of Cultivated Land Resource

Sensitivity	Normal region	Light sensitivity	Medium sensitivity	High sensitivity	Extreme sensitivity
Cultivated land per capita (mou*/person)	>1.2	1.0~1.2	0.8~1.0	0.6~0.8	≤0.6
Sensitive index	1	2	3	4	5

Note: *Mou is a unit of measurement used in China, 15 Mou equals 1 hektare

Table 10-3 Sensitivity Assessment of Cultivated Land Resource of Highway Section

Sensitive index	≤1	≤2	≤3	≤4	≤5
Sensitivity	Minute sensitivity	Light sensitivity	Medium sensitivity	High sensitivity	Extreme sensitivity

Assessment Content

(1) Section single factor assessment

In the environmental impact assessment of highway network planning, eight environmental factors of the cultivated land, protective land, water and soil loss, water environment, acoustic environment, tourist environment, mineral resources and water conservation facilities are selected as the assessment objects with separately calculated sensitivity of cultivated land, sensitivity of protective land, sensitivity of water and soil loss, sensitivity of water environment, sensitivity of acoustic environment, sensitivity of tourist environment, sensitivity of mineral resources and sensitivity of water conservation.

In the environmental impact assessment of Shaanxi province Highway Network Plan, we separately assess the impact of single environmental factor from above eight assessment factors, i.e. single factor assessment.

Carry out the classification and assessment of the impacts on all environmental factors according to the indexes such as the number, scale and degree of environmental constraint factor in each section, and classify them into five degrees: extreme sensitivity impact, high sensitivity impact, medium sensitivity impact, light sensitivity impact and slight sensitivity impact. The impaction degree is known as environmental sensitivity.

The sensitivity is a relative index used to compare the number, scale and degree of environmental constraint factor in each section, and it does not indicate the actual conditions of environmental impact during the construction process of the section.

The road sections are correspondingly labelled as:

SWOT

- extreme sensitivity road section,
- high sensitivity road section,
- medium sensitivity road section,
- light sensitivity road section and
- slight sensitivity road section.

It mainly uses mathematical model method in single factor assessment.

(2) Road section environmental impact synthetic index

To judge the synthetic impacts of different environmental factors on the road section, we use REISI (Road Section Environmental Impact Synthetic Index) to judge the synthetic impacts on the road section. The environmental impact synthetic index is calculated with following formula:

$$REISI = \sum_{i=1}^n p_i \zeta_i$$

Where,

REISI - Road section environmental impact synthetic index;

p_i - Sensitive index of environmental factor i , which is determined by the sensitivity of road section, refer to the indication of table 10-4;

ζ_i - Weight of environment factor i , which is determined with the expert consulting method and analytic hierarchy process.

After calculating the environmental impact synthetic index REISI of each road section with the formula, the road sections were classified into extreme sensitivity road section, high sensitivity road section, medium sensitivity road section, light sensitivity road section and slight sensitivity road section according to the impact degrees. The classification references are shown in the table 10-5.

Besides the determination of the environmental sensitivity of each road section, the extreme sensitivity road sections and high sensitivity road sections shall be emphasized and analyzed when recommending the measures and alternatives to be taken.

Table 10-4 Sensitive Index of Environment Element

Road section sensitivity	Minute sensitivity	Light sensitivity	Medium sensitivity	High sensitivity	Extreme sensitivity
Sensitive index of environmental element	1	2	3	4	5

Table 10-5 Classification References of Road Section Environmental Sensitivity of Road Network Planning

Environmental impact synthetic index REISI	[1.0, 1.8]	(1.8, 2.6]	(2.6, 3.4]	(3.4, 4.2]	(4.2, 5.0]
Road section sensitivity	Minute sensitivity	Light sensitivity	Medium sensitivity	High sensitivity	Extreme sensitivity

The environmental impact synthetic assessment of road section mainly uses the experts consulting method and analytic hierarchy process combined with mathematical model method for assessment.

(3) Road network synthetic environmental impact assessment

The synthetic impact of road network planning is characterized by the environmental impact synthetic index of road network, and the calculation method is as follow:

$$E = \sum_{i=1}^n REISI_i \delta_i$$

Where: E - Environmental impact synthetic index of road network;

$REISI_i$ - Road section i environmental impact synthetic index;

δ_i - Ratio of length of road section i to the road section to be constructed in whole road network.

The classification standard of the environmental impact synthetic index of road network E is shown in table 10-6.

Table 10-6 Environmental Impact Synthetic Index of Road Network Planning

No.	Environmental impact synthetic index E	Road network environmental sensitivity	Impact degree of road network on the environment	Road network planning environmental compatibility
1	[1.0, 1.8]	minute sensitivity	The impact is normal which indicates it has little environmental impact on most road section of road network.	The road network planning environmental compatibility is well and only very few road sections need to be adjusted.
2	(1.8, 2.6]	Light sensitivity	The impact degree is light which indicates it has relative small environmental impact on most road section of road network.	The road network planning environmental compatibility is relative well and a few road sections need to be adjusted.

SWOT

3	(2.6, 3.4]	Medium sensitivity	The impact degree is medium which indicates it has relative certain impact for environmental on most road section of road network.	The road network planning environmental compatibility is relative medium and parts road sections need to be adjusted.
4	(3.4, 4.2]	High sensitivity	The impact degree is high which indicates it has relative large environmental impact on most road section of road network.	The road network planning environmental compatibility is relative bad and most road sections need to be adjusted.
5	(4.2, 5.0]	Extreme sensitivity	The impact degree is acute which indicates it has very large environmental impact on most road section of road network.	The road network planning environmental compatibility is relative extreme bad and most road sections need to be adjusted.

11) Environmental Report

“Planning Environmental Impact Report for Expressway Network in Shaanxi Province” includes 9 major parts.

Chapter 1 Introduction

Background and significances of planning, background and significances of planning for expressway network in Shaanxi Province, background, purpose, scope and periods of planning environmental impact assessments of highway network, basis of compilation(including relevant laws, rules, technical regulations, standards and technical project documents), identification of environmental impact, objectives, assessing indexes, methods and working procedures of environmental protection

Chapter 2 Survey of Planning for Expressway Network and Analysis of Coordination

It includes two parts which are the survey of planning and analysis of coordination in planning for expressway network. Purpose, scope, objects and periods of planning, and planning program for expressway network are mainly introduced in the survey of the planning. Analysis of coordination mainly focuses on analysis of compatibility between planning of expressway network and other traffic planning, and planning of urban system, overall planning for land utilization, overall planning for mineral resources, special planning for traffic and transport during “the 11th Five-Year Plan” in Shaanxi Province, and planning for development of traffic and environmental protection

Chapter 3 Survey of Current Environmental Situation in Shaanxi Province

Chapter 3 include 6 parts, which are natural environment, social environment, ecological environment, current environmental quality, sections of natural conditions in Shaanxi Province, current situation of highway construction and environmental protection in Shaanxi Province. Part A “Natural Environment” mainly focuses on geographic configuration, topography, geological conditions, climate, water system and soil; Part B “Social Environment” mainly focuses on current situation of social and economic development, survey of comprehensive transport, conditions of land resources, conditions of mineral resources, conditions of tourist resources; Part C “Ecological Environment” mainly focuses on biological diversity, soil erosion, land desertification, soil salinization, major natural disasters, division of ecological functions, comprehensive assessments of current ecological environment etc.; Part D “Current Environmental Quality” mainly analyzes current situation of atmosphere environment, water environment, sound environment, solid wastes and dangerous wastes; Part E divides Shaanxi Province into sand beach region in north Shaanxi, loess hilly and gully region in north Shaanxi, loess plateau on north reaches of the Weihe River, plain region in central Shaanxi and hilly areas in Qinling and Mt. Basha area, and mainly according to factors such as topography, land configuration, rivers and climate etc., and mainly analyzes environmental problems in various regions and major environmental issues that relevant parties shall pay attention to during highway construction; Part F summarizes the achievements in highway construction and environmental protection in Shaanxi Province, analyzes the current situation of environmental protection of highway network in Shaanxi Province, and puts forth environmental problems during highway construction in Shaanxi Province through retrospective analysis of expressway construction in Shaanxi Province.

Chapter 4 Environmental Impact Analysis and Assessment

SWOT

We conduct predictive assessment of environmental impact that may occur during construction of highway network in Chapter 4, mainly including land resources, conservation areas, water and soil erosion, water environment, mineral resources, water conservancy facilities, sound environment, environmental air, tourist resources and social environment et., and trial assessment of accumulated impact. We conduct comprehensive environmental impact of various road sections, and conduct graded assessment of road sections according to extent of impact by means of expert consultancy and hierarchical analysis methods.

Chapter 5 Alleviating Measures and Suggestions

The part mainly include measures and suggestions for alleviating impact on land resources, measures for alleviating impact on ecological environment, measures and suggestions for alleviating impact on water environment, measures for alleviating impact of development of mineral resources, measures for alleviating impact on water conservancy facilities, measures for alleviating impact on sound environment, measures and suggestions for alleviating impact on tourist resources, and suggestions on planning and layout of highway network.

Chapter 6 Environmental Management, Monitoring and Follow-UP Assessment

It mainly introduces environmental management structure, supervision structure, monitoring agencies and environmental supervision agency during implementation of highway network planning; The second part is environment monitoring program of the planning, including mentoring factors and monitoring program; The third part is the contents of follow-up assessment, and the fourth part is requirements for environmental impact assessment of the project.

Chapter 7 Public Participation

The first part introduces time of public participation in investigation, scope, object and means of investigation, and the second part is statistic analysis of results of public participation.

Chapter 8 Difficulties and Analysis of Uncertainty

It analyzes difficulties in planning environmental impact assessments of highway network from the perspective of means of planning environmental impact assessments of highway network, data collection and public participation etc., and then analyzes uncertainty during planning environmental impact assessments of highway network.

Chapter 9 Summary of Implementation

The ninth part is the summary of the parts listed above.

12) Integration into decision-making process

The planning program has been completed before the finish of environmental impact assessment of the project, which itself started late. Therefore the environmental impact assessment of the planning program has been little used for decision making in planning of highway network.

However, the plan's environmental impact assessment report puts forth requirements for the planning of the next level, and specific requirements for environmental impact assessment of various road sections in the plan.

The planner can optimize the route of each road section when he research feasibility study report according to the sensitive environmental points recognised in the SEA report.

13) Preliminary Recommendations

The section summarises the key results from the SWOT and highlights the strengths and weaknesses of the EIA, bearing in mind the good practice principles illustrated during the project June (2007) kick-off meeting and seminars.

Provide recommendations how to improve the SEA for any future use.

Table 13-1 Summary of the key results

Stage	Key issues	Strengths	Weaknesses	Recommendations
Planning timeline	<ul style="list-style-type: none"> - timing of the EIA - information exchange - institutional cooperation 	<ul style="list-style-type: none"> - EIA process completed 	<ul style="list-style-type: none"> - too late result from EIA 	<ul style="list-style-type: none"> - communication improved between planning authority and the SEAP (EAP) - EIA is required for the approval of the plan EIA recommendations are made obligatory for approval of the plans and programmes, etc.
Actors and Responsibilities	<ul style="list-style-type: none"> - consultations with authorities - consultations with the public 	<ul style="list-style-type: none"> - consultations with authorities -with university teaches -on website 	<ul style="list-style-type: none"> - no minutes of the meetings with the authorities 	<ul style="list-style-type: none"> - to make public consultations compulsory for SEA;
Baseline Information	Information about the Shaanxi Foundation of prediction & impact	Some of data collected	Lack of data especially maps	Government should establish an institution to encourage sharing all kinds of information
Method	<ul style="list-style-type: none"> -prediction -impact 	Some methods were put forward by project team	<ul style="list-style-type: none"> -route uncertainty -some issues not covered 	
Alternative	<ul style="list-style-type: none"> -models -construction -layout 	0 scheme	No others	-carry out SEA for comprehensive transport planning

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