E2712 V3

China: Jilin-Tumen-Hunchun Railway Project

Environmental Impact Assessment

China Academy of Railway Sciences

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吉林至珲春新建铁路地理位置图
Location map of new express railway from Jilin to Hunchun
俄 罗 斯
内 蒙 古 自 治 区
黑 龙 江 省
吉 林 省
辽 宁 省
河 北 省
朝 鲜
渤 海
齐齐哈尔
大庆
哈尔滨
长春
吉林
珲春
沈阳
大连
北京
天津
济南
哈齐客运专线
哈牡客运专线
哈大客运专线
吉珲线
长吉城际铁路
秦沈客运专线
京沈客运专线
沈丹客运专线
东白线
东边道
丹大客运专线
津秦客运专线
京津城际铁路
烟大轮渡
图 例 legend
设计铁路 Designed railway
在建铁路 Under-construction railway
规划铁路 Planned railway
既有铁路 Current railway
高速公路 Highway
中铁工程设计咨询集团有限公司
China Railway Engineer Consultants Group

1. General

1.1 Preparation description

The project, starting from Jilin city in the west, is located within Jilin province, extending to Hunchun city of Yanbian Korean Autonomous Prefecture in the east. It goes through districts Changyi, Fengman, Longtan, and Jiaohe city of Jinlin city, and cities Dunhua, Longjing, Yanji, Tumen, and Hunchun as well as Antu county of Yanbian Prefecture (**See Figure Above**). In the Jilin-Hunchun Railway Project, double-tracked main line, with a total length of 365.352km, is to be built from Jilin to Hunchun, and 3.31km-length (double-tracked) Changchun-Tumen and Longtanshan-Shulan connection lines are to be built.

The project, connecting with Tumen port and Hunchun port, is mainly intended for passengers from city to city and tourists in cities along line of the railway. The railway will serve as engine for cooperation and development in Tumen River area, as well as construction of Changchun-Jilin-Tumenjiang Regional Development and Opening-up Pioneer Zone; represent an important part of high-speed railway network in the northeast China as the branch of Harbin-Dalian Railway Line along with Changchun-Jilin Intercity Railway, will be an important infrastructure for Changchun-Jilin-Tumenjiang railway line; and will play an role of guarantee in promoting national unity and strengthening national defense.

The project is designed by China Railway Engineering Consults Group Co., Ltd., which prepared report for Pre-feasibility Study on New Jilin-Hunchun Passenger Dedicated Railway Line (for review) in December 2008, report for Feasibility Study on New Jilin-Hunchun Passenger Dedicated Railway Line in June, 2009, and conducted feasibility review in October, 2009.

The Ministry of Railways has entrusted China Academy of Railway Science and China Railway Engineering Consults Group Co., Ltd. with environment impact assessment of the project. After accepting such entrustment, environment impact assessment (EIA) staff made site investigations on and monitored the current conditions of the society, economy, the public and environment-sensitive points along the railway line, heard opinions from all related local authorities along the railway line, and made forecast and analysis on environment impact of specific issues, now, this report is made.

We acknowledge many authorities such as the Environmental Protection Department of Jilin province, the Environmental Protection Bureau of Jilin city, the Environmental Protection Bureau of Yanbian Prefecture, and Environmental Protection Bureaus of cities and counties along the railway line given powerful support and related authorities such as the department in charge of

planning, land and resource, forestry and water resources providing great assistance along the railway line in preparing this report.

1.2 Preparation basis

The project environmental assessment complies with China laws and regulations, as well as the World Bank safeguard policies. For laws, regulations, rules, specifications, plan, planning documents, and related technical documents on the environmental protection involved in preparation of the report, see Annex 1.

Of the World Bank safeguard polices, the following are triggered.

- OP/BP4.01 Environmental Assessment
- OP/BP4.36 Natural Habitats
- OP/BP4.11 Physical Cultural Resources
- OP/BP 4.10 Indigenous Peoples
- OP/BP4.12 Involuntary Resettlement

1.3 Purpose of assessment

Understand the current conditions of environment in the region by site investigations and monitoring on environment of environment-sensitive targets distributed along the New Jilin-Hunchun Railway. Forecast impacts on environment during the construction and operation following the guiding thought of sustainable development, and implementing the principle of “prevention crucial, protection first”, "Laying equal stress on development and protection", and EIA-based design, construction as well as environment administration. Make necessary demonstrations on correction measures as specified in engineering design documents in accordance with the forecast results. In the principle of “Reducing pollutants by replacing old technologies with new ones”, propose related measures and suggestions to reduce and control discharge of pollutants, and achieve regional overall control goal, thus offering scientific basis for environment administration and environment planning by local environmental protection departments.

To avoid hidden threats on future work due to environment impacts of the project, make decisions according to democracy and science by implementing the thought of putting people into first place and carrying out the project demonstration in which the public along the railway participate. Lead the public to participate in management and supervision of environmental protection during the

construction and operation of the project, and such public participation also popularizes the related laws and policies on environmental protection of the state to some extent.

Feasibility of the project is demonstrated in the view of environmental protection, and with aid of economic analysis, offering basis for environmental protection projects and environment administration of the project.

1.4 Principle of assessment

In accordance with the related laws, regulations and documents on environmental protection of the state, guided by EIA guidelines and standards for railway EIA technology, we propose technologically-feasible and economically-reasonable correction measures and suggestions according to results of assessment on different sections selected based on different assessment elements. In the principle of focusing on environment-sensitive points such as involved ecological disruption, environment noises and vibrations, we make assessments with aid of necessary supplementary site investigations, monitoring and analogy monitoring, while considering the engineering design, and making good use of existing data in the light of the new railway features.

1.5 Scope of assessment

1.5.1 Engineering scope involved in the assessment

The engineering study covers:

(1) Jilin Railway Station (excluded) [CK0+000=Changchun-Tumen K126+590.376 (Jilin Railway Station center)] to North Hunchun Railway Station (included) (design terminal of Jilin-Hunchun Railway CK362+200) is 365.734km in length; and CK0+380-CK362+200 is the main line subject to the study, with new main line of 365.352km. Therefore, scope of the assessment starts at CK0+380.

(2) Supporting works of Jilin Railway Station

New Changchun-Tumen and Longtanshan-Shulan connection lines (Jilin Railway Station to South of Longtanshan Railway Station) with length of 3.31km (double-tracked).

1.5.2 Scope of assessment of environment elements

(1) Ecological environment

Areas within 300m from the center line of outer rails on sides of the railway; if the railway goes

through environment-sensitive area, the scope may be widened; areas within 100m from sides of construction assess; station, construction camp, soil excavating and depositing site, and areas within 100m from boundaries of lands for large temporary works.

(2) Sound environment

The scope of assessment falls within 200m from the center line of outer rails on sides of railway.

(3) Vibration

Vibrations from trains affect graveyard in Maoer Mountain and Old Longtan Town, i.e. area within 60m from the center line of outer rails on sides of the railway.

(4) Water environment

Water pollution sources, key passing water and main receiving water within the engineering design scope are to be assessed.

(5) Atmosphere environment

All stations falling within the engineering design scope are provided with new boilers and chimneys.

(6) Electromagnetic environment

Article **5.1.1** of the Standard for Environmental Influence Assessment of Railway Construction Projects **TB10502-93** states that impacts on watching TV within **50m** from the center line of outer rails shall be assessed, and in this assessment, 50m is increased to **80m**. For power frequency electromagnetic field of traction substation, impacts within 50m from the enclosing wall shall be assessed.

1.6 Key assessments

The key assessments are ecological environment impact assessment, sound environment impact assessment, environment vibration impact assessment, and water environment impact assessment.

1.7 Assessment grading

The project is a large and new one. In accordance with relevant provisions of technical guidelines HJ/T2.2～2.5 and HJ/T19-1997 as well as TB10502-93 Standard for Environmental Influence Assessment of Railway Construction Projects, all specific assessments are graded as follows:

1. Ecological environment assessment

The project affects area greater than 50km^2, but it results in construction-related biomass reduction by less than 50%, therefore, construction of the project neither affects specifies diversity, nor results in land desertification or deteriorates physical and chemical properties of land. The proposed project passes through far lake area in the Songhuajiang Three Lake Reserve of Jilin province, Mingyue Provincial Matsutake Nature Reserve of Antu county, and National Salmon Germplasm Resources Reserve of Mijiang River, which are intended to protect forest ecology, and preserve aquatic resources such as water resources, matsutake resources and salmon, and in accordance with the Technical Guidelines for Environment Impact Assessment---Ecological Environment Impact of Nature Resources Development (HJ/T 19-1997), the ecological environment assessment is determined to be grade 1.

2. Noise environment assessment

As a new and large project, it passes through those areas to which standard for class II area as specified in the standard GB3096-2008 applies basically. Before and after construction of the project, noise level is raised by more than 5dB, consequently notably increasing noise-affected population. Referring to HJ2.4—2009 Technical Guidelines for Environment Impact Assessment—Sound Environment, and TB10502-93 Standard for Environmental Influence Assessment of Railway Construction Projects, the noise environment assessment is assessed at grade 1.

3. Water environment assessment

9 railway stations are involved in the project, and construction of the project results in additional 1.05~124.6m^3/d of waste water, which is discharged at single port in these stations. Most of pollutants are non-persistent, and concentration of water subject to prediction is less than 7, therefore, the waste water is “simple” in terms of its complexity. In accordance with Article 5 of HJ/T2.3-93 Technical Guidelines for Environment Impact Assessment, the water environment impact is assessed at grade 3.

4. Atmosphere environment assessment

The railway runs in cold areas, and according to the design, heating is realized using coal-fired boiler with the maximum capacity of 1.4MW, while electric heating plays an auxiliary role. Atmospheric pollutants from the project are mainly smoke & dust and SO_2 contained in the flue gas, and calculations based on related provisions in the Technical Guidelines for Environment Impact Assessment---Atmosphere Environment (HJ2.2-2008) have shown that Pi in the SO_2 and smoke & dust are 4.6% and 3.2% respectively. The atmosphere environment impact is assessed at grade 3.

1.8 Assessment standard and assessment life

1.8.1 Assessment standard

With regard to the proposed standard for the environment impact assessment, on July 20, 2010, the assessing organization submitted the "Letter Concerning Approval of Executed Standard for Assessing Environment Impacts of New Jilin-Hunchun Passenger Dedicated Railway", i.e., Tie Ke Huan Letter No. [2010]10, to the Environmental Protection Department of Jilin province. According to the "Reply on Applicable Standards for Assessing Environment Impacts of New Jilin-Hunchun Passenger Dedicated Railway" (August 1, 2010), the following are determined to be applicable for this EIA:

Table 1-8-1 Assessment standard

Type of standard	Environment element	Standard No.	Standard name	Type of function zone and standard values	Applicable scope
Standard for quality	Sound environment	GB3096-2008	Environmental Quality Standard for Noise	Class II zone with 60dBA in daytime and 50dBA in night	Over 60m from the center line of outer rails
				Class 4b zone with 70dBA in daytime and 60dBA in night	Over 30-60m from the center line of outer rails
		Huan Fa No. [2003]94 Notice on Relevant Issues for Environment Impact Assessment on such Construction Projects as Highway and Railway (Light Rail included)		60dBA in daytime and 50dBA in night	Noise control is not required outside those other than such special and noise-sensitive buildings as schools and hospitals, and in schools without boarding students and hospitals without inpatient department
	Vibration environment	GB10070-88	Standard of Vibration in Urban Area Environment	80dBA in daytime and 80dBA in night	Sides of main railway line
	Water environment	GB3838-2002	Environmental Quality Standard for Surface Water	Standard for water zones classified as II—V.	Channels and rivers near sides of railway line

Type of standard	Environment element	Standard No.	Standard name	Type of function zone and standard values	Applicable scope
Standard for discharging	Sound environment	GB12525-90	Amendment to Limits and Measurement Methods of Railway Noise on the Boundary Alongside Railway Line	70dBA in daytime and 70dBA in night	30m from the center line of outer rails
		GB12523-2008	Noise Limits for Construction Site	Determined in accordance with the nature of adjacent sensitive points on construction site and type of construction	Construction site and construction access
	Water environment	GB8978-1996	Integrated Wastewater Discharge Standard	Standard for class III	Wastewater from Railways Stations of West Jiaohe, Dunhua, West Antu, North Hunchun, West Yanji and Tumen discharged into municipal pipes
					Railway Stations of North Weihuling, South Dashitou and North Liangshui produce little wastewater, which is recycled.
				Class II water	The railway crosses over Songhuajiang River
				Class III water	The railway crosses over Jiao River
				Class V water	The railway crosses over Mudanjiang River
				Class III water	The railway crosses over Chaoyang River
				Class II-III water	The railway crosses over Buerhatong River
				Class IV water	The railway crosses over Gaya River

Type of standard	Environment element	Standard No.	Standard name	Type of function zone and standard values	Applicable scope
					For wastewater at construction sites during construction period, the standard for discharging is to be determined in accordance with functions of receiving water.
Standard for discharging	Electromagnetic environment	HJ/T24-1998	Technical Regulations on Environmental Impact Assessment of Electromagnetic Radiation Produced by 500 KV Ultrahigh Voltage Transmission and Transfer Power Engineering	Power frequency electric field of 4kV/m Power frequency magnetic induction intensity of 0.1mT	Health affected
		/	Damage-based constant method recommended by International Radio Consultative Committee (CCIR)	Signal to noise ratio not less than 35dB	Limits of effects on receiving of TV set along the railway line

(1) Standard for water environment

Discharge port of the pollution source complies with GB8978-1996 Integrated Wastewater Discharge Standard; and receiving water for wastewater discharged out of the pollution source complies with GB3838-2002 Environmental Quality Standard for Surface Water. For the concrete use of the standards, see the tables 1-8-2～1-8-3.

Table 1-8-2 Limits of wastewater discharge

Item / Standard	pH	SS	COD	BOD_5	Petroleum	Animal oil and vegetable oil	Ammonia nitrogen	Applicable scope
GB8978-1996---Standard for class-I discharging	6~9	70	100	20	5	10	15	Hunchun Railway Station
GB8978-1996---Standard for class-III discharging	6~9	400	500	300	20	100	/	Railways Stations of West Jiaohe, Dunhua, West Antu, North Hunchun, West Yanji and Tumen
GB5084-2005 Standard for dry farming	5.5～8.5	200	300	150	10	/	/	Railway Stations of North Weihuling, South Dashitou and North Liangshui

Note: pH is dimensionless, and the concentration is in mg/L.

Standard value for quality of surface water environment

Table 1-8-3 Standard value for quality of surface water environment

Item / Executive standard	pH	COD_{Cr}	BOD_5	Ammonia nitrogen	Applicable scope
GB3838-2002 Environmental quality standard for surface water environment—Class II	6~9	15	3	0.5	Songhuajiang River, and Buerhatong River
GB3838-2002 Environmental quality standard for surface water environment—Class III	6~9	20	4	1.0	Jiaohe River, Chaoyang River and Buerhatong River
GB3838-2002 Environmental quality standard for surface water environment—Class IV	6~9	30	6	1.5	Gaya River

GB3838-2002 Environmental quality standard for surface water environment—Class V	6~9	40	10	2.0	Songhuajiang River

Note: pH is dimensionless, and the concentration is in mg/L.

(2) Standard for atmosphere environment

According to ambient air classification, the construction project is located within class-II area. According to ambient air classification, the construction project is located within class-II area. The quality of ambient air complies with the Ambient air quality standard (GB3095-1996)—standard for class-2 air.

Boiler flue gas complies with GB13271-2001 Emission standard of air pollutants for boilers—Standard for period II of class-II area.

Table 1-8-4 Ambient Air Quality Standard mg/m^3

Standard value / Item	Daily average
TSP	0.30
SO_2	0.15

Table 1-8-5 Standard value as specified in the Emission Standard of Air Pollutants for Boilers—Standard for period II of class-II area mg/m3

Item	Smoke dust	SO_2	NO_X
<0.7MW for coal-fired boiler	120	900	/
≥0.7MW for coal-fired boiler	200	900	/

(3) Electromagnetic monitoring and basis & standard for assessment

HJ/T24-1998 Technical Regulations on Environmental Impact Assessment of Electromagnetic Radiation Produced by 500 KV Ultrahigh Voltage Transmission and Transfer Power Engineering

For effects of electrified railway on receiving of TV set, research achievements got in the past are used. When the signal to noise ratio is 35dB, it indicates to watch TV normally, and for quality of TV pictures, adopt damage-based five-level grading system recommended by CCIR.

1.8.2 Assessment life

The assessment life, determined according to the design service life, comes to an end by 2020 in the near future, and 2030 for a long term.

1.9 Target of environmental protection

1.9.1 Ecology protection

After detailed investigations on natures of nature reserves, forest parks, drinking water source protection areas and cultural relics protection units located within the propose railway construction area, and on the basis of their relations with the propose railway, determine that the ecology-sensitive targets involved in the project are mainly the nature reserve, forest parks, cultural relics protection units through which the railway runs, as well as lands, forest lands, arable lands, animals, plants and capital farmlands distributed along the railway line. For targets of ecological environment protection along the railway line, see the table 1-9-1.

Table 1-9-1 Targets of environmental protection along Jilin-Hunchun Railway

No.	Administrative district	Name	Relationship with line locations
1	Jilin City	Songhuajiang River Three Lake Reserve of Jinlin province	Passing through the far lake area over 40.5km
2	Yanbian Prefecture	Mingyue Provincial Matsutake Nature Reserve of Antu county	Parallel to the national highway, and running through the national highway over 41.3km
3		~~Riguangshan Provincial Forest Park~~	~~Running through the park in tunnel~~
5		National Salmon Germplasm Resources Reserve of Mijiang River	Crossing through the core zone and experiment zone.
6	Along the railway line	Lands, forest lands, arable lands, animals, plants, capital farmlands, soil excavating and depositing site	Occupied for the project, and affected by the project

1.9.2 Target of water environmental protection

Water bodies over which the project passes are mainly Songhuajiang River, Mudangjiang River,

Jiaohe River, Chaoyang River, Buerhatong River and Gaya River. Songhuajiang River over which the railway crosses is the drinking water source protection area. For targets of water environment protection of the project, see the table 1-9-2.

Table 1-9-2 Targets of water environmental protection along Jilin-Hunchun Railway

No.	Administrative district	Name	Quality standard	Affecting factors	Protected
1	Jilin city	Class-II protection area of surface drinking water source of Jilin city (Songhuajiang River)	III	Bridges crossing over the river	Water quality
2		Domestic drinking water source quasi-protection area of Jiaohe city	III	Bridges crossing over the river	Water quality
3		Jiaohe River	III	Bridges crossing over the river	Water quality
4	Yanbian Prefecture	Chaoyang River	III	Bridges crossing over the river	Water quality
5		Buerhatong River	II～III	Bridges crossing over the river	Water quality
6		Gaya River	III	Bridges crossing over the river	Water quality
7	The whole railway line	Underground water within tunnel and surface water at entrance and exit of tunnel	/	Construction water inflow and drainage	Water quality and quantity

1.9.3 Target of sound environment protection and vibration environment protection

Along the railway line, there are 107 targets of sound environment protection, 77 targets of

vibration environment protection and 84 targets of electromagnetic environment protection. For these targets, see the Annex 2.

2 General descriptions about the project and analysis

2.1 General descriptions

2.1.1 Railway line engineering

(1) Direction of the railway line

The railway line runs as follows: starting from intercity train of the Jilin Railway Station→changing the direction to the east at a radius of 400m, reaching the existing Changchun-Tumengjiang Railway over the Sonhuajiang River and the existing Longtanshan –Fengman Railway→passing through the construction control zone between Old Longtanshan Town and Maoershan Graveyard→crossing over the ring highway→running in the north of Songhuajiang Three Lake Reserve in Zhongsha, and reaching Qingling town in the east→crossing through Laoyeling in tunnel, and reaching the West Jiaohe Station, which is to be built in the southwest Jiaohe city→passing through Fuqiang town, Huangnihe town, and Weihuling town, and reaching the new Dunhua station northern to the existing Dunhua Railway Station→South Dashitou Station to be located in the south of Dashitou town of Daqiao township→running in the north to Buerhatong River, and crossing over the river bear Liangbing town→reaching West Antu Station to be located in the southwest of Antu city→going in the south of Shimen town and north of Tongfo Temple→reaching to-be-built West Yanji Station after crossing over Chaoyang River in the north of Chaoyangchuan town→changing its direction to the northeast, and passing through Northern Xing'an town to the north of Yanji urban district→running to the southeast, and crossing over the existing Changchun-Tumen Railway line and Buerhatong River in the north of Mopanshan Town→running **northeastward**~~→after passing Nanshui village, crossing through Riguangshan Provincial Forest Park eastward→after crossing at a radius of 1,600m, integrating with Changchun-Tumen Railway line→entering into the existing Tumen Station→crossing over Tumen-Hunchun Railway line→turning to the east at Gaya River, and running to Northern Station of Liangshui town~~→**North Tumen Station** - ~~changing its direction to the southeast by~~ crossing over Mijiang River in the north of Mijiang town and Yingan River→reaching eastern suburb of Hunchun city→running eastward, and reaching North Hunchun Station to be located in Shuangxin village→terminal CK362+200. The total length of the railway line is 365.352km. The length of main line is 113.543km within Jilin city, and 251.809km within Yanji city.

(2) Key technical standards

1) Railway classification: Passenger dedicated line;

2) Target speed value: 250km/h

3) Number of main line: Double;

4) Line distance: 4.6m

5) Minimum radius of curve: generally 4,500m, and 3,200m in case of difficulty;

6) Maximum slope: 20‰

7) Type of traction: electric;

8) Type of train: D-prefaced trainsets;

9) Effective length of receiving departure track: 650m;

10) Operation control mode of train: Auto-control;

(2) Scale and characteristics of the project

For the scale and characteristics of the project, see the table 2-1-1.

Table 2-1-1 Table for components and main technical indexes for Newly Built Jilin-Hunchun Rail Line Project

I. Basic information of the project			Valley of the project	Songhuajiang River valley and Tumen River valley
Project name	New Jilin-Hunchun Railway			
Construction location	Jilin city of Jilin province, and Yanbian Korean Autonomous Prefecture			
Construction unit	Shenyang Railway Administration Bureau			
Investment unit	Ministry of Railways and Jilin Province			
Construction scale	Railway classification	Grade I	Number of main line	Double
	Design speed	250 for passenger train	Construction length	Total length of the railway line: 365.352km.
	Type of traction engine	Electric	Number of stations	8 new stations and 1 station to be altered
Total investment amounts	4,041,692.37×10^4Yuan		Length of subgrade	107.997km

Construction duration	4 years from January, 2011 to December, 2014

II. Floor area					III. Key technical indexes		
Project components		Total	Permanently occupied land	Temporarily occupied land	Name of key works	Key indexes	
						Main line	Changchun-Tumen and Longtanshan-Shulan connection lines
Main body works	Subgrade: 107.997km	717.65	717.65		Extra large bridge	56 bridges/75,453.66m	1 bridge/1714m
	Station	206.84	206.84		Large and medium bridge	47 bridges /13141.45m	
	Bridge and culvert: 88.611km	152.21	152.21		Small bridge	1 bridge/16m	
	Tunnel 155.144km	43.01	43.01		Medium bridge framework Small bridge framework	31 bridges-6,747 square meters	
	Relocation of road	54.07	54.07		Culvert framework	278 bridges—7,649 horizontal linear meters	
Living quarter for construction		190.45		190.45	190.45	85 bridges/155144m	
Construction road area		117.38		117.38	117.38	212.1km	
Borrow area		260.93		260.93	260.93	202.1km	
Waste slag yard		474.34		474.34	474.34	588893m^2	
Total		2216.88	1173.78	1043.11043.1	1043.1		

III. Quantity of earth and stone works（Unit: 10^4m^3）

Project components	Earth excavation	Fill earth	Transportation party	Borrow earth	Waste earth	Description

Main body works	Subgrade	1645.1	1506.79	1142.33	297.61	502.77	Earth and stone works across the whole line Total quantity: 6990.29 (208.98 earths and stones for subgrade and station are waste slag from construction of tunnel)
	Station	369.67	659.12	45.74	471.25	323.93	
	Tunnel	2285	0	0	0	2076.02	
	Bridge	306.02	218.59	218.59	0	87.43	
Total		4605.79	2384.5	1406.66	768.86	2990.15	

2.1.2 Rail and subgrade works

1. Rail work

The new Jilin-Hunchun Rail mainly adopts the ballast rail ; and for tunnel with length greater than 6km, double—block type ballastless rail are used. Install long continuous welded track through railway station. For connection lines, they are designed in accordance with the standard for heavy track, and for ballast track structures, install long continuous welded track through railway station.

(1) Steel rail

For the steel rail, they are the new ones without bolt holes and with fixed-length of 100m and 60kg/m, their maximum allowable deviation, straightness and allowable distortion value comply with the relevant requirements of Tie Ke Ji Letter No. [2005]298 Interim Specifications for 60kg/m Steel Rails of 250km/h Passenger Dedicated Railway Line.

(2) Road bed

In this railway, super ballasts with compactness of 1.75g/cm^3 are used, the support with rigidity of 110kN/mm is used. For other ballasts, their physical mechanical properties shall comply with the requirements of the related regulations of the Ministry of Railways.

2. Subgrade work

(1) Length of subgrade

Main line of the railway is 365.352km in total length, among which the design length of section subgrade is 107.997km, accounting for 29.56% of the total length of the railway line. The road cut is about 45.355km and road embankment about 62.642km in length.

The total length of connection lines is 3.31km, among which length of section subgrade is 1.596km.

(2) Width of subgrade

In the straight section, the width of subgrade surface is 13.4m, the width of road shoulder is larger than 1.2m See Fig. 2.1:

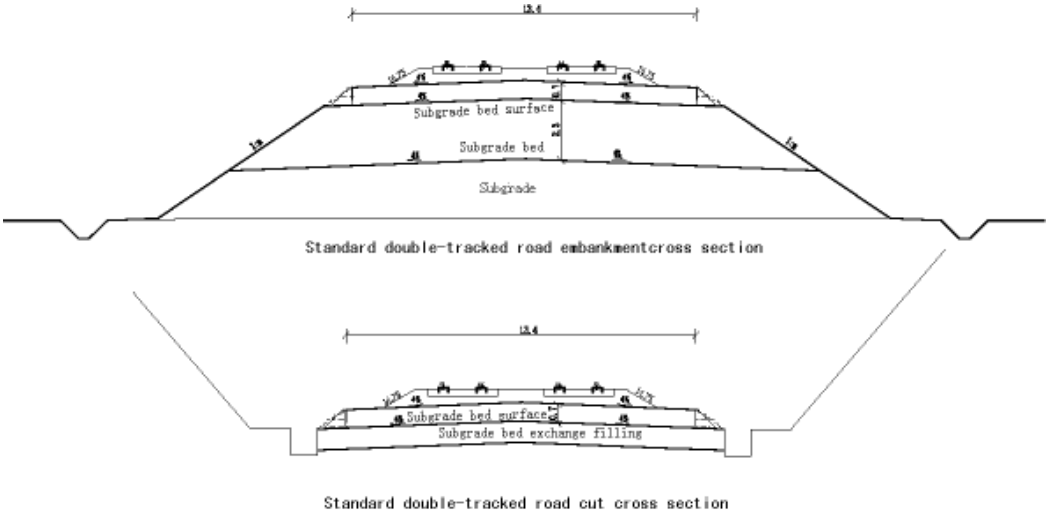


Fig. 2-1: Typical road embankment and road cut sections

(3) Quantity of earth and stone works

Total quantity of earth and stone works for the subgrade, tunnel, station, and bridge subgrade is 6900.29×104m^3, among which 2384.50×104m^3 is filling earth and 4605.79×104m^3 is excavated earth. For quantity of key earth and stone works, see the table 2-1-2.

Table 2-1-2 Summary for quantity of earth and stone works Unit: 10^{4}m^3

Project name	Sections	Tunnel	Station	Bridge	Total
Fill earth	1506.79	0	659.12	218.59	2384.5
Earth excavation	1645.10	2285	369.67	306.02	4605.79
Total	3151.89	2285	1028.79	524.61	6990.29

(4) Distribution of construction sites of subgrade

Sections through which the railway passes, which require special subgrades, are deep road cut, loose and soft zone and road cut of expansive rocks (soils). Across the railway line, the total length of road embankment is 2.877km, and that of the deep road cut is 5.358km.

Loose and soft zone: CK176+100～CK176+350, located in terrace area, with flat and open

topography, and arable lands across most of the surfaces.

Road cut section of expansive rocks (soils): CK260+950～CK261+280, located in hilly area, with little irregular topography and on which vegetations are growing.

For quantities of reinforcement and protection works of high road embankment, deep road cut and subgrade along the whole railway line, see tables 2-1-3 and 2-1-4.

After checking against the latest data, the height of sections subject to heightening and deep cutting as indicated in the original design has been optimized and reduced or such heightening or deep cutting have been cancelled by: 1. Changing 19m high road embankment of the original CK001+709~ CK001+777 section with extra large bridge which is because the starting milestone of extra bridge over Songhuajiang River has been adjusted to CK1+271.59; 2. Canceling 28m deep road cut of the CK297+500~ CK297+789 section through optimization of longitudinal section of railway line; 3. Adjusting 42m deep road cut of the CK298+885~ CK298+927 section down to less than 7m through optimization of longitudinal section of railway line; and 4. Adjusting 37m deep road cut of the CK299+137~ CK299+247 section down to less than 5m through optimization of longitudinal section of railway line.

Table 2-1-3 Table for information of high road embankment and deep road cut along the complete railway line

Administrative districts	Starting point	End point	Heightening scope (m)	Average heightening value (m)	Length (m)	High road embankment
Longtan district, Jilin city	CK000+980	CK001+272	8.1-13.8	11.0	292	Section 1
	CK007+560	CK007+620	10.8-11.8	11.2	60	Section 2
	CK008+380	CK008+700	8.2-9.4	8.7	320	Section 3
	CK010+920	CK011+000	9.4-13.2	11.5	80	Section 4
	CK013+820	CK013+860	8.0-11.2	10.5	40	Section 5
	CK015+690	CK015+880	8.1-15.1	11.3	190	Section 6
	CK020+600	CK020+740	8.8-12.3	10.8	140	Section 7
Jiaohe city	CK026+100	CK026+160	10.4-14.2	11.9	60	Section 8
	CK030+720	CK030+800	8.9-9.7	9.3	80	Section 9
	CK033+240	CK033+300	8.2-9.7	8.9	60	Section 10
	CK046+060	CK046+140	8.4-17.0	10.9	80	Section 11
	CK054+200	CK054+300	8.5-11.5	10.2	100	Section 12
	CK072+560	CK072+720	8.7-10.1	9.4	160	Section 13
	CK076+700	CK076+740	8.8-10.8	10.2	40	Section 14

	CK089+980	CK090+020	8.3-8.5	8.4	40	Section 15
	CK090+120	CK090+160	8.0-8.8	8.4	40	Section 16
	CK090+300	CK090+420	8.1-8.9	8.5	120	Section 17
	CK109+900	CK110+040	8.4-9.4	9.0	140	Section 18
Dunhua city	CK117+240	CK117+320	8.0-8.4	8.2	80	Section 19
	CK118+660	CK118+780	8.0-9.6	9.0	120	Section 20
	CK189+140	CK189+420	8.1-11.1	9.5	280	Section 21
Antu city	CK202+300	CK202+360	8.5-9.2	9.0	60	Section 22
	CK204+080	CK204+120	9.2-13.9	11.9	40	Section 23
Yanji city	CK268+400	CK268+440	9.0-15.8	12.0	40	Section 24
Tumen city	CK290+940	CK291+020	10.2-12.4	11.7	80	Section 25
	CK307+260	CK307+332	8.1-9.1	8.5	72	Section 26
Total					2814	
Administrative districts	**Starting point**	**End point**	**Deepening scope (m)**	**Average deepening value (m)**	**Length (m)**	**Deep road cut**
Longtan district, Jilin city	CK007+820	CK007+880	12.9-14.3	13.7	60	Section 1
	CK010+560	CK010+620	12.6-24.3	18.6	60	Section 2

	CK016+040	CK016+100	13.1-22.8	18.8	60	Section 3
	CK016+220	CK016+320	14.6-23.5	18.8	100	Section 4
	CK017+720	CK017+880	12.7-19.5	14.8	160	Section 5
	CK021+000	CK021+160	12.6-22.3	16.4	160	Section 6
Jiaohe city	CK026+240	CK026+300	16.3-23.7	19.6	60	Section 7
	CK062+800	CK063+000	12.3-20.2	16.9	200	Section 8
	CK073+060	CK073+160	13.1-15.8	14.9	100	Section 9
	CK074+000	CK074+140	12.0-13.9	13.2	140	Section 10
	CK100+860	CK100+940	13.2-25.7	20.6	80	Section 11
	CK103+060	CK103+140	13.2-24.1	18.5	80	Section 12
	CK103+240	CK103+360	12.2-21.1	16.1	120	Section 13
	CK104+560	CK104+720	13.5-18.7	16.0	160	Section 14
Dunhua city	CK114+100	CK114+140	12.8-14.4	13.8	40	Section 15
	CK115+300	CK115+340	12.4-14.6	13.8	40	Section 16
	CK118+400	CK118+440	12.0-14.6	13.5	40	Section 17
	CK120+040	CK120+120	12.6-18.7	16.0	80	Section 18

	CK124+260	CK124+300	12.7-18.2	15.4	40	Section 19
	CK150+200	CK150+240	12.2-13.7	13.0	40	Section 20
	CK150+340	CK150+440	12.5-16.1	14.4	100	Section 21
	CK161+760	CK161+820	13.3-20.2	16.6	60	Section 22
	CK162+440	CK162+560	12.9-21.9	16.8	120	Section 23
	CK166+460	CK166+609	12.9-27.7	22.6	149	Section 24
	CK166+620	CK166+760	12.2-16.9	15.4	140	Section 25
	CK172+540	CK172+580	13.1-17.2	15.4	40	Section 26
	CK185+620	CK185+774	12.4-23.2	18.3	154	Section 27
	CK189+600	CK189+720	12.3-21.2	17.2	120	Section 28
Antu city	CK198+757	CK198+820	13.3-21.7	17.5	63	Section 29
	CK214+840	CK214+920	13.9-16.2	14.7	80	Section 30
	CK226+120	CK226+320	12.1-16.8	15.3	200	Section 31
Longjing city	CK248+420	CK248+500	12.6-19.2	16.5	80	Section 32
	CK248+840	CK248+880	13.4-17.7	16.0	40	Section 33
	CK249+920	CK250+020	13.9-24.5	19.4	100	Section 34

Yanji city	CK269+580	CK269+700	12.2-16.0	14.6	120	Section 35
	CK270+460	CK270+640	13.0-18.8	16.2	180	Section 36
	CK270+980	CK271+040	12.5-15.0	13.6	60	Section 37
Tumen city	CK283+220	CK283+300	12.7-19.0	16.5	80	Section 38
Hunchun city	CK355+140	CK355+380	14.2-23.1	19.0	240	Section 39
	CK356+620	CK356+860	12.6-25.0	18.4	240	Section 40
Total					4186	

Table 2-1-4 Table for quantities of main subgrade works

Actions / Type	Concrete actions	Unit	Quantity
Slope protection	Dry-masonry flag stone protection	(m^3)	8543
	Gravel anti-filtration course	(m^3)	4272
	3D ecological green protection	(m^2)	159030
	M7.5 cement grouted flag stone	(m^3)	656800
	C15 prefabricated concrete	(m^3)	49875
	C20 concrete cavity brick	(m^3)	19307

	Window and banking up with soils internally	(m^3)	15382
	Placing grass seeds	(m^2)	659768
	Broadcasting and planting grasses	(m^2)	1330258
	River locust	(Stem)	10687626
	25kN/m two-way geo-grid	（m^2)	2418274
	Smooth blasting	（m^2)	145863
	Foundation excavation (earth)	（m^3)	304184
	Foundation excavation (stone)	（m^3)	456277
Soil excavating and depositing site protection	Broadcasting and planting grasses	（m^2)	59482
	C25 flag stone concrete	(m^3)	3532

2.1.3 Station

9 stations are assigned for the railway, and they are stations of west Jiaohe, north Weihuling, Dunhua, south Dashitou, west Antu, west Yanji, Tumen, ~~north Liangshui(~~**removed during design stage~~)~~**, and north Hunchun, among which Tumen station is an existing one, and others are new intermediate ones.

Along the railway line, 3 overall repair sites are newly provided, and they are located in stations of west Jiaohe, Dunhua and Tumen, and in stations of Dunhua, west Antu and north Yanji, each new AT traction substation is built respectively. As for general descriptions of distribution of main-line stations and detailed information of stations, see tables 2-1-5 (1)~(2).

Table 2-1-5 (1) General description of stations

Type of line	No.	Name of station	Central mileage	Inter-station distance	Nature of station	Open to trains or not	
						2020	2030
Jilin-Hunchun Railway	1	Jilin (excluded)	Changchun-Tumen K126+533 Jilin-Tumen DK0+000	66.537	Passenger station	Yes	Yes
	2	West Jiaohe	DK66+535	52.22	Intermediate station	Yes	Yes
	3	North Weihuling	DK116+365	39.315	Overtaking station	Yes	Yes
	4	Dunhua	DK155+680	19.12	Intermediate station	Yes	Yes
	5	South Dashitou	DK174+800	43.13	Intermediate station	Yes	Yes
	6	West Antu	DK216+450	49.99	Intermediate station	Yes	Yes
	7	West Yanji	DK266+450	40.28	Passenger station	Yes	Yes
	8	Tumen	DK305+550	17.632	Intermediate station	Yes	Yes

Type of line	No.	Name of station	Central mileage	Inter-station distance	Nature of station	Open to trains or not	
						2020	2030
	~~9~~	~~North Liangshui~~	~~DK323+182~~		Intermediate station	Yes	Yes
				37.918			
	10	North Hunchun	DK361+100		Intermediate station	Yes	Yes

Table 2-1-5 (2) General description of stations

Name of station	Scale of station	Lands occupied	Quantity of earth and stone works (m^2)
West Jiaohe	4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m.	Newly-occupied land of 15.87 hm^2, most of which are arable lands.	Fill earth: 88.8 Earth excavation: 25.1
North Weihuling	4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m.	Newly-occupied land of 12.4 hm^2, most of which are arable lands.	Fill earth: 44.1 Earth excavation: 2.93
Dunhua	High-speed lot with 2 platforms and 2 tracks, 4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m. Ordinary lot with 5 receiving departure tracks (1 main line included), 1 intermediate platform with dimensions of 500×10.5×0.5m. Effective length of receiving departure track: 1,050m	Newly-occupied land of 39.8 hm^2, most of which are arable lands.	Fill earth: 3.55 Earth excavation: 179.84
South Dashitou	Station with 2 platforms and 4 tracks, 4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m.	Newly-occupied land of 10 hm^2, most of which are arable lands.	Fill earth: 31.03 Earth excavation: 14.67
West Antu	Station with 2 platforms and 4 tracks, 4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m.	Newly-occupied land of 18.33 hm^2, most of which are arable lands.	Fill earth: 29.4 Earth excavation: 90.63

West Yanji	Station with 4 platforms and 7 tracks, 9 receiving departure tracks (2 main lines included) with effective length of 650m, basic platform with dimensions of 450×12×1.25m, and 3 intermediate platforms with dimensions of 450×12×1.25m. D-prefaced train storage yard of North Yanji Station 2m in the northwest to the station. D-prefaced train storage yard starting from the throat to the west of the line, with 6 storage tracks and 4 reserved storage tracks up to effective length of 538～785m.	Newly-occupied land of 49.47hm^2, most of which are arable lands.	Fill earth: 89.29 Earth excavation: 74.74
Tumen	High-speed lot with 4 receiving departure tracks (2 main lines included) with effective length of 650m, and one basic platform with dimensions of 450×12×1.25m. Ordinary lot with 3 receiving departure tracks (1 main line included) with effective length of 650m, one immediate platform with dimensions of 500×10.5×0.5m, a share with the high-speed lot.	Newly-occupied land of 32.2 hm^2, most of which are arable lands.	Fill earth: 46.26 Earth excavation: 41.92
~~North Liangshui~~	~~4 receiving departure tracks (2 main lines included) with effective length of 650m, and basic platform with dimensions of 450×12×1.25m.~~	~~Newly-occupied land of 14.33 hm^2, most of which are forest lands.~~	~~Fill earth: 23.92~~ ~~Earth excavation: 69.14~~
North Hunchun	Station with 3 platforms and 4 tracks, 4 receiving departure tracks (2 main lines included) with the main line against the platform temporarily, effective length of 650m, and basic platform with dimensions of 450×12×1.25m.	Newly-occupied land of 14 hm^2, most of which are arable lands.	Fill earth: 126.5 Earth excavation: 45.2

Typical station arrangement plans and station configurations are as follows:

(1) West Jiaohe Station

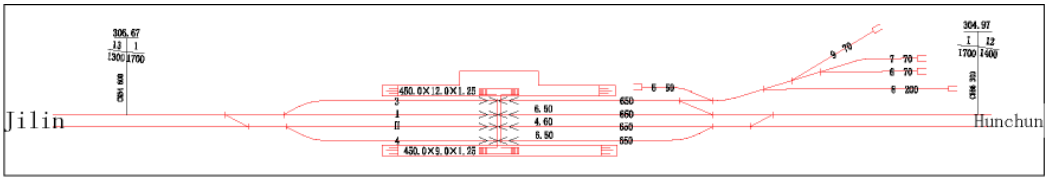


Fig. 2-2 Arrange plan for West Jiaohe Station

The station is located about 2.3km in the west of Jiaohe River, and 0.8km from the national highway No. 302, offering convenient access. It is located at the edge of urban planning area, no urban planning land is occupied, and avoids crossing through the urban district, according to the urban development planning of Jiaohe city.

(2) North Weihuling Sattion:

The station is located about 1.5km in the northeast of Weihuling town. A hill comes between the station and the town (hill top 50m higher than the station), and the station is built in the northern hillside. The occupied lands are arable lands (tobacco planted). The villages and town is located to the southern hillside, therefore, most impacts of noises on the villages and town during the operation period are shielded, thus few impacts are exerted on villager, and at the same time, a road runs from the southern hillside to the northern hillside, therefore, the stations offers convenient traffic, and facilitates transportation of villagers.

(3) Dunhua Station:

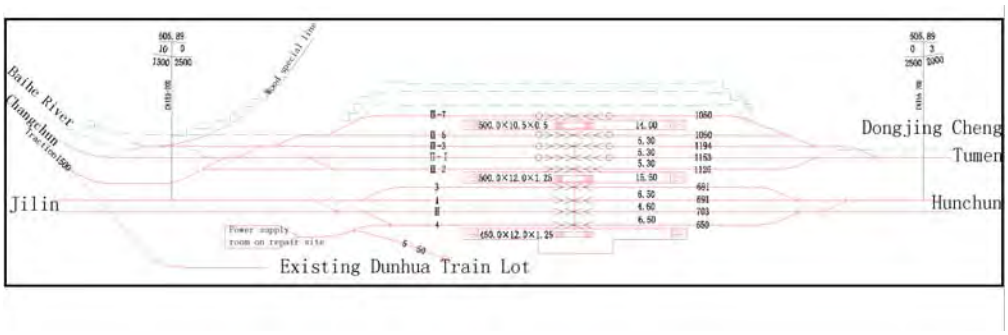


Fig. 2-3 Arrange plan for Dunhua Station

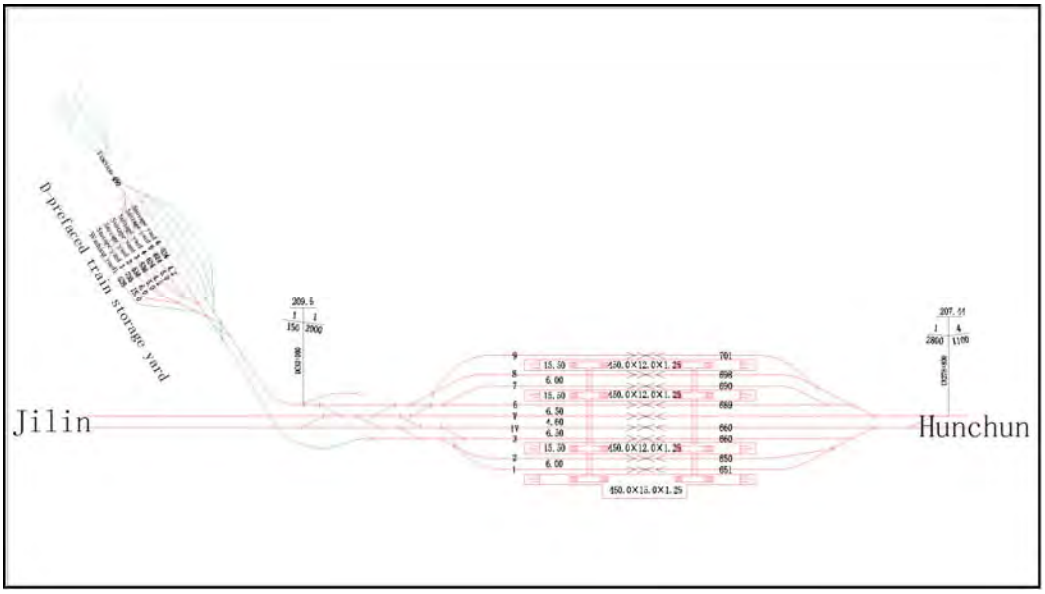
The new Dunhua Station is located about 11km in the northeast of the existing Dunhua Railway Station. Most residential districts involved in construction of the new station are shanty town, which have been incorporated into the list of districts subject to removal for renovation of Dunhua city. Location of the station accords to the urban renovation, and is suitable for the local development. At the same time, the existing Dunhua Railway Station and freight yard, as well as zones of Changchun-Tumen Railway line to the south of this new station must be removed, and their new locations are in the north of the passenger dedicated line, and are parallel to the line. Therefore, portion of the passenger dedicated line in Dunhua city doesn’t result in a secondary division of the urban district, but moves the whole railway lines northward, and makes lines far from the main urban district. The freight services originally offering by the existing Dunhua Railway Station are provided in Daqiao Station of Changchun-Tumen Railway line according to adjustments, thus eliminating impacts of freight services noises on the urban district, improving the sound environment in Dunhua city.

(4) South Dashitou Station:

The station is located about 2km in the southwest of Dashitou town, and 2.4km to the south of the existing Changchun-Tumen Railway line and the national highway No. 302. Cement road runs besides the station location, and the distance from the road to the station is about 700m, thus convenient traffic is offered. Most lands occupied by the station are corn fields, and no residential district is occupied, thus reserving full space for the urban development, and facilitating transportation of residents.

(5) West Antu Station

According to the people's government of Antu county, the preferred option is to build the station near the office building of the county Party committee. After both the geographical factor of the county being surrounded by hills, and the urban development are considered into the design, the station is located in the hillside to the southwest of the office building of the county Party committee, and in this case, most occupied lands are shanty towns. These shanty towns must be removed for the purpose of constructing the station, but such removal just accords to renovation of shanty towns as planned by the government of Antu county, playing a role of accelerating urbanization of the county; and at the same time, the station is built against mountains in the south, i.e. it is on the southern edge of the urban district, therefore, northward development of the urban district is not affected.



(6) West Yanji Station:

The station, about 1km from the building of the people's government of Yanji Prefecture, is located at the fringe area between urban district of Yanji and Chaoyangchuan town and to the north of Yansan Highway. It has a distance of 5.5km from the built urban central district and 3.5km from Chaoyangchuan town. According to the development planning of Yanji city, Chaoyangchuan town will be incorporated into the jurisdiction of the city. With regard to building a station for Jilin-Hunchun passenger dedicated line in Yanji city, based on communications with the concerned departments of the people's government of Yanji city as well as department in charge of planning, and in order to goi with requirements of the local government, inject driving force into the development of Chaoyangchuan town, and to meet requirement of Yanji-Longjing-Tumen integrated development, the station is built to the north of Yansan Highway which presents relatively gentle topography, and such location gives considerations to development both of Yanji city and Chaoyangchuan town, and complies with the urban development planning.

(7) Tumen railway station:

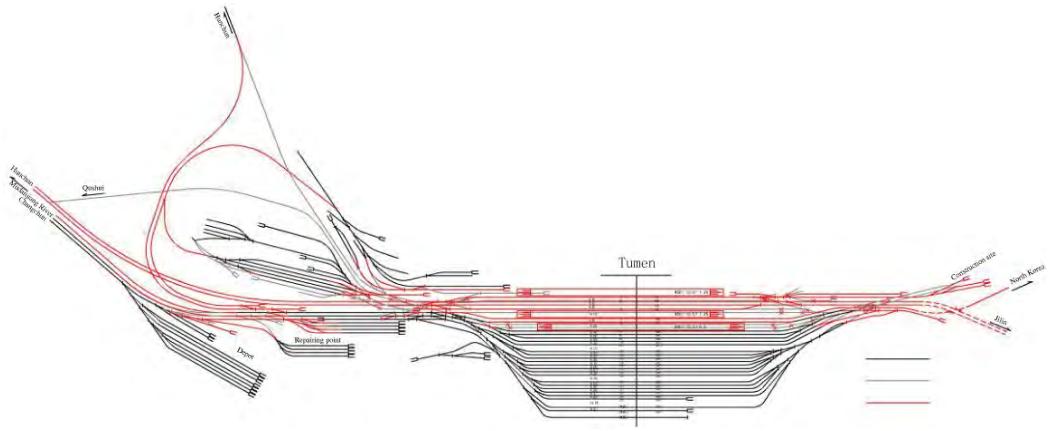


Fig. 2-5 Arrange plan for Tumen Station

The existing Tumen Railway Station is the terminal and port station. It provides receiving departure freight services, and at the same time, development of Tumen city is also based on the Changchun-Tumen Railway and Tumen Railway Station, therefore, the existing Tumen Railway Station has become a landmark in minds of Tumen citizens.The design has given full considerations to opinions of the local government departments, and connecting the Jilin-Tumen passenger dedicated line with the existing Tumen Railway Station can make good use of the existing passenger transportation facilities and facilitate boarding and alighting. Moreover, according to such connection option, only some plants are removed, thus avoiding removal of villages, reserving space for the future urbanization of these villages, and complying with the urban development planning of Tumen city.

~~**(8) North Liangshui station:**~~

~~The station, 2.6km in the northwest of Liangshui town, is located between the national highway No. 302 and Jilin Hunchun Highway, less than 100m from the national highway in the south. Based on those, the station offers convenient traffic, and its locations exert no impact on the development of the town, reserving enough space for the development of the town.~~

(9) North Hunchun station:

The station is located in the north of connection line between Zhanqian Street of Hunchun city and provincial highway No. 201. The station integrates with the urban district through Zhanqian Street, an important traffic road. Therefore, the station offers good traffic, and moreover, it is in good connection with the planned Dongning-Hunchun Railway. To build the station, the arable lands are used, and no resident unit is involved. The station is located on the northeastern edge of land planned for urban district, therefore, it exerts no impacts on the urban development, and complies with the urban development planning.

Photo 2-1 West Jiaohe Station

Photo 2-2 North Weihuling station

Photo 2-3 Current conditions of environment in Dunhua Station

Photo 2-4 Current conditions of environment in South Dashitou Station

Photo 2-5 Current conditions of environment in West Antu Station

Photo 2-6 Current conditions of environment in West Yanji Station

Photo 2-7 Current conditions of environment in North Liangshui Station

Photo 2-8 Current conditions of environment in North Hunchun station

2.1.4 Bridge and culvert

Along the railway line, there are 104 extra large bridges, large bridges, medium bridges and small bridges with total length of 88611.11m. Total length of bridges accounts for 24.25％ of that of the railway line, i.e. 365.352km. The largest bridge is the Dashitou Extra Large Bridge with total length of 5606m; and for distributions of bridge and culvert, see the table 2-1-6:

Water systems over which the railway line runs are Songhuajiang River system and Tumen River system. The railway line crosses over Songhuajiang River and its tributaries of Xinkai River, and Jiaohe River, over Mudanjiang River and its tributaries of Huangni River and Toudao River; over Buerhatong River and its tributaries of Fuxing River, Chaoyang River, Yangji River, and over Tumen River and its tributaries of Gaya River, and Mijiang River. Among these rivers, only Songhuajiang River, a IV-grade channel, must be open to navigation. In addition, the railway line and the Jilin-Hunchun Highway run side by side, and the railway crosses over several highways. For crossing rivers, highways, and bridges, see the table 2-1-7:

Table 2-1-6 Distributions of main-ling-through bridges and culverts

Item	Unit	Quantity
		Double tracks (with box beam)
Extra large bridge	Bridges-Horizontal linear meters	56-75453.66
Large bridge	Bridges-Horizontal linear meters	46-11314.5
Medium bridge	Bridges-Horizontal linear meters	1-26.95
Small bridge	Bridges-Horizontal linear meters	1-16
Total length	Bridges-Horizontal linear meters	104-88611.11
Percentage for length of the railway line	%	24.23

Medium bridge framework	Bridges- Square meters	2-1952
Small bridge framework	Bridges- Square meters	29-4795
Culvert framework	Bridges- Horizontal linear meters	278-7649

Table 2-1-7 Table for main crossing rivers, highways, and bridges

Bridge name	Mileage at starting point	Mileage at terminal	Bridge length (m)	Crossing river/highway	Piles in water	Primary span (m)
Extra large bridge of Songhuajiang River	DK01+777	DK04+664	2887	Songhuajiang River	6PCS	56+96+96+56, and river width about 330m
Xiaochuan extra large bridge	DK12+420	DK13+627	1207	Ring highway	/	40+64+40
Caomugou large bridge 1	DK21+401.80	DK21+776.00	374	Caomugou Reservoir	5PCS	32m-span, and river width about 160m
Extra large bridge of Xinkaihe River	DK34+750	DK35+778	1028	Xinkai River		32m-span, and river width about 25m
Extra large bridge of Jiaohe River	DK67+261	DK70+267	3006	Jiaohe River	5PCS	32m-span, and river width about 140m
Extra large bridge of Xiaojiaohe River	DK82+935	DK83+718	783	Xiaojiaohe River	1PCS	32m-span, and river width about 30m
Erdaokou extra large bridge	DK105+909	DK107+985	2075	Highway	/	40+80+40
Dachuantun extra large bridge 1	DK120+212	DK121+371	1159	Huangnihe River	No	32m-span, and river width about 10m
Dachuantun extra large bridge 3	DK124+455	DK125+220	765	Highway	/	48+80+48
Ping an bao extra large bridge	DK146+285	DK149+878	3593	Highway	/	40+64+40
Extra large bridge of	DK156+350	DK159+520	3170	Mudanjiang	6PCS	32m-span, and river width about

Bridge name	Mileage at starting point	Mileage at terminal	Bridge length (m)	Crossing river/highway	Piles in water	Primary span (m)
Mudanjiang River				River		180m
Dashitou extra large brtidge	DK176+848	DK182+454	5606	Toudao River	No	32m-span, and river width about 20m
Extra large bridge of Buerhatong river of Antu	DK213+372	DK214+810	1438	Buerhatong River	No	32m-span, and river width about 15m
Antu extra large bridge	DK217+350	DK218+000	650	Fuxing River	No	32m-span, and river width about 25m
Extra large bridge of Buerhatong river of Shimen	DK233+375	DK233+782	407	Buerhatong River	1PCS	32m-span, and river width about 40m
Extra large bridge of Chaoyanghe River	DK260+898	DK265+034	4136	Chaoyang River	1PCS	32m-span, and river width about 32m
Extra large bridge of Yaji River	DK273+324	DK276+838	3514	Yaji River	No	32m-span, and river width about 18m
Extra large bridge of Buerhatong river of Mopanshan	DK283+320	DK284+577	1257	Buerhatong River	4PCS	32m-span, and river width about 115m
Extra large bridge of Gaya River	DK307+332	DK308+509	1177	Gaya River	10 PCS	32m-span, and river width about 260m
Over-highway extra large bridge of Qingrong Village	DK316+803	DK318+206	1403	Highway	/	40+64+40
Over-highway extra large bridge of Nanda River	DK320+510	DK322+829	2318	Highway	/	48+80+48

Bridge name	Mileage at starting point	Mileage at terminal	Bridge length (m)	Crossing river/highway	Piles in water	Primary span (m)
Extra large bridge of Mijiang	DK337+173	DK338+072	899	Mijiang River	1PCS	32m-span, and river width about 35m
Extra large bridge of Ganmijiang River	DK338+838	DK340+129	1291	Gan Mijiang River	4PCS	32m-span, river width about 33m, and 113m-inclined span

2.1.5 Tunnel

There are 85 tunnels along the railway line, with the total extension length of 155.144km, accounting for 42.46％ of total length of the railway line (365.352km). Lafashan tunnel, a double-tracked one with total length of 9,909m, is the longest one (mileage at entrance: CK36+075, and mileage at exit: CK45+984).

Photo2-9 Current conditions of environment at entrance of Lafashan tunnel

Photo 2-10 Current conditions of environment at inclined shaft 2 of Lafashan tunnel

For statistics of tunnel, see the table 2-1-7. For current conditions of environment at entrance of Lafashan Tunnel, see photos 2-9～2-10. For current conditions of environment at entrances, exits and roofs of the large and long tunnels along the whole railway line, see the table 2-1-9.

Table 2-1-8 Statistics table for tunnel according to recommended option

Type of line	Tunnel length divisions	250km/h	
Double-tracked	L≤500m	19 PCS	6101m
	500m< L≤3000m	49 PCS	60056m
	3000m< L≤10000m	17 PCS	88987 m
	Total	85 PCS	155144m

Table 2-1-9 Statistics table for current conditions of environment at entrances, exits and roofs of the large and long tunnels

No.	Tunnel name	Mileage at entrance	Mileage at exit	Length (m)	Maximum buried depth (m)	Number of inclined shafts	Descriptions
1	Caomugou tunnel	DK22+666	DK26+033	3367	387	0	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
2	Lafashan Tunnel	DK36+075	DK45+984	9909	474	4	Vegetations are growing in the location of the tunnel, settlements are found at 160m from the entrance, and no settlements at exist and roof.
3	Shuangmiaozi Tunnel	DK46+190	DK49+507	3317	235	0	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
4	Xiangshui Tunnel	DK54+823	DK59+260	4437	209	1	Vegetations are growing in the location of the tunnel, settlements are found at 266m from the entrance, and no settlements at exist and roof.
5	Shimen Tunnel	DK91+283	DK97+432	6149	289	1	Vegetations are growing in the location of the tunnel, settlements are found at 178m from the entrance, and no settlements at exist and roof.
6	Weihuling Tunnel	DK110+970	DK114+079	3109	205	0	Vegetations are growing in the location of the tunnel, no settlements are found at entrance, and roof, and sensitive points are found at 270m from the exit.
7	Gaotai Tunnel	DK208+683	DK212+251	3568	158	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
8	Jiulong Tunnel	DK218+004	DK221+203	3199	268	0	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
9	Wufengshan Tunnel	DK233+775	DK237+451	3676	291	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance,

No.	Tunnel name	Mileage at entrance	Mileage at exit	Length (m)	Maximum buried depth (m)	Number of inclined shafts	Descriptions
							exist and roof.
10	Jiguanshan Tunnel	DK239+976	DK244+646	4670	217	1	Vegetations are growing in the location of the tunnel, sensitive points are found at 220m from the entrance, and no settlements at exist and roof.
11	Shuinan Tunnel	DK284+626	DK290+869	6243	354	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
12	Shangdongjing Tunnel	DK291+062	DK297+405	6343	197	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
13	Riguangshan Tunnel	DK299+247	DK305+369	6122	248	1	Vegetations are growing in the location of the tunnel, no settlements are found at entrance, residents' houses at 180 to the left of roof DK303+280, and sensitive points within 70m on both sides of the exit.
14	Hou'anshan Tunnel	DK308+542	DK316+471	7929	392	3	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
15	Xixiakan Tunnel	DK326+029	DK332+969	6940	233	2	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
16	Tunnel No. 1 of Xiaopan Mt.	DK340+200	DK345+955	5755	244	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.
17	Tunnel No. 3 of Xiaopan Mt.	DK348+158	DK352+412	4254	190	1	Vegetations are growing in the location of the tunnel, and no settlements are found at entrance, exist and roof.

2.1.6 Water supply and drainage

There are 9 stations for the purpose of the railway line, including the existing Tumen Railway Station, and new stations (for Dunhua station, a new one is built in the northeast of the existing

station, while the old one removed). 180m^3/d wastewater is newly increased by each of these stations, and for the concrete wastewater and discharge directions, see the table 2-1-10.

Table 2-1-10 Discharge of newly-increased wastewater from stations along the railway line

Station	Personnel quota	Domestic water consumption m^3/d	Water consumptions for greening and other purposes m^3/d	Water discharge m^3/d	Discharge direction	Functions of receiving water	Handling actions
West Jiaohe Station	202	20.2	29.5	10.05	Discharged into Jiaohe River through municipal pipes	Class III	Septic-tank and oil separation tank
North Weihuling Sattion	23	2.3	7.0	1.7	Recycled	/	Septic-tank, oil separation tank, and anaerobic filtration container
Dunhua Station	289	28.9	135.2	16	Discharge into Mudanjiang River through municipal pipes	Class V	Septic-tank and oil separation tank
South Dashitou Station	22	2.2	5.5	1.9	Recycled	/	Septic-tank, oil separation tank, and anaerobic filtration container
West Antu Station	77	7.7	20.6	4.7	Discharge into Buerhatong River through municipal pipes	Class III	Septic-tank and oil separation tank
West Yanji Station	148	14.8	526.4	124.6	Discharge into Buerhatong River	Class III	Septic-tank and oil separation tank

Station	Personnel quota	Domestic water consumption m^3/d	Water consumptions for greening and other purposes m^3/d	Water discharge m^3/d	Discharge direction	Functions of receiving water	Handling actions
					through municipal pipes		
Tumen station	219	21.9	39.7	10.85	Discharge into Tumen River through municipal pipes	Boundary river	Septic-tank and oil separation tank
~~North Liangshui station~~	~~13~~	~~1.3~~	~~4.5~~	~~1.05~~	~~Recycled~~	~~/~~	~~Septic-tank, oil separation tank, and anaerobic filtration container~~
North Hunchun station	154	15.4	34.4	9.2	Discharge into Chedarengou River, and finally into Hunchun River (Salmon Reserve)	Class IV	Septic-tank, oil separation tank, and SBR
Total				180.05			

Remarks: Capacity of daily discharge is 60 m^3/d in the existing Dunhua Railway Station, and 80 m^3/d in the existing Tumen Railway Station.

(1) Principe of wastewater treatment design

The railway line results in additional wastewater of 180 m^3/d. In principle, for the existing water supply point, the existing wastewater discharge method remains unchanged, and for the additional wastewater, discharge into the discharge pipe network after pre-treatment. As for installation of new treatment facilities or not, determine according to the wastewater discharge quantity and the corresponding discharge requirements.

For domestic wastewater and operation wastewater in each of new stations, treat them according to the discharge capacity and functions of receiving water near the station. In the West Jiaohe Station in the far lake area of Songhuajiang Three Lake Reserve, the domestic wastewater is discharged into the municipal wastewater pipe network after being treated centrally and flowing out of the reserve through the pipe (about 2km-long).

(2) Wastewater discharge plan

After being pre-treated in septic-tank, septic wastewater from stations of West Jioahe, Dunhua, West Antu, West Anji, and Tumen is discharge into the local urban pipe network together with general domestic wastewater. After being collected in the pipe and treated in the anaerobic filtration container, domestic wastewater from stations of North Weihuling, South Dashitou and North Liangshui is recycled for the purpose of greening in these stations. In North Hunchun Station, after septic wastewater is pre-treated in septic-tank and oil-contained wastewater in oil separation tank, discharge them into the wastewater pipe network of the station.

2.1.7 Buildings, quota and electrification

1. Buildings and quota

For the purpose of the railway line, buildings cover a total area of 65,230m^2, among which 61230m^2 of operation and operation-related buildings, and 4000m^2 of living buildings. For the purpose of the railway, additional 1,147 staff are required, i.e. 3.2 persons/km per main line.

2. Electrification

(1) Supply schemes of traction network, and voltage class

Adopt AT supply mode. The traction supply system with single-phase power frequency (50Hz) and contact network of 25kV rated voltage is used. The maximum long-term operating voltage of the contact network is 27.5kV, and the minimum design operating voltage of the contact network is 20kV.

(2) Plan for distributing traction substations

For the purpose of the railway line, 6 new 220kV traction substations are built at Jilin+30, North Weihuling -18, North Dunhua, West Antu, North Yanji and Tumen +29, and one substation for Changchun-Jilin Railway is used. Capacity of all new traction substations are 2×40 MVA except for the substation at Jilin +36, which has a transformer capacity of 2×50 MVA.

(3) Contact network conductors and catenary type of contact network

1) All carrier cables and contact lines are tension-resistant, high-strength, corrosion-resistant, high-temperature-resistant copper alloy wires with good performance.

2) Contact networks for main lines are auto-tensioned catenary equipment.

2.1.8 Temporary works

For large temporary works and their quantities for the project, see the table 2-1-11.

Up to date, exact locations and scale of large temporary works are yet determined during the feasibility stage. Next, to select the locations of temporary works, such locations and scales must be determined in the principle of making use of existing installations along the railway line as many as possible, occupying lands as few as possible and even occupying no lands.

Table 2-1-11 Quantities bill for major large temporary works

Item	Unit	Quantity	Location	Floor area

Construction access (new) (altered)	km	202.1	Along the railway line	82.68 hm^2
Construction access (altered)	km	212.1	Along the railway line	34.70 hm^2
Rail-laying base	PCS	2	Maxiangtun Railway Station, and Qushui Railway Station	16 hm^2
Material warehouse	PCS	7	Stations of Jilin, Jiaohe, Dunhua, Dashitou, Antu, Yanji and Tumen	7 hm^2
Rail plate prefabrication yard	PCS	4	Jiaohe city, Dashitou town, Yanji city and Liangshui town	40 hm^2
Girder fabrication and storage yard	PCS	6	Xiaochuan, Jiaohe, Liushugou, Weihuling, Antu and West Yanji	56 hm^2
Centralized concrete mixing station	PCS	58	Along the railway line	58 hm^2
Modified soils and graded broken stone mixing station	PCS	18	Along the railway line	18 hm^2

Remarks: 6.5m width for double-tracked access, 3.5m width for single-tracked access, and sand-stone roads.

(1) Material warehouse

7 materials warehouse, respectively located in Jilin station of Changchun-Tumen Railway, stations of Jiaohe, Dunhua, Dashitou, Antu, and Yanji, as well as in freight yard of Tumen station, in which steels, cement, woods and poles are stored.

(2) Rail-laying base

Rail-laying base: Maxiangtun Railway Station of the existing Shenyang-Jilin Railway line and Qushui Railway Station of Changchun-Tumen Railway Station.

(3) Girder fabrication and storage yard

6 girder fabrication and storage yards along the railway line (respective being yards Xiaochuan, Jiaohe, Liushugou, Weihuling, Antu and West Yanji).

(4) Concrete mixing station

58 centralized concrete mixing stations and 18 modified soils and graded broken stone mixing stations according to planning.

2.1.9 Earth-stone quantity balance

Total quantity of earth and stone work for subgrade, station, tunnel and bridge works are 6,990.29×104m^3, among which 2384.50×104m^3 for filling earth and 4605.79×104m^3 for excavation. 1406.66×104m^3 excavated earth are used for backfilling, 208.98×104m^3 soils from tunnel excavation will be used for subgrade and station. 768.86×104m^3 soils are borrowed, and 2990.15×104m^3 soils deposited.

For sectional earth and stone works along the railway line, see tables 2-1-12 ~2-1-16 and Fig. 2-6.

Table 2-1-12 Summary for allocation of earth and stone works for CK0~CK24+460 (urban district of Jilin) Unit: ×10^{4}m^3

Item	Subgrade work	Station work	Tunnel work	Bridge work	Subtotal
Earth excavation	211.29	0	42.62	38.85	292.76
Fill earth	167.46	0	0	27.75	195.21
Excavated soils for backfilling	156.8	0	0	27.75	184.55
Soils from tunnel excavation	10.66	0	0	0	10.66
Borrowed soils	0	0	0	0	0
Waste earth	54.49	0	31.96	11.1	97.55
Total quantity of earth and stone	378.75	0	42.62	66.6	487.97

Table 2-1-13 Summary for allocation of earth and stone works for CK24+460~CK112+535 (urban district of Jiaohe) Unit:×10^{4}m^3

Item	Subgrade work	Station work	Tunnel work	Bridge work	Subtotal
Earth excavation	463.35	25.1	660.52	63.35	1212.32
Fill earth	389.32	88.8	0	45.25	523.37
Excavated soils for backfilling	320.64	0	0	45.25	365.89
Soils from tunnel excavation	21.32	85.42	0	0	106.74
Borrowed soils	47.36	3.38	0	0	50.74
Waste earth	142.71	25.1	553.78	18.1	739.69
Total quantity of earth and stone	852.67	113.9	660.52	108.6	1735.69

Table 2-1-14 Summary for allocation of earth and stone works for CK24+460~CK112+535 (urban district of Dunhua, Antu) Unit:×10^{4}m^3

Item	Subgrade work	Station work	Tunnel work	Bridge work	Subtotal
Earth excavation	466.89	113.58	680.59	109.91	1370.97
Fill earth	543.74	284.35	0	78.51	906.60

Excavated soils for backfilling	353.39	26.02	0	78.51	457.92
Soils from tunnel excavation	30	56.71	0	0.00	86.71
Borrowed soils	160.35	201.62	0	0.00	361.97
Waste earth	113.5	87.56	593.88	31.40	826.34
Total quantity of earth and stone	1010.63	397.93	680.59	188.42	2277.57

Table 2-1-15 Summary for allocation of earth and stone works for CK24+460~CK112+535 (urban district of Longjing-Hunchun) Unit: $\times 10^4 m^3$

Item	Subgrade work	Station work	Tunnel work	Bridge work	Subtotal
Earth excavation	503.57	230.99	901.27	93.91	1729.74
Fill earth	406.27	285.97	0	67.08	759.32
Excavated soils for backfilling	311.5	19.72	0	67.08	398.30
Soils from tunnel excavation	4.87	0	0	0.00	4.87
Borrowed soils	89.9	266.25	0	0.00	356.15
Waste earth	192.07	211.27	896.4	26.83	1326.57
Total quantity of earth and stone	909.84	516.96	901.27	160.99	2489.06

Table 2-1-16 Summary for allocation of earth and stone works across the whole railway line Unit: $\times 10^4 m^3$

Item	Subgrade work	Station work	Tunnel work	Bridge work	Subtotal
Earth excavation	1645.1	369.67	2285	306.02	4605.79
Fill earth	1506.79	659.12	0	218.59	2384.50
Excavated soils for backfilling	1142.33	45.74	0	218.59	1406.66
Soils from tunnel excavation	66.85	142.13	0	0.00	208.98
Borrowed soils	297.61	471.25	0	0.00	768.86
Waste earth	502.77	323.93	2076.02	87.43	2990.15
Total quantity of earth and stone	3151.89	1028.79	2285	524.61	6990.29

Remarks: 1. The railway is a passenger dedicated line. The fill earths are virtually classes-A and class-B backfilling materials, but not class-C, i.e. modified backfilling materials. Some tunnels offers good conditions for mucking, but they are far from the station, and the tunnel undergoes a long construction period, failing to meet requirements on progress of subgrade filling, therefore, in the construction of the railway, earth and stone works mustn't be excavated in the tunnel.

2. Subgrade: there are large amounts of ballasts being discard in the tunnel, and so are the subgrade earth excavations, therefore, in order to make use of subgrade earth excavation, ratio of

utilization of ballasts being discard in the tunnel becomes low. Considering a 35km-long continuous filling earth near Dunhua Station, focus on borrowed earths, and a few earth excavations are used, thus resulting in large amount of waste earths in earth excavation.

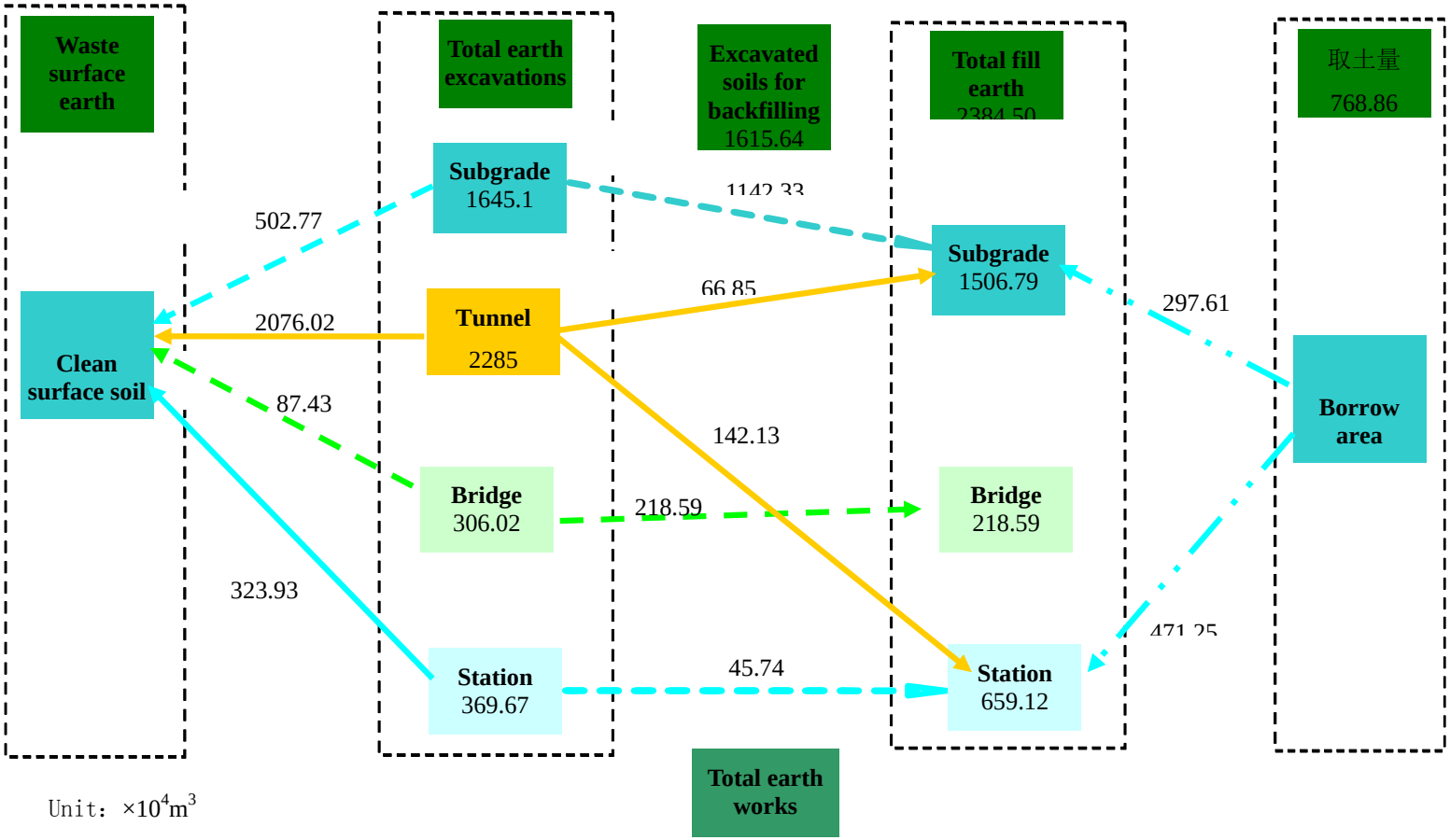


Fig. 2-6 Balance figure for earth and stone work across the railway line

2.1.10 Type and quantity of lands occupied for the project

Permanently-occupied lands will be 1,173.78hm2 and temporarily-occupied lands 1,043.1hm2. For details, see tables 2-17～2-20.

Table 2-17 Statistic table for areas of lands occupied for the project (by districts and counties)

Unit: hm2

Occupied by		Quantity of lands for railway (hm^2)						Total
		Arable land	Forest land	Lands for water areas and water conservancy projects	Residential lands	Commercial lands	Other lands	
Jilin city of Jilin province	Changyi District	0.6	0.4	0	16.88	0.13	0	18.01
	Fenman District	0.67	1.33	0	8.33	0.33	0	10.66
	Longtan District	29.16	45.3	0.36	2.47	11.93	0.39	89.61
	Jiaohe city	100.13	144.07	0.94	0	3.22	0.13	248.49
Yanbian Prefecture of Jilin province	Dunhua city	166.41	104.73	0	0.93	62.72	8.29	343.08
	Antu county	49.39	65.35	1.11	1.0	12.87	15.20	144.92
	Longjing city	13.27	16.82	0.31	0	0.75	4.30	35.45
	Yanji city	66.51	16.46	2.35	1.60	36.08	1.63	124.63
	Tumen city	43.12	39.93	0.67	0	25.69	1.13	110.54
	Hunchun city	16.27	23.71	1.81	0	5.19	1.39	48.37
Total		485.53	458.1	7.55	31.21	158.91	32.46	1173.76

Table 2-18 Summary for areas of lands occupied for the project (by type of works) Unit: hm2

Land type / Type of work	Quantity of lands for railway (hm^2)						Total
	Arable land	Forest land	Lands for water areas and water conservancy projects	Residential lands	Commercial lands	Other lands	
Subgrade	336.58	282.24	5.49	19.87	45.95	27.53	717.66
Station	49.41	58.23	0.00	0.00	99.20	0.00	206.84
Tunnel	3.95	39.05	0.00	0.00	0.00	0.00	43
Bridge and culvert	76.06	53.31	2.07	4.01	11.83	4.93	152.21
Relocation of road	19.54	25.27	0.00	7.33	1.93	0.00	54.07
Total	485.54	458.1	7.56	31.21	158.91	32.46	1173.78

Table 2-19 General summary for areas of lands occupied for the project

Mileage from starting point to terminal	Regions			Quantity of lands for railway (hm^2)						Total
				Arable land	Forest land	water areas and water conservancy	Residential lands	Commercial lands	Other lands	
CK0+000～CK2+500	Jilin city	Changyi District of Jilin city	Subgrade				14.4			14.4
			Station							0
			Tunnel							0
			Bridge				2.15			2.15
			Relocation of road	0.6	0.4		0.33	0.13		1.47
CK2+500～CK3+560		Fenman District of Jilin city	Subgrade				5.47			5.47
			Station							0
			Tunnel							0
			Bridge				1.87			1.87
			Relocation of road	0.67	1.33		1	0.33		3.33
CK3+560～		District of	Subgrade	18.89	30.7	0.29		8.85	0.31	59.04

Mileage from starting point to terminal	Regions			Quantity of lands for railway (hm^2)						Total
				Arable land	Forest land	water areas and water conservancy	Residential lands	Commercial lands	Other lands	
CK24+460			Station							0
			Tunnel		0.75					0.75
			Bridge	5	8.12	0.07		2.34	0.08	15.61
			Relocation of road	5.27	5.73		2.47	0.73		14.2
CK24+460 ~ CK112+535		Jiaohe city	Subgrade	73.54	106.63	0.81	0	2.76	0.11	183.85
			Station	12.6	3.33	0	0	0	0	15.93
			Tunnel	0.15	11.85	0	0	0	0	12
			Bridge	12.31	17.85	0.13	0	0.46	0.02	30.77
			Relocation of road	1.54	4.4	0	0	0	0	5.94
CK112+535 ~ CK191+420	Yanbian Korean Autonomous Prefecture	Dunhua city	Subgrade	128.33	73.59			18.17	7.04	227.14
			Station	12.07	9			41.33		62.4
			Tunnel	0.8	5.2					6
			Bridge	22.68	13.01			3.21	1.25	40.15
			Relocation of road	2.53	3.93		0.93			7.4
CK191+420 ~ CK241+340		Antu city	Subgrade	37.66	44.07	0.99		2.37	13.51	98.59
			Station	3.82	4.33			10.2		18.35
			Tunnel	1.65	9.35					11.01
			Bridge	4.73	5.53	0.13		0.3	1.69	12.37
			Relocation of road	1.53	2.07		1			4.6
CK241+340		jing	Subgrade	10.68	12.5	0.28		0.67	3.83	27.97

Mileage from starting point to terminal	Regions			Quantity of lands for railway (hm^2)						Total
				Arable land	Forest land	water areas and water conservancy	Residential lands	Commercial lands	Other lands	
~ CK253+440			Station							0
			Tunnel	0.23	1.27					1.5
			Bridge	1.29	1.51	0.03		0.08	0.47	3.39
			Relocation of road	1.07	1.53					2.6
CK253+440 ~ CK278+120		Yanji city	Subgrade	35.8	0.14	1.66		7.33	1.15	46.08
			Station	12.5	12			25		49.5
			Tunnel	0.37	2.13					2.5
			Bridge	14.77	0.06	0.69		3.02	0.47	19.01
			Relocation of road	3.07	2.13		1.6	0.73		7.53
CK278+120 ~ CK330+320		Tumen city	Subgrade	24.05	10.73	0.49		5.15	0.83	41.25
			Station	8.42	19.53			18.67		46.62
			Tunnel	0.75	4.25					5.01
			Bridge	8.7	3.88	0.18		1.87	0.3	14.93
			Relocation of road	1.2	1.53					2.73
CK330+320 ~ CK362+200		Hunchun city	Subgrade	7.63	3.88	0.97	0	0.64	0.75	13.87
			Station	0	10.03	0	0	4	0	14.03
			Tunnel	0	4.25	0	0	0	0	4.25
			Bridge	6.58	3.35	0.84	0	0.55	0.65	11.97
			Relocation of road	2.07	2.2	0	0	0	0	4.27
Total				485.54	458.1	7.56	31.21	158.91	32.46	1173.78

Table 2-20 Table for classification of temporarily-occupied lands

Unit: hm^2

Geographical position			Arable land	Forest land	Other lands	Subtotal
Jilin city	Changyi District of Jilin city	Borrow area				0
		Soil (ballast) excavating and depositing site				0
		Construction access	0.21		0.09	0.3
		Construction site and camp	6.3		2.7	9
	Fenman District of Jilin city	Borrow area				0
		Soil (ballast) excavating and depositing site				0
		Construction access	1.23		0.53	1.76
		Construction site and camp	0.7		0.3	1
	Longtan District of Jilin city	Borrow area				0
		Soil (ballast) excavating and depositing site	13.15	1.48		14.63
		Construction access	4.53		1.94	6.47
		Construction site and camp	10.03		4.3	14.33
	Jiaohe city	Borrow area	4.57	18.27	0	22.84
		Soil (ballast) excavating and depositing site	76.19	49.32	0	125.51
		Construction access	20.63	0	8.84	29.47
		Construction site and camp	33.71	0	14.45	48.16
Yanbian Korean Autonomous	Dunhua city	Borrow area	1.51	6.04		7.55
		Soil (ballast) excavating and	13.55	38.22		51.77

Geographical position			Arable land	Forest land	Other lands	Subtotal
Prefecture		depositing site				
		Construction access	9.21		3.95	13.16
		Construction site and camp	23.73		10.17	33.9
	Antu city	Borrow area	6.8	27.2		34
		Soil (ballast) excavating and depositing site	18.28	69.19		87.47
		Construction access	14.17		6.07	20.24
		Construction site and camp	13.77		5.9	19.67
	Longjing city	Borrow area	0.97	3.86		4.83
		Soil (ballast) excavating and depositing site	2.85	13.21		16.06
		Construction access	0		0	0
		Construction site and camp	2.1		0.9	3
	Yanji city	Borrow area	6.89	27.54		34.43
		Soil (ballast) excavating and depositing site	5.55	14.65		20.2
		Construction access	5.24		2.24	7.48
		Construction site and camp	16.89		7.24	24.13
	Tumen city	Borrow area	7.88	31.5		39.38
		Soil (ballast) excavating and depositing site	53.2	45.61		98.81
		Construction access	1.82		0.78	2.6
		Construction site and camp	19.74		8.46	28.2

Geographical position			Arable land	Forest land	Other lands	Subtotal
	Hunchun city	Borrow area	23.583	94.33	0	117.913
		Soil (ballast) excavating and depositing site	27.767	32.124	0	59.891
		Construction access	25.102	0	10.758	35.86
		Construction site and camp	6.347	0	2.72	9.067
Total			478.2	472.54	92.338	1043.1

2.1.11 Operation Plan

(1) Train formation

All passenger cars running on this main line are EMUs with train formation of 8 cars and 16 cars and carrying capacity of 600 passengers and 1200 passengers. The trains running on the Changchun-Tumen Line are normal speed passenger cars.

(2) Train number plan

Table 2-21 gives the planned train number and formation on the main line and the existing Changchun-Tumen Line.

Table 2-21 (1) Train number plan

Name of section	Train number for main line		Changchun-Tumen Longtanshan-Shulan Line (Passenger car)	
	Year 2020	Year 2030	Year 2020	Year 2030
Jilin-Yanji	70	95	/	/
Yanji-Hunchun	23	34	/	/
Jilin-Longtanshan	/	/	11	17

Notes: EMUs only run on the Jinlin-Hunchun Line.

Table 2-21 (2) Main line train formation

Origin and destination	Train	Train number (Number/Date)		
	Type	Year 2020	Year 2030	Formation
1 Main line		70	95	
Beijing-Hunchun	EMU	1	2	16
Tianjin-Hunchun	EMU	1	1	16
Qingdao-Hunchun	EMU	1	1	16
Dalian-Hunchun	EMU	1	2	16
Qiqihar-Hunchun	EMU	1	1	16
Harbin-Hunchun	EMU	1	1	16
Shenyang-Hunchun	EMU	1	2	16
Yanji-Beijing	EMU	2	3	16
Yanji-Shenyang	EMU	3	3	16
Yanji-Harbin	EMU	1	2	16
Yanji-Dalian	EMU	2	3	16
Yanji-Tianjin	EMU	1	1	16

Origin and destination	Train	Train number (Number/Date)		
	Type	Year 2020	Year 2030	Formation
Yanji-Jinan	EMU	1	2	16
Total		17	24	
Changchun-Yanji	EMU	25	32	8
Changchun-Hunchun	EMU	10	14	8
Jilin-Hunchun	EMU	6	10	8
Jilin-Yanji	EMU	12	15	8
Total		53	71	

2.1.12 Project Investment and Construction Stage

(1) Total project investment

The total investment of this project is 40,416,923,700 Yuan-110,624,600 Yuan/kilometer, of which the static investment takes up 36,901,795,000 Yuan-101,003,400 Yuan/kilometer. The loan interest of construction is 2,191,966,600 Yuan. The purchase cost of EMUs is 1,280,000,000 Yuan; And the initial working capital is 43,162,100 Yuan.

This project shall be jointly funded by Ministry of Railway and province, of which the project fund constitutes 50% of total investment. Jilin Province shall contribute 10% of project fund and take responsibility for land acquisition work and cost. The land acquisition cost should be agreed by both parties and separately credited to local stock. The rest capital fund is financed by Ministry of Railway. The fund over the capital funds should be financed from loans of joint ventures.

(2)Total construction time

The total construction time of entire line is 4 years-48 months, of which the construction time of both Lafashan Tunnel and Hou'anshan Tunnel Projects shall be controlled to be 32 months, and their station auxiliary projects and commissioning & operation shall last 3 months and 6 months separately.

(3) Main project construction method, project progress, construction time and measures adopted

a. Subgrade construction

The subgrade construction of entire line can be started after completion of construction preparation and should be completed half month before laying railway tracks. The earthwork & stonework construction shall take the mechanized construction as a major, which shall use bulldozers, scrapers and excavators to work in with dumping trucks and heavy-haul road rollers to roll the subgrade.

The subgrade should be filled and rolled by layers strictly in accordance with the specifications

and design requirements. The optimum paving thickness and rolling times should be determined according to the construction machinery at site. The filling speed should be strictly controlled and the construction should be organized reasonably to ensure the quality of subgrade.

The subgrade project should be carried out by sections and flow processes, of which each construction section takes up about 8 months.

b. Bridge engineering

The bridge foundation of this line is bored piles based. In order not to influence the construction time, the appropriate construction machinery should be selected and well organized according to geological conditions and design requirements. The bridge substructure engineering will be completed in 8 months. The bridge superstructure continuous girder engineering will be completed in 8 months. The total construction time of bridge engineering is 24 months.

The construction time arranged for cofferdams and bored pile foundation is 4 months, and the construction time arranged for bridge pier and abutment is 4 months, and the construction period limit arranged is 10~24 months. The number of bridges with in-water piers for the entire line is 11 as shown in Table 2-6 Main river-crossing bridges and expressway-crossing bridges. The construction progress of Songhua River Bridge is as follows:

(1) The construction time for double wall steel cofferdam and bored pile foundation is 4 months, and the construction time for bridge pier is 4 months;

(2) The main span of continuous girder is 56+96+96+56, and the hanging basket cantilever concrete casting takes 2~3 meters as one block, the construction progress of which is 7 days/block.

The construction technology for water-crossing large-scale bridge along the line is as follows:

The bridge pile foundation of this line uses bored piles with reasonable span arrangement. The construction of bridge piers in the water should be minimized as much as possible, and the concrete should be poured into the cushion cap and the open-cut foundations on site. The construction of in-water pier foundation should use steel sheet pile cofferdam. The concrete abutment should be constructed by using cast-in-situ concrete pile. The execution of works should be in accordance with the water level and surface width. The water surface width should be about 50~200m, and the water depth should be more than 1m. The simple landing stage should be set up to use as in-water operation platform and passage for material and personnel. If the water depth is more than 2m or it is ice period, the landing stage might be removed for safety. The bridge girder shall be 32m normal box girders with simple support structure, which shall be erected by bridge girder erection machine. The brick dust, mud and discarded earth should be transported out and processed intensively.

c. Tunnel engineering

The construction of tunnel shall have total construction time of 33 months. The longest tunnel of this project is Lafashan Tunnel with length of 9909m. There shall be many big and long tunnels on this line, with a total number of 17 tunnels/88987m, of which the tunnels to be designed with incline shaft takes up 13 with a total number of 19 incline shafts. Please see Table 2-8 for details.

The construction of tunnel shall be carried out according to the surrounding-rock type and New Austrian Tunneling Method (NATM). The single-track tunnels surrounded by IV-class and V-class

rock shall be constructed with bench method. The single-track tunnels surrounded by II-class and III-class rock shall be constructed with full section method. The crushed zone surrounded by V-class rock should be consolidated first and then constructed with short bench cut method. The shallow and unsymmetrical section of double-track tunnel surrounded by V-class rock shall be constructed with CRD Method, and the double-track tunnel section surround by V-class and IV-class rock shall be constructed with bench method or ring cut method, and the double-track tunnel section surrounded by II-class and III-class rock shall be constructed with full section method.

The tunnel with length less than 500m shall be constructed from one single entrance and single direction. The tunnel with length more than 500m can be constructed from two tunnel working faces, entrance and exit.

The tunnel entrance slope and the earthwork & stonework construction should be completed before entering. The collapse rock on the mountain slope should be disposed in time, and the drainage works shall be completed at the same time. The gutter should be excavated and constructed at any time. The tunnel entrance should be constructed early, especially for the one with poor geological condition, which should be completed as early as possible, to increase the stability of tunnel entrance and to avoid the mutual interference between tunnel entrance construction and in-tunnel construction.

The short tunnel used for matching up with the long tunnel exit or dealing with the problem of subgrade filling can be drilled in advance to use as transport passage and to solve the construction difficulty.

d. Railway track engineering

This project plans to lay railway tracks separately nearby Dashitou South Station to ensure the continuity of laying tracks. The construction units should plan for the storage of steel rail and sleeper as early as possible. The railway tracks shall be laid at two track-laying basements at the same time by double machine. The project will have the construction time of 3 months.

e. Station auxiliary project

The station auxiliary project will have the construction time of 3 months.

2.2 Engineering analysis

2.2.1 Overview of environmental impact

The main environmental impacts of this project can be classified into two stages, construction stage and operation stage. The environmental impacts during the construction stage mainly includes interference to ecological environment along the line and local pollution caused by construction noise, vibration, sewage, dust, building waste (waste residue), etc. The negative impacts on the environment during the operation stage mainly reflect in term of noise, vibration, sewage, electromagnetic interference, waste, etc. The pollutants are mainly produced by energy loss, including noise, vibration and electromagnetic interference, and secondarily by material loss, including sewage, waste gas and waste material. Please see Fig. 2-7 and Fig. 2-8 for details.

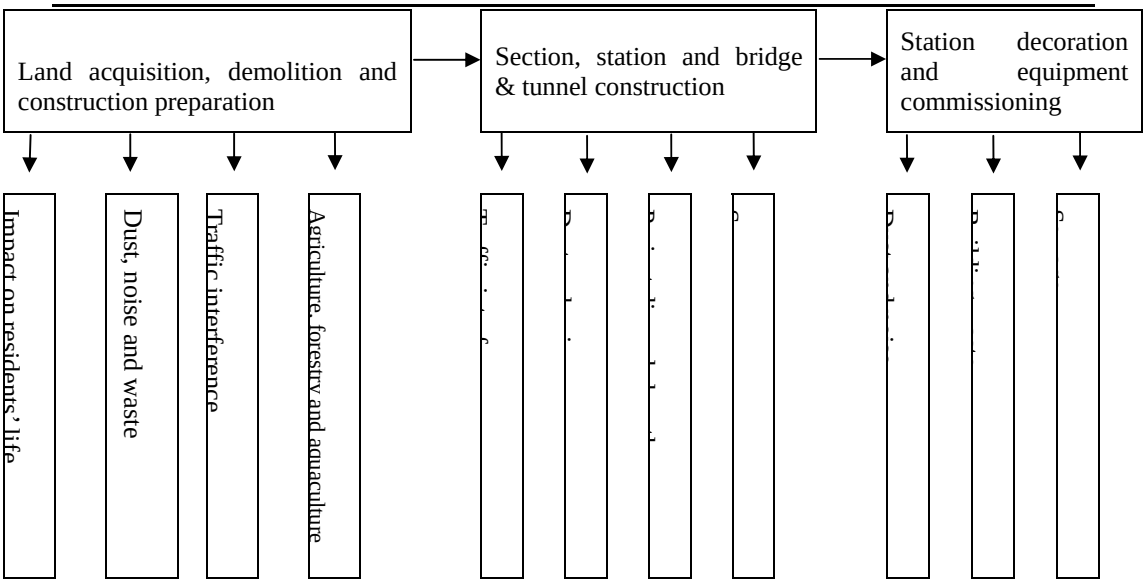


Fig. 2-7 Schematic diagram of environmental impact during the construction stage

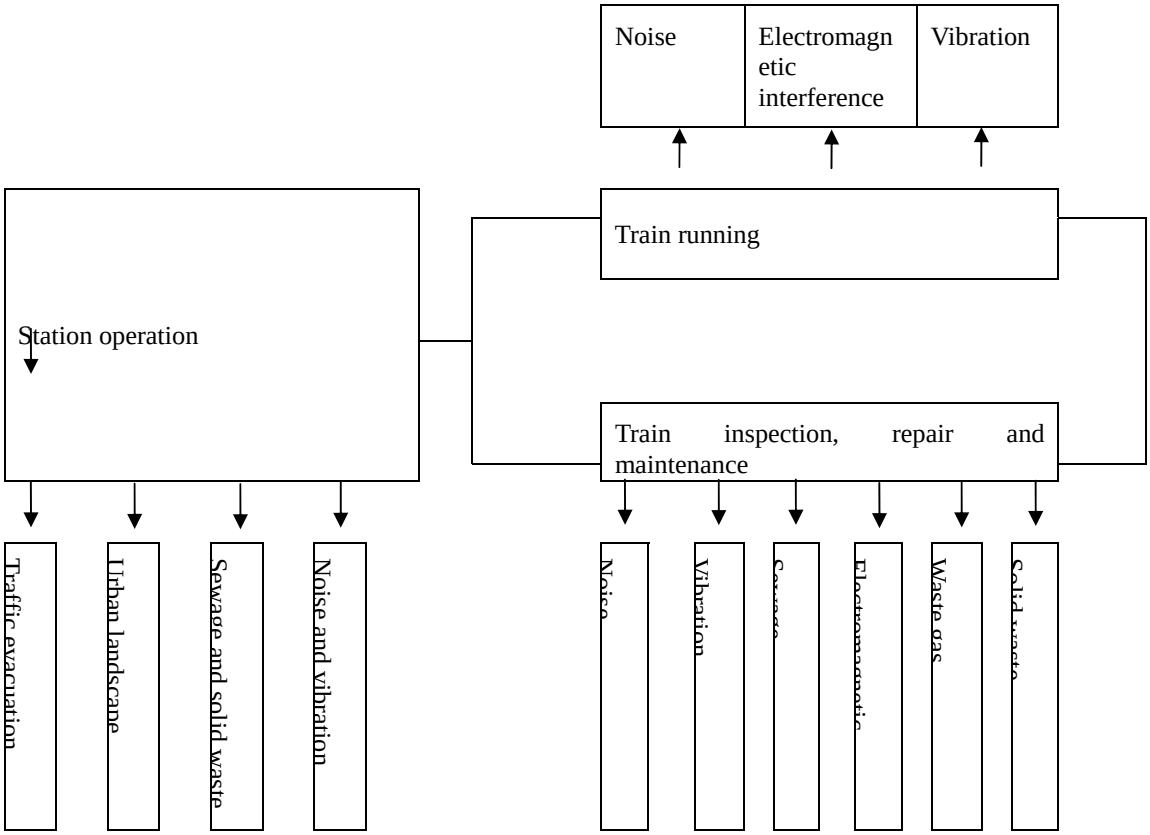


Fig. 2-8 Schematic diagram of environmental impact during the operation stage

2.2.2 Characteristic analysis on environmental impact during the construction stage

(1) During the construction stage, the engineering activities such as embankment filling, cutting excavation and station construction shall lead to vegetation deterioration, earth disturbance and easy-induced water loss and earth erosion, which are relatively significant for deep cutting, soft earth subgrade, immerseable embankment and other special subgrade section. The earth excavation and disposal activities shall change the landform of surface of earth excavating and disposing sites, causing the unbalance of permansive aspect and the water erosion.

(2) The land occupation of project shall change the service function of land, which shall have certain impact on agriculture, forestry, aquaculture industries.

(3) The project construction shall bring negative impacts on urban road traffic on the two sides and water transport. The noise and vibration caused by material transport and equipment field operation shall bring negative impacts on the normal life and work of residents living in the range of 200m on the two sides of road.

(4) The bridge and tunnel construction shall account for a large share of this project. The mud and sewage from bridge foundation bored pile construction, the sewage from tunnel entrance and incline shaft construction, and the domestic sewage discharged by constructors shall cause pollutions to water environment around.

(5) The dust from the processes of field construction and material transport and the waste gas discharged by fuel construction machinery shall influence the air environment in the range of 200m, and the dust pollution is especially significant.

(6) The project construction shall demolish a part of housing and bring negative impacts on the life quality of residents in a short term.

2.2.3 Analysis on environmental impact during the operation stage

(1) The noises, vibrations, electromagnetic interferences caused by trains running on the line have negative impacts on the living environment and the wireless television of residents along the line.

(2) The discharges of noise, sewage, solid waste have certain impacts on the environment.

2.2.4 Identification and screening of environmental impact

According to the characteristics of environmental impact from construction stage and operation stage and the specificity and sensitivity of environment along the line, the impacts on various environment elements by engineering activities should be made into “Environmental impact

identification and screening matrix chart", see Fig. 2-9.

Engineering stages	Engineering activity	Impact degree identification	Natural ecological environment					Physics-chemical environment					Social economic environment					
			Landform	Vegetation	Water and earth conservation	Agricultural irrigation	Drainage	Surface water	Acoustic environment	Vibration	Electromagnetic	Ambient air	Life of residents	Agriculture and forestry industry	Local economy	Land transport	Maritime transport	Tourism landscape
Impact degree identification			I	I	I	II	II	II	I	I	I	III	I	I	I	II	II	II
Construction stage	Land acquisition and demolition	II	-S	-S	-S								-M	-M	-M			
	Open construction road and develop temporary project	II	-L	-L	-L	-M	-M	-M	-M	-S		-M	-M			-M	-S	
	Construction material storage and transport	II							-M	-S		-M		-M	+M	-S	-M	
	Subgrade and earthwork & stonework construction	I	-L	-L	-L	-M	-M	-M	-M	-M		-M	-M			-M	-S	
	Bridge construction	II	-M	-M	-M	-M	-M	-M										
	Subgrade protection	I		+M	+L	+S	+S	+M				+M		+M				

	construction																	
	Housing construction	III	+S						-S			-S						
	Greening and recovery construction	I	+L	+L	+L	+S	+S		+S			+M		+M				
	Construction waste slag	II	-M	-M	-M	-S	-S	-S				-S		-S				
	Life of constructor	III						-S				-S		-S	+S			
Operation stage	Train service	I							-L	-L	-L	-S						+M
	Station	I						-M	-M		-M		+L		+L	+L		
	Locomotive maintenance	III						-S	-S	-S	-S							
	Domestic waste of staff	III	-S	-S	-S				-S			-S						

Fig. 2-9 Construction environmental impact identification and screening matrix chart

(1) Single impact degree identification: It reflects the impact of a certain type of construction project on certain environment element, the degree of which are identified in accordance with following symbols.+: Positive impact; -: Negative impact; L: Appreciable impact.

(2) Combined impact degree identification: It reflects the combined impact of a certain type of construction project on environment elements, or the degree of combined impact of engineering behavior on a certain influenced element.

2.2.5 Ecological environment impact analysis

The impacts of railway engineering construction of ecological environment mainly exist in the stage of engineering construction, which mainly include land acquisition, construction excavation and filling, waste earth and slag, construction demolition, etc. In addition, the engineering construction also have impacts on the rivers, channels, natural reserve, forest part, cultural relics and historic sites distributed along the line.

Both the construction stage and the operation stage of this project have different degrees of impact on the ecological environment. The impacts of construction stage on the ecological environment mainly include land use pattern changes, ground surface disturbances and water loss and soil erosion long the line, which are separately caused by the land use and waste slag of engineering construction. If the bridge foundation construction adopts improper protection, it is possible to increase the suspended matters in the water. The impacts of operation stage on the ecological environment mainly include the block of ecological corridors, the cut-off of ground surface water regime in the partial section, changes of landscape type, the induced environmental pollution, the aggravated environmental load, etc., which are possible caused by subgrade construction.

(1)The permanent and temporary works of this project cover 2216.88hm2, which shall change the original land function and reduce the vegetation and cultivated land resources. It shall also impact the output of agricultural and sideline production along the line. The change from original natural environment or agricultural environment to artificial environment mainly characterized by railway linear corridor shall have direct impacts on the agricultural population living on farming income.

(2) The earth-rock work volume of this project is 6990.29×104m3, which is mainly composed of filling, cutting, borrowing and wasting, of which the earth excavated for filling is 1406.66×104m3, the earth borrowed is 768.86×104m3, and the earth wasted is 2990.15×104m3. The earth excavating and depositing sites mainly occupy the cultivated land and forest land. The main impacts of earth excavating and depositing sites on ecological environment include the increase of temporary land occupation and the causing of water loss and soil erosion. In the process of placing waste soil, the water loss and soil erosion shall be triggered by improper stacking after rain wash. When borrowing soil from the excavation site, the surface soil should be removed, which shall destroy the surface material adhere to the soil. Due to the decisive effects of erosion protection works of vegetation, the damage to vegetation can lead to the increase of water loss and soil erosion in the same condition and the pollution of ambient environment.

(3) The permanent land occupations of this project mainly include subgrade and station construction. The excavation of subgrade bed shall change, crush, bury or damage the original vegetation and landform, and also change the service function of land. It can also make the surface soil in the range of railway land acquisition to be bare and loose deposits without original anti-erosion and soil fixation capacity of vegetation. The flattening of station site can also destroy the vegetation and landform and damage the original anti-erosion capacity of ground surface. In the process of excavation of subgrade and side slope of station, the high-cliffed and unstable artificial excavation may be produced, especially when cutting into a mountain, drilling rock walls, reducing peak or filling valley in a mountainous area. These can

change the original slope structure and reduce the stability of side slope. If no protection measures are taken, it is easy to cause scouring and increase water loose and soil erosion, and even make the side slope unstable to cause collapse, landslide, etc.

(4) The environmental impacts caused by the construction of bridge engineering may be extensive. As a navigable river, the Songhua River in this project has certain requirements on the height and width of bridge clearance. The design and construction of river-crossing bridge need to meet the navigable requirement. The aperture diameter of river-crossing bridge for animal migration, pedestrian and farming vehicle is required to meet relevant requirements so that the impacts of bridge construction on the ecology and living environment can be reduced.

The urban area, natural preservation zone and other such areas that have special requirements on bridge construction should take landscape into consideration when building bridges. If the bridge location, structure type, construction from, material, color, etc. are not properly selection and disharmonious with the surrounding landscape, the visual disturbance and depression can be brought to the pedestrians, causing the landscape impact.

The total number of super-large-scale, large-scale and medium-scale bridges to be built for the main line of this project is 103 with total length of 88595.11m, of which the total length of culvert is 7649 linear meters. The bridges take up 24.25% of full length of line. One super-large-scale bridge with a total length of 1714m shall be built for the connecting line between Changchun-Tumen Line and Longtanshan-Shulan Line. The main river-crossing bridges include Songhuajiang River super-large-scale bridge (Class II Water column), Xiaojiao River super-large-scale bridge (Class III Water column), Mudanjiang River super-large-scale bridge (Class V Water column), Bu’erhatong River super-large-scale bridge (Class II~III Water column), Changyang River super-large-scale bridge (Class III Water column), Gaya River super-large-scale bridge (Class IV Water colunm), Mijiang River super-large-scale (Salmon protection area), etc. The construction of bridge foundation (in-water cofferdam, bored pile, foundation excavation, etc.) will produce mud and waste soil. If they cannot be processed properly, the decrease o water quality of downstream section shall be caused. The construction of bridges of this line will also have certain impacts on the flood discharge and field irrigation along the line.

(5) Along the line, the main bad geological conditions are bedding, dangerous rock, and rockslide. The details are as follow: Along the line, the steep gullies are widely developed in the middle and low hills and hilly area which is deep from a few meters to tens of meters, with many landslide and collapse. The bedding exists in the Jurassic gray sandy stone, Cretaceous powder sandy stone and shale on right bank of Buerhatong River which is located in west of Mingyue Town, Antu County, right bank of Buerhatong River in its downstream from Laotougou to Tofo Temple, as well as right bank from Chayangchuan to Yanji. In the section from Dongmopan Mountain in Yanji to Tumen and to Huichun, there are deep valleys, steep terrain, developed geological structure and joint fracture, broken rocks, and dangerous rock and falling rocks are distributed in part of steep slope.

(6) The station is constructed in every county and city along the line in this project which will make a much more convenient traffic for the area along the line, accelerate the labor and information communication, and boost the economy. Meanwhile, new environmental effect will happen and increase the environmental burden of those areas.

(7) The greening will be carried out along this line to restore and improve the ecological environment along the railway line.

(8) The removal and rebuilding area is 588893m2 for the project. The project will cause the migration and rehabitation of some residents along the railway line, and their living environment and quality will be changed accordingly. The influence mainly covers Jinlin City, Dunhua Station, Aantu West Station, Yanji West Station, Yanji City, Tumen Station and some village along the line.

(9)This project is an important part of Chang-Tu Railway (railway line from Changchun City to Tumen City), and will be transportation passage for Tumen Port and Huihun Port. In order to carry out the strategy of revitalizing National Old Industrial Bases, the project is a very important part of traffic system for Chang-Ji-Tu Frontier Developing Zone, and will help to improve the investment atmosphere of those areas.

The project will contribute to improve the transportation efficiency and service level, optimize the port function with Russia and North Korean, promote the urbanization of cities along the line, improve the economy and trade communicate and develop the exploration of natural resources.

Meanwhile, with the development of economical development and exploration level, some bad environmental effect will be induced and increase the environmental burden of those area.

2.2.6 Acoustic Environment Impact Analysis

The noise sources of the construction include construction equipment noise and vehicle noise. Construction machine will make loud noise. There are various types of machinery and equipment on the site, including loaders, excavators, bulldozers, concrete mixers, mud machine, heavy cranes, rotary drilling rig, roller, and etc., and those and the main noise source. Based on a large number of on-site monitoring data in the past, the construction machinery noise shall be 65 ~ 80dBA 30m away. The details are in Table 12-2.

The noise from transportation vehicles is also loud. In the construction, the transportation of earth and stone, sand stone, equipment and materials may need a lot of transport vehicles, and those transport vehicles, especially for heavy vehicles, will produce a loud noise and will influence the surrounding environment along the access roads and existing highways by frequent transportation. The n noise strength of heavy vehicle is 62 ~ 72dBA 30m away. The details are in Table 12-2.

After operation, the main noise source to the environment will be the train. The environmental impact assessment of train noise source strength uses the noise source strength in the Value and Governing of Vibration Resource Noise Strength during the Environmental Impact Assessment of Railway Construction, MOR[2010]No.44, revised version of 2010. The operation noise of Ji-Hui Railway is in Table 2-22.

Table 2-22 (1) Noise source Strength of EMU

Units: dBA

Speed，km/h	Embankment section	Bridge section

	Ballast track	Ballastless track
160	79.5	73.5
170	80.0	74.0
180	81.0	75.0
190	81.5	75.5
200	82.5	76.5
210	83.5	77.5
220	84.5	78.5
230	85.5	79.5
240	86.0	80.0
250	86.5	80.5

Line conditions: seamless high-speed railway, 60kg / m rail, rail surface in good condition, concrete sleepers, straight embankment; bridge section use box girder with the width of 13.4m with 1m high protection wall.

Reference point: 25m away from the railway center line, and 3.5m above the rail top surface.

Table 2-22 (2) Noise source strength of passenger trains of 160km / h and below

Speed，km/h	50	60	70	80	90	100	110	120
Source strength, dBA	72.0	73.5	75.0	76.5	78.0	79.5	81.0	82.0

Line conditions: class Ⅰ railway or high-speed railway, seamless, 60kg/m rail, rail surface in good condition, concrete sleepers, ballast track, straight embankment line. As for normal-speed Railway Bridge, its noise source strength values shall be increased by 3dBA based on the a.m. table.

Reference point: 25m away from the center line of railway, and 3.5m above the rail top surface.

2.2.7 Analysis of environmental vibration influence

The vibration during construction mainly comes from a variety of construction machinery, heavy vehicles and piling vibration. According to the construction characteristics of this project, the machinery causing vibration are excavators, bulldozers, heavy trucks, road rollers, drilling - grouting machine, air compressor, hammer picks and so on. According to analogy investigation, the vibration source strength values of major construction machinery and equipment are listed in Table 2-20.

The vibration level of pile driver is at the 83 ~ 88dB 30m away. Referring to the "Urban

Environmental Vibration Standard” in the "mixed zone ", the noise value is 75dB in daytime and 72dB at night time, whose influence could be 80～100m, which is far more than the allowed value. The other vibration construction equipment cause 72dB or more than that at the point of 30m away could basically meet the vibration standard of 72dB at night time specified in Urban Environmental Vibration Standard.

Table 2-23 Reference vibration level of construction machinery vibration source

SN	Name of construction equipment	vibration level (vertical to the Z vibration level, dB)	
		10m away from the vibration source	30m away from the vibration source
1	Excavator	80	71
2	Bulldozer	79	69
3	Heavy transporter	74	64
4	Roller	82	71
5	Drilling - grouting machine	63	/
6	Air Compressor	81	71
7	hammer picks	85	73
8	Diesel pile driver	98	83
9	Vibrating pile driver	93	83

During the operation, the vibration mainly comes from the collision of wheel and rail, and transferred to tunnel lining and bridge foundation via sleepers and track, and then to the ground, causing the vibration of building. The strength of vibration is mainly related to type of locomotive, load, speed, bridge structure, line conditions, geological conditions and other geological factors.

The vibration strength in this environmental assessment is the determined value in Value and Governing of Vibration Resource Noise Strength during the Environmental Impact Assessment of Railway Construction, MOR[2010]No.44, revised version of 2010.

The operation noise of Ji-Hui Railway is in Table 2-24.

Table 2-24 (1) Vibration source strength of passenger EMU

Units: dB

Speed，km/h	Embankment railway	Bridge railway
	Ballast track	Ballast track
160	76.0	67.5
170	76.5	68.0
180	77.0	69.0
190	77.5	69.5

200	78.0	70.5
210	78.5	71.5
220	79.0	72.5
230	79.5	73.5
240	80.0	74.0
250	80.5	74.5

Line conditions: high-speed rail, seamless, 60kg / m rail, rail surface in good condition, concrete sleepers, straight embankment line; bridge section is box girder in width of 13.4m.

Geological conditions: alluvium.

Axle load: 16t.

Reference point: on the ground and 30m away from the railway center line.

Table 2-24 (2) vibration source strength of passenger train with the speed of 160km / h and below

Speed，km/h	50～70	80～110	120
Source strength，dB	76.5	77.0	77.5

Line conditions: class Ⅰ railway or high-speed railway, seamless, 60kg/m rail, rail surface in good condition, concrete sleepers, ballast track straight embankment line. As for normal-speed Railway Bridge, its noise source strength values shall be increased by 3dBA based on the a.m. table.

Axle load: 21t.

Geological conditions: alluvium.

Reference point: on the ground and 30m away from the railway center line.

2.2.8 Analysis of influence to water environment

(1) Analysis of influence to water environment during construction

The wastewater during construction is mainly living wastewater from construction living area, oily water caused by vehicle maintenance, muddy water produced by piling. The waste water at each site is not so much, but the waste water will have bad impact on the surrounding area if no protection measure is taken in a long construction period.

(2) Analysis of impact on water environment during operation

The waste water during operation mainly comes from the living waste water in each station. The waste water is not so much, and mainly flows to the municipal sewage pipes. If the drainage is small, the waste water could be recycled.

The waste water of Jiaohe West station, Dunhua station, Antu West Station, Hunchun North

Station, Yanji West Stations and Tumen Station flows to municipal sewage pipe; Weihuling North station, Dashitou South Station, Liangshui North Station produce a small amount of waste water, so the waste water flows into the septic pool and grease traps and anaerobic filter tank, and then reused.

2.2.9 Electromagnetic Impact

The sparking and discharging will happen when the pantograph departs from the OCS during the running of locomotive, which will produces high frequency electromagnetic radiation; when the locomotive is running through a viaduct, the shadowing effect will influence the TV signal nearby.

Based on the analogy survey to the existing electrified railway, it is expected that the

Electromagnetic interference strength at the point 10m away from the center line is 25～55dB(μV/m) in case of TV signal frequency more than 30MHz. The affected area is not farther than 50m away from the track center line or traction transformation facilities. The electromagnetism mainly influences the low frequency television, and has less influence to the high frequency.

Electric field intensity under the OCS at the height of human being is around 1.3kV, which is lower than 4kV / m specified as recommended value in HJ/T24-1998. The frequency magnetic induction strength is less than 5mG (0.5μT) when it is 5m away from the main facility of traction transformation station, and the frequency magnetic induction strength the fencing is much lower. Therefore, the frequency electromagnetic field generated by traction transformation substation will not have harmful effects to the nearby residents.

Many studies indicate that electrified railway electromagnetic radiation does not affect human health both on high-speed and low speed railway.

2.2.10 Analysis of impact on air

The construction related to air quality are mainly exhaust of diesel construction machinery and transport vehicles, the dust produced during the excavation, backfilling, demolition and loading and unloading of sand, stone and powder material, dust caused by traffic. The main contamination during construction is dust, which could be reduced by wetting and restricted within 50m of construction area.

The locomotive is driven by electricity in full section and will not cause exhaust. Meanwhile, the operation of electrified railway could reduce the exhaust emission by public traffic along the railway. The heating system in Jiaohe West station uses the geothermy and the other stations use coal boiler for heating in winter, so the air pollution mainly comes from the boiler during operation.

2.2.11 Solid waste effect

The solid waste during construction is mainly generated from living rubbish of construction residence and construction waste. During operation, the solid waste mainly comes from the passenger trains, railway stations and other office and living area. The garbage bag is provided on the passenger train, and the rubbish is collected and sent to city sanitation for treatment, which

will not affect the surrounding environment so much..

3. Alternative Analysis

The proposed railway line is located in Jilin Province linking two neighbouring cities, i.e. Jilin City and Yanbian Prefecture. At present there is no express railway between Jilin City and Hunchun. The existing mixed-used (freight and passenger) single track railway between Jilin and Tumen and Tumen and Hunchun follow an lod alignment and are working to capacity. According to a 2009 record, the allowed speed of Chang-Tu section(Jilin to Tumen) is 90km/h, which means the one way trip from Jilin to Tumen is 7 hours at a actual speed of passenger 57.6km / h; the allowed speed of Tu-Hui Railway is 45 ~ 55km/h, with no passenger trains. Therefore, the line speed is low, and hardly meets the needs of economic development along the line.The new line will substantially reduce the travel time between Jilin and cities of Yanji, Tumen and Hunchun. The travel time between Jilin and Tumen will be reduced from preent about several hours to about two hours.

Without the proposed JiTuHun railway project, the increasing passenger and fright transportation demand would have to be met through widerning of the existing highway network and construction of new high-grade highway, which will have larger environmental footprint and social impact given its wider ROW. Furthermore, vehicles will have higher emission of air pollutants and green hose gases, compared to the railway for equivalent transportation capacity of passenger and freight, and poses higher risks of traffic safety in Chiense context.

The topographic conditions in the region are complicated with environmental sensitive areas. The proposed railway line will be constructed within an existing transport corridor, in parallel to several major highways including G302, G201, G202 highways and Changchun-Tumen Expressway, as well as Changchun-Tumen and Tumen-Hunchun railways. It is noted that this is the only available regional west-east transport corridor given the good ecological conditions in both south and north of the corridor. The economic hubs along the railway line are Jilin city, Jiaohe, Dunhua, Antu, Yanji, Tumen and Hunchun, and these hubs are located far from each other (40-70 km in average). Stations shall be set up for each economic hub, because it is extremely difficult so select routes and locate stations. Based on special geographic location, geological conditions and functional / technical stanards of the railway, the concept of environmetal protection was seriously considered in the alignment location during feasibiilty studies. Utmost effort has been made to avoid the environmentally sensitive areas as much as possible to ensure environmental feasibility of the alignment. In this regard, alternatives analysis has been regarded as one of the most important mitigation measures to minimize potential adverse environmental and social impact.

However, due to the distribution of economic hubs and special natural conditions along the line, there are 6 environmentally sensitive areas that will be impacted. These include (1) Jinlin Provincial Songhua River Three-Lake Nature Reservel, (2) Antu Mingyue Pine Mushroom Provincial Nature Reserve, (3) Mijiang River Salmon Resource Protection Area, (4) Jinlin City Water Source Protection Area, (5) Jiaohe City Water Source Protection Area, and (6) Longtanshan Relics Site and Maoershan Cemetery. Potential impacts and mitigation measures for these sites are addressed in later chapters.

Alternative alignments for various sections have been extensively studied, during which a comprehensive comparison was conducted to choose the optimal scheme in terms of environmetnal and social impacts, technical fesibility, and financial and economic benefits. Consultation with local government and relevant authorities of environmentally senstive areas were conducted and fully incoporated into the alternative selection process. Figure 3-1 shows the main alternatives and environmental protection objects of the project. Several key sections alternative comparison processes are summried in below sections.

Legend

- Recommended alternative
- Nature Reserve
- Forest Park
- Drinking Water Source Class I Protection Zone
- Drinking Water Source Class II Protection Zone
- Borrow Pits
- Soils/Spoils Disposal Sites
- Noise Sensitive Spots

Figure 3-1 Jinlin-Hunchun Railway Alternative and Environmental Protection Objects

3.1 The introduction of Jilin Joint Terminal

According to the positioning and direction of Ji Hui the passenger line, the plan for Jinlin Station and plan for Shuangji Station are the two main topics to introduce the joint terminal plan based on the estimated yearly passenger traffic, transportation organizations, status and urban planning of existing railway. The line alignment is shown in Figure 3-1 in details.

（1）Introduction of Jilin station (Plan Ⅰ)

The plan combines the status and urban planning of Jilin Joint Terminal, as well as the Longtan Mountain Protected Area and Maoershan Graveyard Protected Area. The plan also studies the program of going southwards to leave protected areas (Plan I-1) and going through the protected area in a controlled scope (Plan I-2). The alignment of the line is shown in Figure 3-2.

a) Going southwards to leave protected areas(Plan I-1)

The railway is going out Jinli Station and going over Shanghai Road and Jiefang Road, and then going over the flyover along the south side of Dongtan Street, and then going across Songhujiang River and Longfeng Railway, and then passing the south side of Maoershan Protected Area, and going eastwards over the City Expressway, and then going northeast, and then going east after passing Niangniang Temple, then the railway going along the north of Sanhu Provincial Natural Protected Zone, and then going east via Qingling Town and through Laoyeling, and finally reach the end point. The line is 56.42km, including 46.024km of bridge and tunnel, amounting 81.57% of the total. In this plan, 6.4km of Chang-Tu Connection Line and Long-Shu Connection Line shall be constructed. The total investment is 6,528,049,000 RMB.

b) Going through the protected area in a controlled scope (Plan I-2)

The line starts from Jinlin Station, and going east by the Chang-Tu Railway, and then going across Songhuajiang River on the south side of the existing railway bridge, and then going over the Long-Feng Railway, and Binjiang East Road to northeast, and then going through the restricted area in Longtanshan Protected Area and Maoershan Protected Area, going to the special railway for Jilin Refining Factory via Xiadatun, and then going over the City Expressway in north of Jilin Refining Factory, and going along the north of Sanhu Provincial Natural Protected Zone, and then going east via Qingling Town and through Laoyeling, and finally reach the end point CK59+100. The line is 59.1km, including 40.756km of bridge and tunnel, amounting 68.96％ of the total. In this plan, 4.7km of Chang-Tu Connection Line and Long-Shu Connection Line shall be constructed. The total investment is 6,044,635,000 RMB .

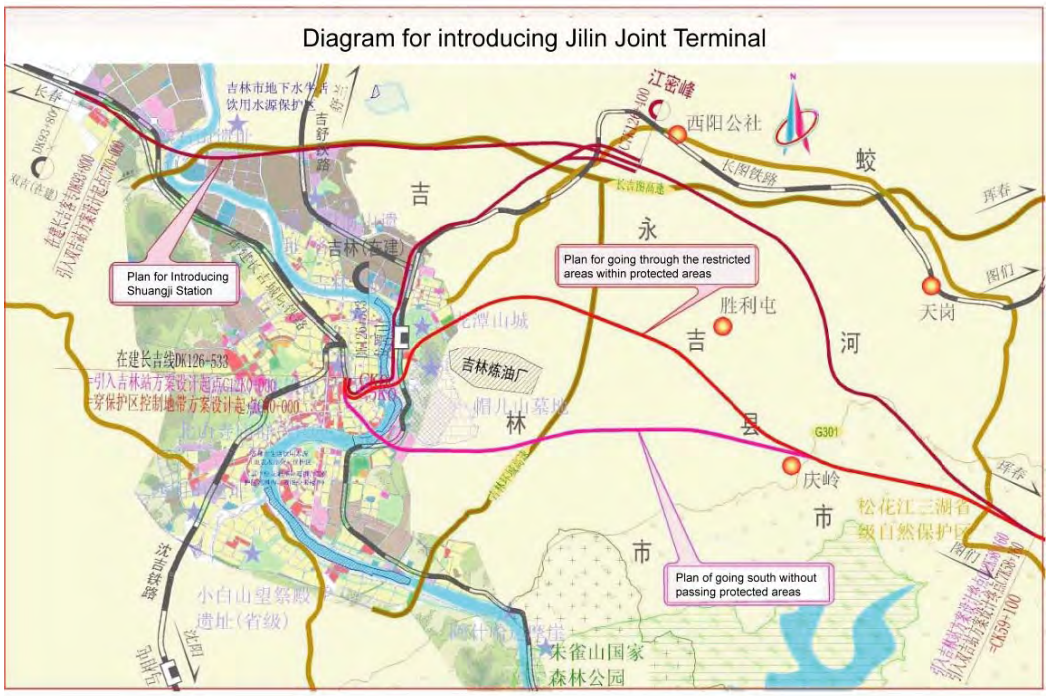


Figure 3-2 Jinlin Joint Options

(2) Plan for Introducing Shuangji Station (Plan II)

The railway starts from Shuangji Station of Changji intercity Railway, the old Changji Intercity railway going to the Jilin Station by the Upwards and Downwards Line in east of Shuangji Station. After going out of the station, Jihui PDL goes over the Chang-Tu Railway and Songhuajiang River near the Jiu Station, and then going east over the Chang-Ji-Tu Expressway along the north of Changhua Sewage Factory, and going over the Chang-Ji Expressway in south of Xiaotangfang after passing Beikouqin and Tangfangling, and then going over the existing Chang-Tu Railway at Dachapeng, and arriving Mifeng South Station(to be constructed), and then going southeast and finally reaching the end point CK59+100. The line is 72.452km, including 48.577 km of bridge and tunnel, amounting 67.05％ of the total. The total investment is 7,614,129,000 RMB.

In addition, a new Passenger Connection Line shall be constructed to connect Jilin Station along the existing Chang-Tu Railway. The Passenger Connection Line is going out of Intercity Yard of Jilin Station, and then going east along the existing Chang-Tu Railway, and then going over the Songhuajiang East Road, Songhuajiang River from the existing railway bridge, and going parallel with Long-Feng Branch Line in its west, and then going north at the Sidaogou, going east after going over the Chang-Ji-Tu Expressway, and then reaching Mifeng South Station. The line is 20.212km (double line), with the total investment of 1,676,358,000RMB. 2.9km of double lines and 14.536km of single line will be remodeled on Changji Railway after going out of the Changji Station. The number of major projects and investment are shown in table 3-1.

Analyzing the advantage and disadvantage of the plan

Table 3-1 Analysis of advantage and disadvantage

Item	Analysis of advantage and disadvantage	Assessment		
		Plan I-1	Plan I-2	Plan Ⅱ
Condition of the line	The line of plan I-1 program is the shortest one and the investment is not relatively small. The percentage of bridge and tunnel is the highest, so the construction is complex and difficult. The related connection line is only 6.4km. The line of Plan I-2 is relatively short, and 2.68km longer than that of Plan I-1 but 13.352km shorter than that of Plan II. The investment is the smallest,483.414 million RMB less than that of Plan I-1 and 3,245,851,000 RMB less than that of Plan II. The line has a relatively big percentage of bridge and tunnel, so the construction will be more complex and difficult. The related connection line is the shortest, only 4.7km. The line of Plan Ⅱ is the longest one, and going over the relatively flat terrain, easy to implement construction, but having the highest investment. The line in Plan II needs a construction of East Connection Line to join Jilin Station, which is 20.212km (double line). 2.9km of double line and 14.536km of single line shall be remodeled on Changji Railway. The connection line is too long, causing a huge construction.	Relatively bad	good	bad
geological conditions	The relative altitude difference in Plan I-1 and Plan I-2 is from 300 to 800m, and there is a small amount of full-weathered surface layer, with big amount of exposed bedrock, mainly Mesozoic intrusive granite, granodiorite, etc.; the terrain in Plan Ⅱ-1 are hilly, valleys, with soft soil and soft soil partly.	good	good	bad
Operating conditions and transport Organization	Plan I-1 and Plan I-2: all the passenger train could be managed in Jilin station with a smooth traffic, and equipment could be centralized and managed, while the high speed train shall have the speed limited passing Jilin station; Plan Ⅱ: All the initial departure trains and arriving trains shall be managed in Jilin Station via the Passenger East Ring Line, and the high speed could go through directly. The plan could meet the high speed and convenience required by passenger dedicated line (PDL), and traffic organization is easy and traffic flow is smooth.	good	good	bad
Running length	the operating length of Plan I-1, Plan I-2, Plan Ⅱ are : 75.33km, 78.01km, 72.452km; Plan Ⅱ has the shortest operating length.	bad	bad	good
Cooperation with urban planning	The line of Plan I-1 goes through the city along south of the Dongtang Street after going out of Jilin Station, so the removing and rebuilding work is the hardest one. The line of Plan I-2 is going out of the city along the existing line, having the smallest removing and rebuilding, and conforms to the urban planning, easy to attract passengers, having a good traffic condition. The line of Plan II goes through the city in a big area, and will have a lot of removing and rebuilding, does not meet the urban planning.	bad	good	bad
Impact on environment	The line of Plan I-2 goes through the Maoershan National Heritage Base, and will have bad impact on the sensitive environment, but the construction of PDL through the base is already approved by cultural relics department. The line of Plan II in Songhuajiang Provincial Nature Reserve is	Relatively bad	bad	good

	23km shorter than that in plan I-1, has the minimum impact on the sensitive environment.			
Construction conditions and time	The Lafalashan Tunnel in Plan I-1 is 9.8km long; Lafalashan Tunnel in Plan I-2 program is 12.3km, Lafalashan Tunnel in Plan II is 17.3km. The construction condition is poor and construction time is long.	bad	bad	good

Recommendations

to sum up: The line of Plan I-2 goes though the protected area and has impact on the sensitive environment, but the approval is obtained from the National Cultural Relics Department for constructing PDL through the protected area. The plan fully uses the existing urban facilities, and convenient for passengers, having less impact on local planning and the smallest investment. It is recommended to use Plan I-2, which is, connecting to Jilin Station and going through the protected area.

3.2 Plan for section from Jilin to Jiaohe

At the investigation stage, the section at CK7 +000- CK70 +000 has many factors that may influence the alignment of the line. After considering the terrain conditions, Songhuajiang River and Three-lake Protected Area, Lafashan National Forest Park, Jiaohe Living Water Source Proection Area, two plans are studied in the design; one is a straight line going through west of Jiaohe City, and the other one is going along the expressway. The two plans are shown in Figure 3-3.

1. Plan explanation (Section CK7-CK70)

(1) The Straightening plan via Jiaohe West (Plan Ⅰ program, red line)

The railway of this plan starts from CK7+000, going eastwards and going over the City Expressway, and arriving Qingling Town(Xinkaihe Town) via Zhongsha, Shahenangou and Songhuajiang River Conservation Area, and then going through Laoyeling by a 9.8km and 3.2km tunnel, and then reach the new Jiaohe West station. The line is 57.997km, including 39.90km of bridge and tunnel, amounting 68.71％ of the total. The total investment is 4,743,885,000 RMB.

(2) Along the Expressway corridor (Plan II, Blue line)

The railway of this plan starts from CK7+000, going over the City Expressway and then going northeastwards and arriving Tiangang Town so as to avoid Tiangang Ggranite Exploration Area, and then going over the Chang-Tu Railway, G302, Chang-Ji-Tu Expressway, and then going southeast and going through Laoyeling, and then reach the new Jiaohe West station. The line is 65.057km, including 31.6km of bridge and tunnel, amounting 48.65％ of the total. The total investment is 4,917,816,000 RMB.

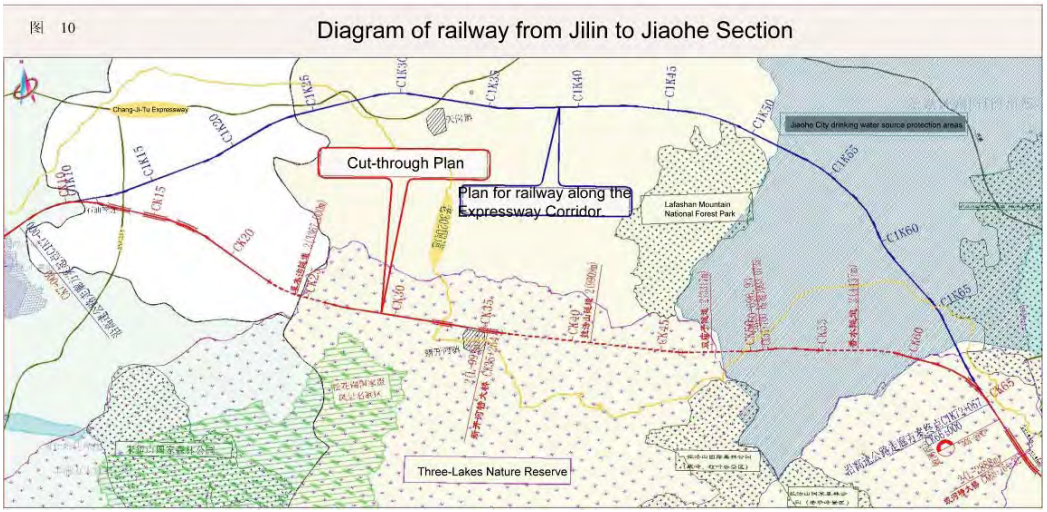


Figure 3-3 Jilin-Jiaohe Section Alternative Analysis

2. Scheme advantages and disadvantages analysis

Refer to table 3-2 for the Influence of Scheme and Scheme Ⅱ on the environment:

Table-3-2 Scheme comparison table from Jilin to Jiaohe section

Scheme / Category	Straighter scheme across west of Jiaohe (scheme Ⅰ, red line)	Along the road corridor scheme (scheme Ⅱ, blue line)	Advantages and disadvantages comparison analysis
Influence on ecological sensitive area	1. Section CK24+700 ～ CK48+120 and CK60+400 ～ CK69+000 respectively across three lakes nature reserve of Songhua River far lake 23.4km (bridge and tunnel account for 90%), 8.6km (bridge and tunnel account for 40%), 32km in total, and Jiaohe West Station will be set up within the second section. 2. CK48+120 ～ CK60+400 across Jiaohe Quasi water reserves 11.3km. 3. The nearest distance from Lafa Mountain National Forest Park is 800m. Although this scheme across the first section (23.4km) of three lakes nature reserve, it is mainly in the form of bridge and tunnel, and the section passed belong to the edge of far lake of the reserve and the forestland covered is mostly natural secondary forest; the main function of the far lake area is to store water, protect water and soil, prevent pollution and protect ecological environment with forest vegetation the line covers forest vegetation damage is mainly by	1. Section C1K68+120(=CK62) ～ CK69+00 cross three lakes nature reserve of Songhua River far lake for 7km (bridge and tunnel account for 40%) and Jiaohe West Station will be set up within the reserve. 2. C1K51+600～C1K67+500 cross Jiaohe quasi-water reserve 15.9km and this scheme is near the water intake. C1K48 ～ C1K48+800 is close to the boundary of Lafa Mountain National Forest Park. Comparatively speaking, the scheme that along the highway bypasses the first section of the three lake reserve, but the line is close to the Frozen lake ditch scenic spot of Lafa Mountain National Forest Park., the forest cover of this scenic spot is 96%, most of which are natural forest areas, it is the nearest original ecological zone of Jilin city. The forest land occupied by the road crossing the scenic spot and the natural forest within the scenic spot is integrated, so the bridge tunnel proportion of the scheme of the line along the highway is low (about 49%), the forestland and farmland occupied is	Scheme I cross three lake reserve for a long range, it has great influence on the reserve. Scheme II has great influence on the water source and Lafa park. Analysing from the perspective of three lake reserve, scheme II is better than scheme I. Analysing from the prespective of the influence of the whole railway line scheme on the forest vegetation and wildlife, scheme I is better than scheme II. Analysing from the perspective of the source of drinking water of Jiaohe, scheme I is

Scheme / Category		Straighter scheme across west of Jiaohe (scheme Ⅰ, red line)	Along the road corridor scheme (scheme Ⅱ, blue line)	Advantages and disadvantages comparison analysis
		embankment land expropriation and tunnel portal, according to the design, the forest vegetation along the embankments and the tunnel portal will be recovered after the project completion, this will effectively alleviate the influence of the project on the vegetation; besides, though there are some international reserve plants, the quantity is limited, the percentage is very low compared with this region; meanwhile, as the area the line crossed is at the edge of the reserve, there are many villages, and the ravine and valley and mountain region along the river have been exploited to farmland, rare wildlife can really be seen, and the section across the reserve in this scheme are mostly tunnels, wildlife still can pass from the top of the tunnel, therefore, the project has little influence on the wildlife passageway.	greater than scheme I, and the permanent occupation of more embankment has greater destructiveness on the forestland; As there are large number of national protective vegetations like ASH, the national protective vegetation this scheme involves is bigger than scheme I, thus analysing from the reserve, the influence of this scheme is greater than scheme I despite of the fact that the line is not cross the three lake reserve; as for the influence on the wildlife, the forestland involves in this scheme is more than that of scheme I, although the line in this scheme does not cross the reserve, the activity of wildlife within this area is possible, therefore, the influence of this scheme on the wildlife passway in the form of embankment occupation is greater than scheme I.	recommended.
Influence on urban planning		This scheme cross the new town planned by Jiaohe city, so there is no influence of city separation, and the new Jiaohe West Station located in the new town of Jiaohe city and on the edge of the old town, it is convenient for the resident to come in and out, and thus it complies with the development plan of Jiaohe city.	The influence of this scheme on the city planning of Jiaohe city is the same as scheme I.	equivalent
Influence on social environment		Ore does not involved in this scheme	The scheme along the highway is at north edge of Tiangang quarry yard in section C1K29+250-C1K34+250, across Wudaohe iron-copper-tinpolymetallic census area of Jilin Jiaohe 5.45kim in section C1K40+970-C1K46+420, at present, the private excavation of this census area is hard to identify, the underground gob has hidden dangers for the safety of the line.	Recommend scheme I
Influence on ecological environment	Land coverage circumstances	This scheme covers about 132hm2 area of forestland and farmland.	Covers about 224hm2, which are mainly forest land and farmland.	Recommend scheme I
	Earthwork circumstances	The earthwork on the embankment is about 2.8 million m2 and tunnel excavation amount to 3.68 million m2 , the total is about 6.48 million m2 .	Embankment earthwork is about 6.2million m2, tunnel 2.4 million m2, 8.6 million m2 in total.	Recommend scheme I
	Bridge and tunnel circumstances	The bridge tunnel proportion is 68.71％, the investment is high and the longest tunnel is 9.099kim, the construction is difficult. This scheme involves 16 rivers, involves 1 water reserve and is 8.5km away from secondary reserve.	The bridge tunnel proportion is 48.65%, though the control project is little, the length of the line increased about 7km, so the investment is high. 20 rivers and 1 water reserve are involved and is 5km away from secondary reserve.	Recommend scheme I
Population influence		There are 22 villages that will be influenced by the railway, wherein 3 schools and 1920 people/480 families are involved, which distribute along	There are 28 villages that will be influenced by the railway, wherein 5 schools and 2496 people/624 families are involved, which distribute along the two	Recommend scheme I

Scheme / Category	Straighter scheme across west of Jiaohe (scheme Ⅰ, red line)	Along the road corridor scheme (scheme Ⅱ, blue line)	Advantages and disadvantages comparison analysis
	the two sides of the line within 100m, of which 118 families should be moved. The project has little influence on the sensitive area compared with scheme II, the investment is relatively low for noise protective measures.	sides of the line within 80m, of which 142 families should be moved. The railway cross in the middle of some villages, it will greatly separate the villages and influence the life of the residents. The project has great influence on the sensitive area compared with scheme I, the investment is relatively high for noise protective measures.	

In conclusion, the straighter scheme cross the west of Jiaohe (scheme I, red line) cross the three lake reserve for a long distance, but the first section crossed is mainly bridge and tunnel, thus the great land occupation and ecological damage of natural reserve by the embankment is avoid; while compared from the influnce on the resident along the line, the project occupation and investment and earthwork quantity, this scheme is better than the scheme that along highway corridor (scheme II, blue line); meanwhile, the scheme along the highway crosses the Wudaohe iron-copper-tinpolymetallic census area of Jilin Jiaohe 5.45kim in the section of C1K40+970-C1K46+420, this involves core, and private excavation and underground gob of the census area will endanger the safety of the line; as the mileage of scheme along the highway is about 7 km, the operation fee of 30 years will increase 86,442 Yuan. Therefore, all things considered, Environmental Impact Acssessment recommends the straighter scheme cross the west of Jiaohe.

3.3 Section from Jiaohe to Weihu Ling

The section of CK76 +000- CK131 +000 passes east of Jiaohe City and west of Dunhua City which is mainly controlled by the geological condition at Dabinghugou molybdenum area and Jilin Huangnihe Dalizi Provincial Forest Park. The plan mainly studies the Baishishan short tunnel and Baishishan Long tunnel. The alignment of this plan is shown in details in Figure 3-4.

1. Plan explanation (Section CK76-CK131)

(1) Baishishan short tunnel plan (Plan Ⅰ, red)

The line starts from CK76 +000, and going cross G302, existing Chang-Tu Railway, Xiaojiao River, and then going northeast, and then going east over existing Chang-Tu Railway and G302 via Zhaojiagou, Xin Village, Ailin Village, and Dabinhu molybdenum mine, and then going over Chang-Ji-Tu Expressway, G302, Changtu-Railway via Huangsongdian Line, going southeast to north of Weihuling and going to Weihuling North Station, and then going over Chang-Tu Railway, G302, Chang-Ji-Tu Expressway again, and arriving the end point CK131+000. The line is 57.492km, including 31.52km of bridge and tunnel, amounting 54.83% of the total. The total investment is 4,524,476,000 RMB.

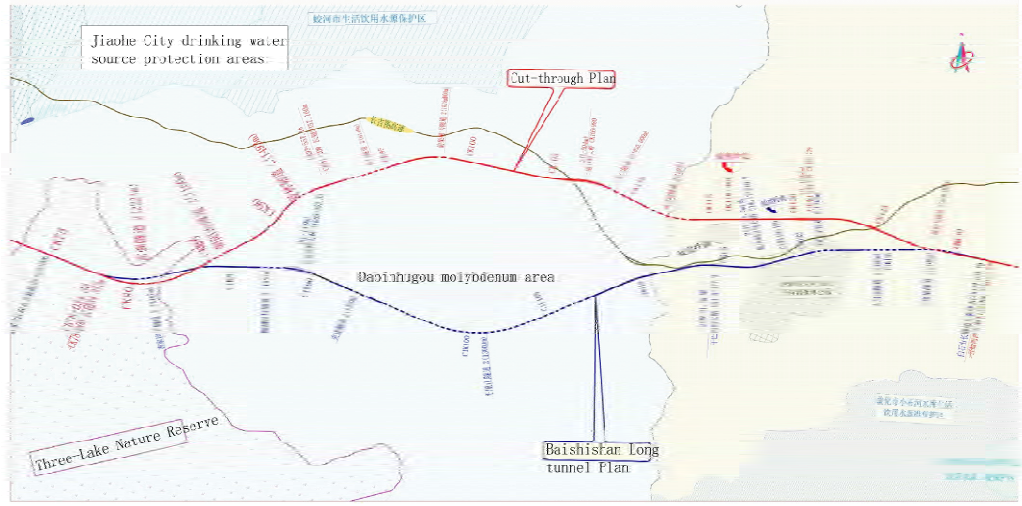


Figure 3-4 Diagram of plan for section from Jiaohe to Weihuling

(2) Baishishan long tunnel plan (Plan Ⅱ)

The line starts from CK76 +000, and going over G302, Chang-Tu Railway, Xiaojiaohe, and then going Southeast along Xiaojiaohe, and then going through the Pingdingshan Tunnel via Baishishan, and then going round Dabinhugou molybdenum area, and then going east to Weihuling South Station, and going over G201, and going to a new station to north of Dashitou Town via Daqiao Town, and then going east to the end point. The line is 55.142km, including 37.53km of bridge and tunnel, amounting 68.07% of the total. The total investment is 4,619,554,000 RMB.

2. The advantages and disadvantages of the plan

The impact of Plan I an Plan II on environment is shown in Table 3-3:

Table 3-3 Comparison of plan for section from Jiaohe to Weihuling

Item \ Plan		Plan of Baishishan short tunnel (Plan Ⅰ, red line)	Plan of Baishishan long tunnel (Plan Ⅱ, Blue Line)	Comparison of advantage and disadvantage
Impact to ecological sensitive area		1. The plan starts in Songhuajiang River three lakes protected area, the alignment is consistent with Plan Ⅱ. 2. The line going round the Jilin Huangnihe Dalizi Provincial Forest Park.	1. The plan starts in Songhuajiang River three lakes protected area, the alignment is consistent with Plan I. 2, The section C1K117 +450 ~ C1K122 +500 going through Jilin Huangnihe Dalizi Provincial Forest Park about 5.05km, and the Weihu South Station in the park.	Plan 1 avoids Dalizi Provincial Forest Park . Plan II goes through the park with station. Plan I is recommended.
Impact on urban planning		The line in this plan is close to Weihuling Town and convenient for the residents. The line is isolated from the village by hill, so the noise impact is greatly reduced.	The station is far away from the village and isolated by expressway, so it is not convenient to get on and off.	Plan Ⅰ is recommend
Ecological impact	Farmland occupation	Covering 174hm2, mainly woodland and farmland.	Covering about 124hm2, mainly woodland and farmland. The birch in the forest park shall be cut down.	Plan Ⅰ is recommend
	Earth and rock condition	The total amount of earthwork is about 4820000M3, and 2850000M3 for tunnel, 7670000 M3 in all.	The total amount of earthwork is about 3260000M3, and 3700000M3 for tunnel, 7670000 M3 in all.	Plan II is recommend
	Bridge and tunnel condition	Bridge and Tunnel percentage is 54.83% with low investment and no long tunnel, no control projects	Bridge and Tunnel percentage is 68.07%, with a super long tunnel around 13km, big investment and difficult construction	Plan I is recommend
Influenced by population		7 villages are influenced by railways, so the investment to reduce noise is relatively big.	6 villages are influenced by railways, so the investment to reduce noise is relatively small.	same

In summary, the Baishishan short tunnel plan (Plan Ⅰ, red line) avoids Jilin Huangnihe Dalizi provincial forest park, which takes more land but could save the natural birch forest. Meanwhile, this plan avoids the molybdenum mine area. Concerning the long tunnel plan, the effect on molybdenum mine is much smaller. When analyzing the influence to the residents and the construction soil and rock, the two plans are equal. However, Plan I could save more investment, and convenient for the Weihuling residents. Therefore, considering in an over view, the Baishishan Short tunnel plan is recommended based on environmental assessment.

3.4 Plan of Tumen Station (CK277-CK320)

According to the function orientation and direction of Ji-Hui Railway and considering the station layout, the urban planning, the geological condition as well as military facilities, studies are made on going in the south and going out in the north at Tumen Station, and Tumen west station and Tumen North station are planned. The alignment of each plan is shown in Figure 3-5.

1) Plan of going in from the south and out from the north (plan Ⅰ)

The line of this plan starts from CK277+000, going east through Guangji Village and Mopan Village of Changan Town, and then going over the Chang-Tu railway and Buerhatong River, and then going through the Riguangshan Provincial Forest Park in form of tunnel after passing Shuinan Village. The line leads to Tumen Station through the Tumen City in a radius of 1600m, and then going over the Tui-Hui Railway, Gaya River, G302 and going eastwards and reaching the end point CK320+500 via Anshan Tunnel. The line is 44.674km, including 36.937km of bridge and tunnel, amounting 82.68% of the total. The total investment is 4,527,573,000 RMB.

2) Plan to set Tumen West Station (Plan Ⅱ)

The line of this plan starts form CK277+000 and going to north of Shangdongjing Village , having the alignment like the plan of going to Tumen Station in south and going out in north. Then the line going north to Lixin Village, and going to Wugong Village which is in west of Tumen city where the Tumen West Station is set, then the line is going east over the Chang-Tu Railway, Mu-Tu Railway, Gaya River, G302, and then reaching end point after going through the 7.9km Changhouan Tunnel. The line is 42.095km, including 34.106km of bridge and tunnel, amounting 81.02％ of the total. The total investment is 3,959,250,000 RMB.

3)Plan of setting Tumen North Station(Plan III)

The line of this plan starts at CK277+400 and going east via Guangji Village and Mopan Village in Changan Town, and then going east over the Changtu Railway, Buerhatong River, and then going northeast to Bishui Village, and then going southeast to passing Changtu Railway and Tu-Mu railway and heading existing Qushui Station where the Tumen North Station is set, then going out of Qushui Station in the south and going over the Gaya River, G302 and reaching the end point via Aanshan Tunnel. The line is 38.688km, including 31.202km of bridge and tunnel, amounting 80.65％ of the total. The total investment is 3,686,317,000 RMB.

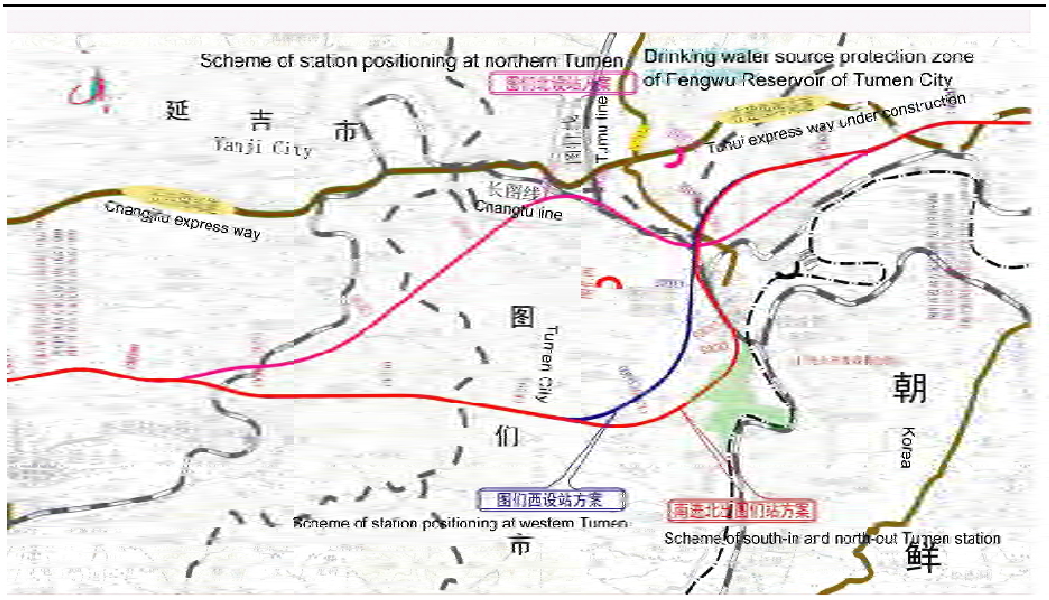


Fig. 3-5 Comparison diagram of Tumen station site scheme

Table 3-4 Comparison table of Tumen station site scheme

Scheme / Type		Tumen station scheme (Scheme I, red line)	Scheme of station positioning at western Tumen (Scheme II, blue line)	Scheme of station positioning at northern Tumen (Scheme III, pink line)	Comparative analysis of advantages and disadvantages
Influence on ecological sensitive area		1. Cross the Sunny Hill Provincial Forest Park in tunnel type at CK301+600~CK303+850 section. 2. The line bypasses the state-level cultural relics of Mopan village mountain town in the front and rear of CK285, and passes 200m outside of the controlled construction belts.	1. Bypass the Sunny Hill Provincial Forest Park and the nearest distance from the park is 1km. 2. The line bypasses the state-level cultural relics of Mopan village mountain town in the front and rear of CK285, and passes 200m outside of the controlled construction belts.	1. Bypass the state-level cultural relics of Mopan village mountain town. 2. Bypass the Sunny Hill Provincial Forest Park.	Scheme I is to cross the Sunny Hill Provincial Forest Park in tunnel type and to bypass the cultural relics; Scheme II and III bypass the forest park and the cultural relics; Scheme II and III are recommended.
Influence on urban planning		This scheme fully exerts the existing stations and is best for resident trip; but this scheme may cause mass removal of private houses and enterprises and institutions.	This scheme is closer to the city and is of less convenience than Scheme I.	This Scheme is good for long-dated development of Tumen city, but may cause slight inconvenience for resident trip.	Scheme II and III are recommended.
Influence on ecological	Occupation of land	The area covered is about 63hm2 and is mainly woodland, plowland, land for residence use and land for	The area covered is about 71hm2 and is mainly woodland,	The area covered is about 66hm2 and is mainly plowland,	Scheme I and III are recommended.

environment		commercial use.	plowland, land for residence use and land for commercial use.	land for residence use and land for commercial use.	
	Earthwork conditions	The road earthwork is about 1,730,000m3, the station site earthwork is about 900,000 m3, the dug tunnel earthwork is 4,290,000 m3, and the total is 6,920,000 m3.	The road earthwork is about 1,780,000 m3, the station site earthwork is about 1,980,000 m3, the dug tunnel earthwork is 3,980,000m3, and the total is 7,740,000 m3.	The road earthwork is about 1,956,000 m3, the station site earthwork is about 586,000 m3, the dug tunnel earthwork is 3,560,000 m3, and the total is 6,100,000 m3.	Scheme III is recommended.
Situation of influenced population		8 villages are influenced by the railway, and the investment of noise reduction measures taken by this project is relatively large.	10 villages are influenced by the railway, and the investment of noise reduction measures taken by this project is the largest.	5 villages are influenced by the railway, and the investment of noise reduction measures taken by this project is the least.	Scheme III is recommended.

In conclusion, the schemes of leading in Tumen area have different advantages and disadvantages, but as a major route of passenger transportation, this line should focus on providing convenience for passenger trip and coordination with city development planning. Therefore the Scheme of station positioning at northern Tumen is relatively reasonable by overall comparison.

3.5 Compatibility analysis of project construction and city planning

3.5.1 Compatibility analysis of project construction and overall city planning of Jilin

(1) Overall city planning

As a famous ancient city of Dongbei province, the central city of Jilin is currently divided into the north of the river, city center and new town in the south of the river by the Songhua River, forming a pattern including the northern industrial park, central commercial district, financial district, the southern scientific and technological district and the high-tech zone. The overall planning of the city adopts Level 2 distributed group layout structure, with the first structure consisting of the main urban area and two groups of Shuangji and Fengman, the secondary structure consisting of the center group and four periphery groups of the west, the north, the south and the southwest. It is estimated that the city population of the central city of Jilin in 2020 and 2030 will respectively be 2,200,000 and 3,300,000.

(2) Comprehensive city traffic planning

The comprehensive city traffic planning builds a “double ring + radiation” shape fast road net system, linking Changtu and Hajishen expressway; the internal city builds a comprehensive traffic

net taking fast roads and arterial roads as its framework. Plan and build the traffic transportation pattern with “One center, two systems”. The passenger transportation system consists of one center station and two passenger transportation stations; the center station is located in Jlin Station and the two passenger stations are respectively located in Shahezi of the western new town and the neighborhood of Zunyi Road in the north of the river.

(3) Relationship between the line scheme and city planning

According to “The commitment letter of the people’s government of Jilin City on the scheme of leading Jitu passenger dedicated lines from Jilin Station”, it is urged to lead the Jitu passenger dedicated lines from Jilin Station along the existing Changtu line, then to cross the controlled construction belts of the state-level cultural relics protection unit of Maoshan Graveyard in the middle of Longtan Mountain Protection Area and Maoshan Protection Area in overpass and tunnel type after crossing the Songhua River. In this way it won’t destroy the ground and the shallow layer while crossing the controlled construction belts outside the core area, which can not only guarantee the technological requirements of railway passenger dedicated lines, but also can satisfy the overall planning requirements of Jilin City, and can effectively protect the state-level cultural relics.

Combining the overall planning of Jilin City and the trend of this line, the newly-built railway from Jilin to Hunchun starts from the existing Jilin Station which is in south-north-trend, and the line must cross the Songhua River to head to Jiaohe City in the east when it goes along the southeast after coming out the station. The exiting Jilin Station is located in the center district of Jilin City surrounded with compact residential districts and commercial districts. Considering that ordinary speed trains go the existing Changtu line, four lines (among which two lines are used for ordinary speed trains to go along the existing Changtu line) are required to come out the Jilin Station and cross the river, which covers a large area. In order to reduce the removal influence on the urban area caused by the newly-built railway to the utmost extent, this line adopts the scheme of parallelizing the existing Changtu lines, broadening the existing railway passages, so as to avoid a secondary division for the urban area and reduce bad influences such as land occupation and noise to the minimum, and thus the line trend satisfies the city planning of Jilin. Please refer to Figure 3-6 for the relationship between the line and the overall planning of Jilin City.

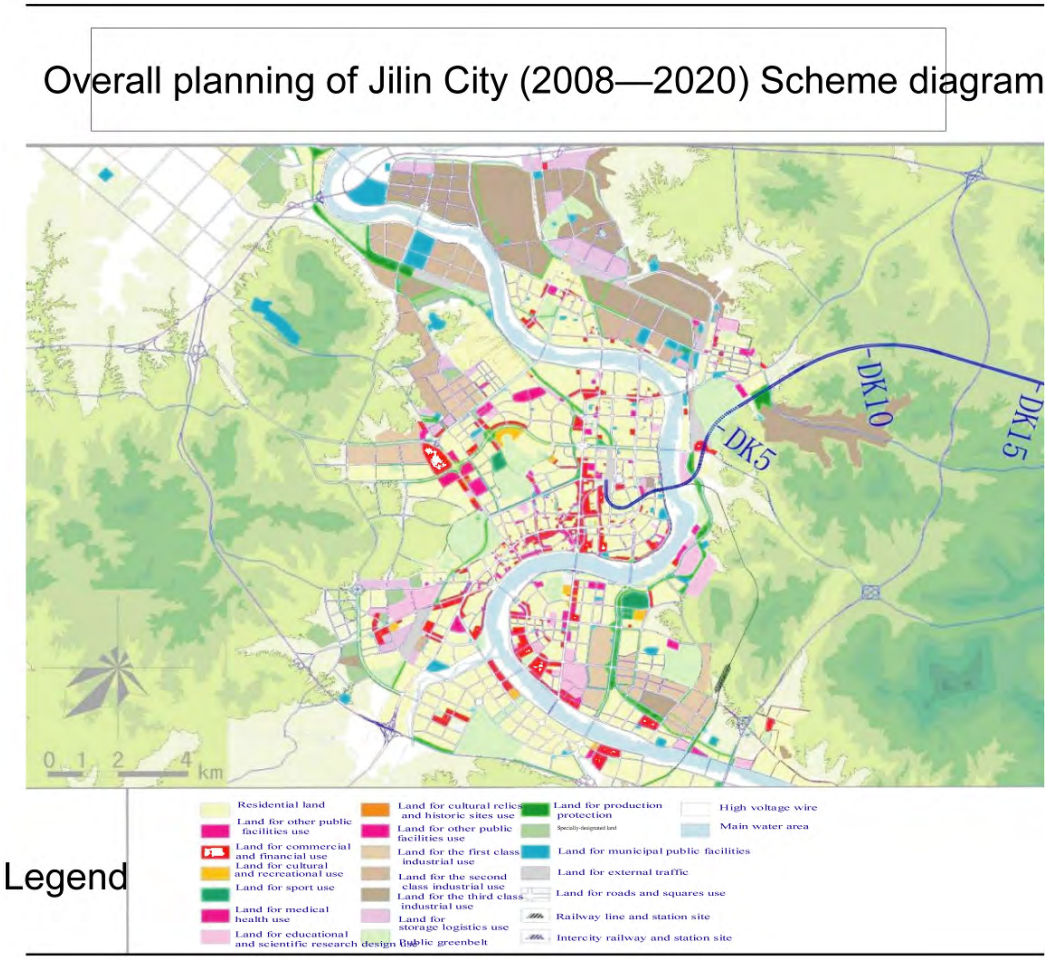


Fig. 3-6 Relationship between the newly-built railway line from Jilin to Hunchun and the overall planning of Jilin City

According to the railway trend, the existing lines to be parallelized mainly cross residential districts before crossing the Songhua River, and the total removal is 88940m2 according to field statistics. Although a great lot of residential districts close to the line have been removed along the line before the newly-built railway crosses the Songhua River, the train of this line has more number and acoustic barrier noise-reduction measures have been taken for both sides of this line in the design, there are 4450 linear meters of acoustic barrier is set in total. And considering that the urban area has numerous 6-7 storey buildings, the height of the acoustic barrier is designed to be 4m. The designed noise-reduction measures are regarded by environmental review to effectively reduce the noise influence on residents on both sides of the railway after the newly-built railway is been put into use.

The line mainly cross Yongan Village, Luchang Village in overpass type after crossing the Songhua River, and the total removal is 7695m2. Acoustic barrier noise-reduction measures have been taken for the passed village areas in the design, and a total 2.5m acoustic barrier of 970 linear meters is set so as to effectively relieve the noise influence of railway. To analyze according to Fig.

13, the line crosses part of the land for commercial and financial use under planning after crossing the river. According to the field investigation, the Songhua River road bridge in the lower reach of the existing railway bridge is under construction currently, and the planned commercial and financial land to be passed by the railway is mainly farmland and some houses and enterprises. This line passes in overpass type and covers a smaller area; however, in consideration of a certain degree noise and vibration influence on both sides of the line after the railway is been put into use, and an overpass railway across the sky may produce landscape effect, it is suggested that buildings demanding high noise and vibration conditions should not be built in the adjacent areas of both sides of the railway for city planning.

3.5.2 Compatibility analysis of project construction and overall city planning of Yanji

(1) Overall city planning

According to “The overall city planning of Yanji” (2007~2030), the city development direction of Yanji and the main economic connection direction are consistent, which give priority to development towards the west and the north, one is that Yanji urban area develops continuously towards the west driven by the prefectural administrative and cultural center, and the other is to promote the west to develop towards the urban area of the west Chaoyangchuan driven by the prefectural new emerging industry centralized zone, new center construction and new Yanji Station (Yanji Station of Changtu fast railway). It is estimated that the city population of the central city of Yanji in 2020 and 2030 will respectively be 510,000 and 550,000.

The planning shapes a pattern of “The main urban area of Yanji + The auxiliary urban area of Chaoyangchuan”, and shapes a public center layout with “Two major and two auxiliary”. Marked by the Maoer Mountain and framed by two rivers (the Buerhatong River and the Yanji River), the central city is divided into 8 functional areas.

(2) Comprehensive city traffic planning

The traffic planning takes the orientation of serving the central city of Tumen River area, builds a fast and convenient comprehensive traffic net system with reasonable layout consisting of roads, railways, airlines and diversified transport manners. The road shapes a road net framework with “Three horizontals”, “two verticals” and “Five connections”, and the city road sets up a third class city net system of arterial roads, sub arterial roads and branches.

With respect to railways, it is planned to newly build the Changtu fast railway, renovate and improve the existing Changtu railway and the eastern border railways. It is planned to build a new Yanji Station (Yanji Station of Changtu fast railway) in the new district of Chaoyangchuan, which mainly serves for passenger transport; emphasize the functional division of the existing Yanji Station and Chaoyangchuan Station, with Yanji Station serving for passenger transport and Chaoyangchuan Station serving for freight transport.

(3) Relationship between the project and the planning of Yanji City

According to “YSZH No. [2009]40”, Yanji City strongly urges that the address selection of

Chaoyangchuan Town should be the most reasonable, which can not only satisfy the development planning of Yantulong City and Yanji City, but can be good for residents of Yanji and even other cities of Yanbian prefecture to fully use the existing city basic facilities and can reduce project investment. After discussing with local authorities time after time, the design combines the smooth and direct features of passenger dedicated lines to confirm the station address selection scheme, so as to offer better services for people's trip.

The recommended line scheme (station positioning in the west of Yanji) is 6.6km from the current city center and is located between the urban area of Yanji City and Chaoyangchuan Town. As a central developing city area with convenient traffic to the built-up district of the city, it is easy to attract the existing passenger flow, as well as to give attention to future passenger flow development, and to be convenient for linking supporting facilities of the city and passengers' trip, thus the station site conforms to local planning. Please refer to Figure 14 for the relationship between the line and the overall planning of Yanji City.

The Jihun passenger dedicated line is an electrical traction railway, the former scheme of leading the existing Yanji Station is affected by the airport military facilities and fails to conform to rules of related aviation radio navigation station configuration and field environment requirements such as the air force military standard No. [1691] "No high voltage transmission lines, electrical railways, etc. should be built within 500m around radar stations", therefore this scheme cannot lead the existing Yanji Station.

The former scheme of station positioning at northern Yanji is to station at the hillside of the east bank of Yanji River 5km from the north of Buerhatong River in Juzi Street of Yanji City. It may result in mass removal of residential district in the station range, and the station address is 16km away from Chaoyangchuan Town, therefore Chaoyangchuan Town cannot be driven to develop effectively in view of the city development planning of Yanji; at the same time, Yanji City is now establishing the Yanji Water Treatment plant which is located in about 1.5km from the east side of Juzi Street and the north side of the line. Though the line won't cross the inlet pipelines of the water plant, it intersects the outlet and supply pipelines of the water plant. Furthermore, it may cause greater influence on outlet pipelines of the water plant to position the Yanji North Station here due to the large occupation of land, and may also cause high risks of future water supply security and may be bad for the city water supply security; if position the station at the north of the joint of Yanji City and Chaoyangchuan, due to the ground elevation of the passing section is 300～390m, the line elevation is 270m, and the line mainly passes in tunnel type, so it does not meet the requirements of station positioning. Therefore, in order to combine the city development planning of Yanji and take account of driving the main urban area of Yanji City and Chaoyangchuan Town to develop jointly, Yanji Station is built at the joint of the two places. As for the involved planning residential districts on both sides of the line, it is suggested that the local authority make corresponding adjustment for city planning and prepare the railway passage in advance.

Fig. 3-7 Relationship between the line and the overall planning of Jilin City

According to Fig. 3-7, the newly-built railway respectively crosses some planning areas of Chaoyangchuan Town and Yanji City in super major bridge type while spanning Chaoyang River and Yanji River. At the same time, in consideration of the integrated development trend of Chaoyangchuan Town and Yanji City, Yanji West Station is built at the joint of the two places so as to offer convenient trip for residents of both places. The direction of this line and the station position scheme has been fully accepted by each authority of Yanji City.

The line mainly passes residential land and industrial land of the planning areas of Chaoyangchuan Town. According to field investigation, the south-north road along the river is being renovated currently, and farmland and separate villages are disturbed along both sides. The line passes in super major bridge type and the total removal of houses is 3900m2. Acoustic barrier (1630 linear meters), sound insulation window measures have been taken for passing villages in the design, which can effectively relieve the noise influence caused by railways. It is suggested that the local authority combine the railway direction and do not plan the adjacent areas on both sides of the line as residential districts, and prepare the railway passage in advance at the same time aiming to the planning industrial land to be crossed.

The line mainly passes residential districts of the planning areas of both sides of Yanji River of Yanji City. According to field investigation, the house removal of the districts to be passed by the line is about 32300m2, Acoustic barrier (3780 linear meters), sound insulation window measures have been taken for passing villages in the design, which can effectively relieve the noise influence caused by railways. It is suggested that the local authority combine the railway direction and do not plan the adjacent areas that are not under construction on both sides of the line as residential districts, and prepare the railway passage in advance at the same time aiming to the planning industrial land to be crossed.

3.5.3 Compatibility analysis of station address along the line and local city development planning

1. Dunhua Station

Dunhua Station has been built in Changtu Line when it passes Dunhua City. This time a newly-built Jilin-Hunchun railway is leaded to Dunhua City. For the convenience of passengers' trip and transfer and railway operation management, and in order to take full advantage of the existing freight, work areas, special lines and other facilities, combining the city planning, the existing railway state and Jihun railway direction, the scheme of moving the existing Dunhua Station to the east is taken in the design. The relationship between the station position of this scheme and the city planning is shown in the figure 3-8 below:

Combining the field exploration situation, the scheme of moving the existing Dunhua Station to the east mainly passes the residential districts: Penghu District to the north side of the existing Dunhua Station, and Shuangsheng Village before crossing Mudan River. According to the city planning of Dunhua, the local

regional city government of Penghu District is taking account of removal and renovation combining the city planning, but the renovation has still not been put into action due to the lack of capital. When the newly-built Jilin-Hunchun railway is led to Dunhua and passes this district, the above mentioned districts could be removed, thus the construction of Dunhua City can be quickened and the city development planning can be satisfied; Shuangsheng Village is located in the rurbania, it may bring mass removal for this village to build Dunhua Station here, thus the urban construction of this district can be quickened. According to field investigation, the villagers expressed support for the passing by railway.

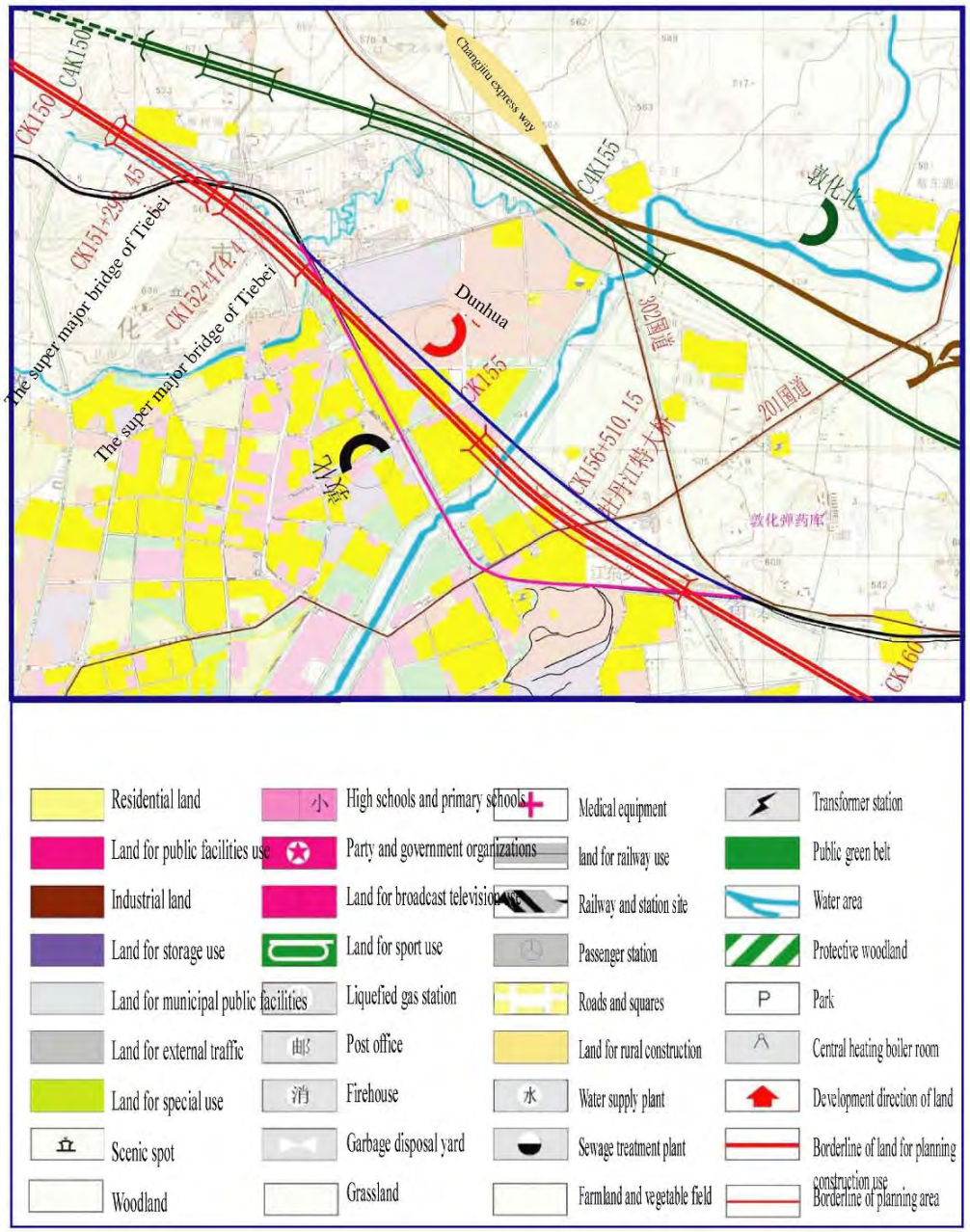


Figure 3-8 Dunhua Station Layout

The black line in the figure is the existing Changtu Line. After leading Jihun passenger dedicated line to Dunhua City, the section (namely the pink line in the figure) of the existing Changtu Line on the south side of the new Dunhua Station will be removed and be changed to the north side of the main line (namely the

blue line in the figure)

And parallel the passenger dedicated line. At the same time, after the removal of the existing Dunhua Station, the freight will be adjusted to Daqiao Station of the existing Changtu Line so as to eliminate the noise influence on the adjacent area of the station due to the freight. Seen from the station layout, the new Dunhua Station makes the whole railway move northward to the Dunhua urban area, which is convenient for residents' trip while keeping away from the main urban area, and is good for space expansion of the city and conforms to the city development planning.

The people's government of Dunhua City approves this station site scheme with "*The letter of related opinions on the design scheme of the passenger dedicated line from Jilin to Tumen in Dunhua*" (DZH No. [2009]43).

3. Jiaohe West Station, Antu Station, Tumen Station, Hunchun North Station

(1) Jiaohe West Station

The scheme of Jiaohe west station site is approved according to "*The letter of the people's government of Jiaohe City on opinions on Jihun passenger dedicated line direction and station positioning*" (JZH No. [2010]36). The design adopts the scheme of Jiaohe West Station based on serving for the place to the utmost extent.

(2) Antu Station

According to "*The letter of related opinions on the design scheme of the passenger dedicated line*

from Jilin to Tumen in Antu" by the people's government of Antu County, the "*Scheme of station positioning at the west of Antu*" is preferentially adopted since it conforms to the overall city planning of Antu County and is convenient for people's trip. It takes account of serving for local economic development to the utmost extent in the design. The scheme of station positioning at the west of Antu is adopted.

(3) Tumen Station

According to the "*Proposals for the adopted scheme of the passenger dedicated railway line from Jilin to Tumen*" (TZH No. [2009]28), it is suggested to upgrade Tumen Railway Station using the existing marshalling of Tumen Railway Station and other basic facilities. Adhering to the principles of serving for the place to the utmost extent and taking advantage of the existing railway facilities to the maximum, the design adopts the scheme of leading the existing Tumen Station according to local opinions.

(4) Hunchun North Station

Hunchun is the termination of this line. Considering that Hunchun City takes the east and north as its development direction, the station positioning should be convenient for residents' trip and conform to the city development planning simultaneously. According to the "*Letter of opinions on the station address selection of the passenger dedicated line from Jilin to Hunchun*" (HZH No. [2009]29), the preferential scheme is the northeast of the old urban area of Hunchun City, which is located in the north side of the connection between Zhanqian Street of Hunchun City and Provincial Highway 201. Taking advantage of the connection between Zhanqian Street ---- a main city road

and the urban area, this scheme offers convenient traffic and the connection between Zhanchang and railways in Jilin direction and Dongning Direction is quite smooth. Based on the above local opinions and in view of local development, in the design Hunchun North Station is built in the place with high favor of the local government.

3.5.4 Analysis of Compatibility Between Engineering Construction and Rail Network Plan

This project is an important part of Changchun-Tumen line, and the rail transportation channel between Tumen Board-port and Hunchun Board-port.

Presently, Changchun-Jilin intercity railway of this channel is under construction. The existing Jilin-Tumen section of Changchun-Tumen line was built in 1910, and is in line with national standards for Second Grade of Single line, diesel traction, capacity utilization rate 74.5%, the allowable speed on this line is only 90km/h. Tumen-Hunchun line is local rail of Jilin province, and is in line with national standards for Third Grade of Single line, diesel traction, capacity utilization rate 70%, the allowable speed on this line is only 70km/h. With low allowable speed,, the existing rails can basically meet the requirements of freight transportation of this area, but passenger transportation service quality is not high, and passenger transportation capacity is tight, which could no longer meet transportation demand for developing and opening up pilot zone of Changchun-Jilin-Tumen

After completion of project, density of passenger flow at short and long term travel section shall separately reach 16,200,000 and 22,250,000, with 70 or 95 passenger trains running per day, travel time from Changchun to Hunchun shall be shortened from 10h to 2h and 10 minutes. With many

features like rapid, safe, comfortable, punctual, large capacity etc, this line is very attractive to passenger transportation and will remedy defect of single traffic structure of this area, increase capacity and flexibility of passenger transportation of this channel, meet the growing passenger traffic demand along this line and improve infrastructure condition along the line. At the same time, this project can connect with Changchun-Jilin intercity rail, Harbin-Dalian passenger dedicated line, Harbin-Mudanjiang passenger dedicated line, Harbin-Qiqihaer passenger dedicated line etc, together form a northeast expressed regional rail network. Therefore, the construction of Jilin-Hunchun rail meets completely the direction and requirements of *Long and Mid-Term Plan of the China's Railway* (revised 2008) and The Eleventh Five-year Plan.

Legend
Existing rail
Planned passenger dedicated line
Planned rail
Research program on planned rail
Planned electrified rail
Planned expansion of railway capacity

Figure 3-9 Long and Mid-Term Plan of the China's Railway (revised 2008)

4 General Situation of the Environment along the Project

4.1 General Situation of Natural Environment

4.1.1 Topography and Geomorphy

The upcoming construction of Jilin-Hunchun rail line is located in the middle-east of Jilin province. It passes through medium low mountains area of middle section of Changbai mountain, there are relatively flat and open basin valleys distributed here. This line passes successively from northwest to southeast the following types of topography: Songhuajiang River alluvial plain, medium low eroded hilly area of Laoyeling, Jiaohe basin, medium low eroded hilly area of Weihuling, Dunhua basin, low mountain of Haerbaling and valley area of Buerhatong river, Yanji basin, valley of Buerhatong river and low hilly area of left bank of Tumen river, Hunchun basin. The highest peak of this area is Laoyeling with an altitude of 1,285m, the lowest point is Hunchun basin, with altitude around 30～40m. The altitude of medium low mountain area is between 500～1000m, relative relief 200～500m;general altitude of basin and hilly area 200～500m，relative relief 50～200m. With numerous streams of Songhuajiang and Tumenjiang river, water system of area along this line is well developed (See Figure 4-1). This line passes through successively the following types of topography from northwest to south east:

(1) Songhuajiang River alluvial plain（CK0+000~CK3+560）

Di'erSonghuaJiang passes through the east of plain from south to north in a shape of Chinese character “几”, generally the ground level is 184~220m, the river terraces of two banks distribute asymmetrically, this area is open and relatively flat, it belongs to Jilin city, crowded with dense building.

（2）Medium low eroded hilly area of Laoyeling（CK3+560~CK61+000）

The altitude of Laoyeling, the highest peak of this area is 1,285m, the common altitude of hilly area set to pass through by this line is 200~500m, relative relief is 50~200m，altitude of medium low mountain is 500~1000m，relative relief 200~500m，most of mountaintops are round, gully development, moderate dissected topography, vegetation developed, thick forest.

（3）Jiaohe basin（CK61+000~CK80+000）

This is a synclinal tectonic basin, 42km long, 18km wide, extending north northeast, with wide-fleet rivers in the middle of basin, terrace development on two banks, the terrain gradually gets higher from the river valley to the east and west sides, mainly dominated by low and flat hills, altitude 260~340m, relative relief 5~30m, numerous villages and towns distributed in the valley, most of lands are farmlands, hilly area is densely wooded.

（4）Medium low eroded hilly area of Weihuling（CK80+000~CK112+535）

The altitude of Taipingding mountain, the highest peak of this area is 1,283m, altitude of area set to pass through by this line is between 500~1000m, relative relief 200~500m, most mountaintop is round, gully development, shallow dissected topography, vegetation develop, thick forest.

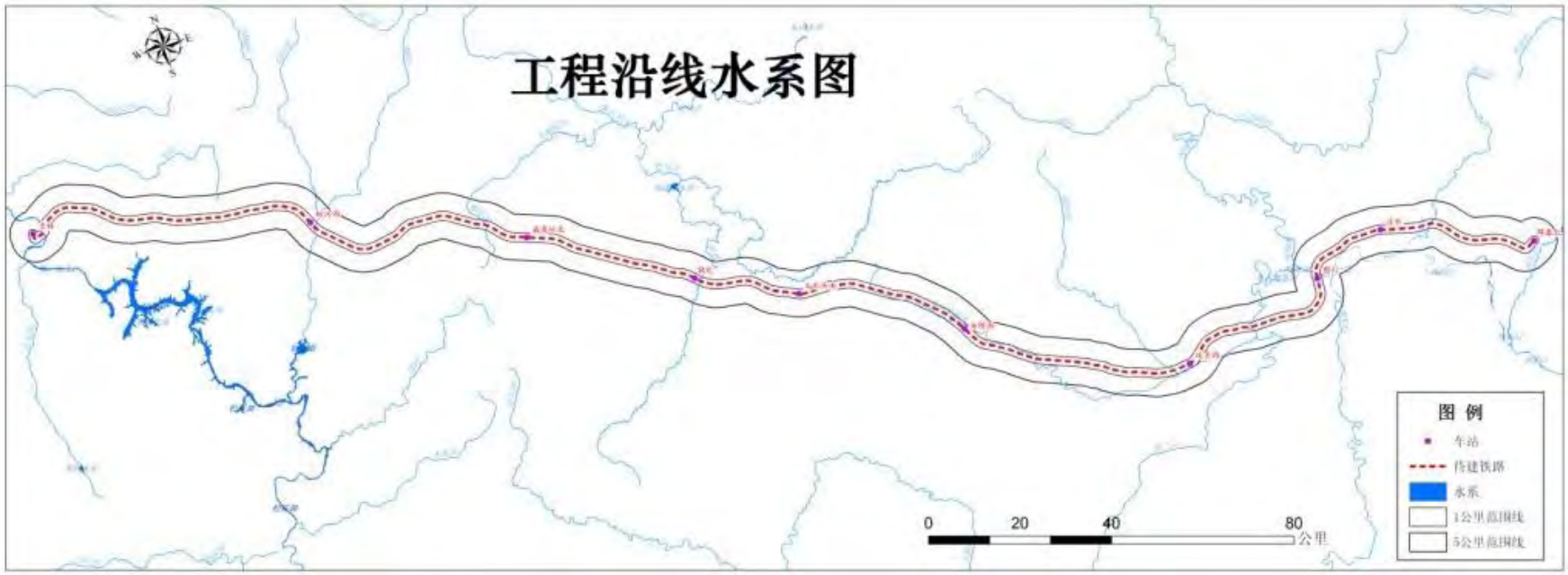


Figure 3-1 Water System along the Proposed Raiway Line

（5）Dunhua basin（CK112+5535-CK191+420）

The river bed of Mudanjiang and its branches Huangnihe, Shahe etc is wide fleet, terrace development on two banks, altitude is generally between 490~540m, forming the floor of basin, distributed intermittently with inselbergs, the lands of valley are mostly farmland, numerous villages and towns distributed in the valley, hilly area is densely wooded.

（6）Low mountain of Haerbaling and valley area of Buerhatong river（CK191+420-CK241+340）

Haerbaling is water shed of Songhuajiang River and Tumenjiang River, altitude of most low mountains is between 600 and 800m, Buerhatong river passes through this area from west to east, the section of valley in the shape of “V”, valley floor at some sections is wide, farmlands distributed at both sides of channel, the stream has a steep gradient, the fall in this area is around 200m, slopes on both banks are densely wooded.

（7）Yanji basin（CK241+340~CK278+120）

Yanji basin is a narrow and long fault basin, the basin floor is the valley plain, Buerhatong river passes through basin from west to east, the river bed is wide and fleet, overbank and terraces are developed, altitude within the range of 160~230m, Yanji city is located here, crowded by dense buildings, suburb is covered with farmlands and there are numerous villages and towns, the landforms on both sides are mostly low and even hills with altitude of 200~500m, relative relief 50~200m，vegetation was successfully established on slopes, some are dry lands, most of them are densely wooded.

（8）Valley of Buerhatong river and low hilly area of left bank of Tumen river（CK278+120~CK352+300）

After passing through the east of Yanji basin, the valley of Buerhatong river becomes narrow and meandering in “V” shape through low mountain area in the east part of Yanji basin, converging with Gaya river in northwest Tumen city, winding its way through Tumen city into Tumen river, with steep slopes on either side, there is a large difference between the highest and lowest point, altitude of low mountains and hills between 250~600m, relative relief 50~200m， gully developed along this line, moderate dissected topography, vegetation developed, densely wooded.

（9）Hunchun basin（CK352+300~CK362+200）

The basin floor is alluvial plain, Tumen river passes through the western part of basin, Hunchun river passes through the center of basin, broad river, terraces on either side are wide and flat, altitude 30~50m, basin is surrounded by low mountains and hills, vegetation developed, densely wooded.

4.1.2 Geological structure and Earth Layer Lithology

（1）Geological structure

The tectonic structures of areas along the line is located in the east section of Tianshan-Xing'an

geosynclinal folded zone, southeast of late Jilin-Heilongjiang Variscan fold belt，crossing from west to east two secondary structure units，Jilin eugeosynclinal fold belt and Yanbian eugeosynclinal fold belt. This area has experienced successively Variscan orogeny, Yanshanian orogeny and Himalayan Orogeny.

Linear fold and thrust fault are the main features of Jilin eugeosynclinal fold belt, the well developed fault structures are in north east, north-northeast direction；paleozoic linear fold developed in Yanbian eugeosynclinal fold belt, with gentle and broad Mesozoic and Cenozoic folding, fault structures developed in north-northeast, northeast, north-south, east-west and north-west direction. The main deep and big fault structure along the line are Songhuajiang fault (F1), Tiangang-Wulihe fault (F2), Dunhua-Jingbohu fault (F13), Tunlin river-Chaoyang river fault (F22), Mijiang-Gaya river revived fault （F28）.

Since Quaternary it is dominated by large secular movement of the earth's crust, river terraces of multi-grade are developed, Songhuajiang fault and Dunhua-Mishan fault are active, Quaternary basalt erupts in the shape of line and belt.

（2）Lithology

Exposed strata along the line are mainly Permian System of the late Palaeozoic, Jurassic System and Cretaceous System of the Mesozoic Erathem, tertiary stratum and quaternary stratum of the Cenozoic Erathem，multiple Magma intrusions occurred during this period, and a large area of Quaternary effusive rocks distributed here. Lithologies of the Permian System are mainly metamorphic siltstone, metamorphic fine sandstone, slates etc, distributed mainly on western Laoyeling, west side of Jiaohe basin, low mountains and hilly areas between Tumen and Hunchun and sporadically distributed at other areas. Lithologies of the Jurassic System are conglomerate, sandstone, breccias, andesite, andesite-tuff, Lithologies of the Cretaceous System are conglomerate, coarse and fine sandstone and shale，concentratedly distributed in Jiaohe, Yanji, Antu and around Tumen basin. The lithologies of tertiary stratum are conglomerate, sandstone, fine sandstone, siltstone and shale, sporadically distributed in north of Dunhua county and the western mountain area of Hunchun city. Multiple Magma intrusions occurred during the period of Variscan and Yanshanian，the main lithologies are biotite plagiogranite, granodiorite, dacite, diorite etc. widely distributed along the whole line. Effusive rocks of Tertiary and Quaternary ages are mainly a variety of basalts, concentratedly distributed in the area of Dunhua-Huangheni. Various loose deposits of the Quaternary accumulated along the whole line, mainly basin, river terraces and valley, with variable thickness.

4.1.3 Basic intensity of earthquake

According to *Seismic ground motion parameter zonation map of China*（GB18306-2001）, seismic ground motion parameters along the whole line are as follows:

Table 4-1 Seismic Ground Motion Parameter Zonation Sheet

Sections	Start and End Mileage (Run-through)	Seismic peak ground acceleration	Seismic intensity	Characteristic period of the seismic response spectrum	Remarks

Sections	Start and End Mileage (Run-through)	Seismic peak ground acceleration	Seismic intensity	Characteristic period of the seismic response spectrum	Remarks
Jilin—Weihuling	CK0+000-CK11+300	0.10g	Ⅶ degree	0.35s	
	CK11+300-CK73+600	0.05g	Ⅵ degree	0.35s	
	CK73+600-CK111+470	＜0.05g	＜Ⅵ degree	0.35s	
Weihuling—Antu	CK111+470-CK190+900	＜0.05g	＜Ⅵ degree	0.35s	
	CK190+900-CK233+000	0.05g	Ⅵdegree	0.35s	
Antu—Hunchun	CK233+000-CK250+350	0.10g	Ⅶ degree	0.35s	
	CK250+350-terminus	0.05g	Ⅵ degree	0.35s	

According to the zonation specified in *Seismic ground motion parameter zonation map of China*，site condition belongs to stable flat medium-stiff soil site, characteristic period of the seismic response spectrum of various construction sites shall be regulated based on the type of site and regulate correspondingly after the completion of *seismic safety evaluation*.

4.1.4 Climatic characteristics

This area is situated in north subtemperate zone, with a humid and semi-humid continental monsoon climate. According to zonation based on influence of climate on railway engineering, this area belongs to freezing zone. Summer is short and warm, winter is long and cold, spring is dry and windy, autumn is cool, the four seasons are distinct. Annual average temperature 4.0～6.8℃, average temperature in January -10.3～-23.4℃, average temperature in July 20.5～23.9℃; the extremely high temperature 36.3～37.7℃, the extremely low temperature -29.2～-42.5℃, mean annual precipitation 528～670mm，mainly during the period from June6 to August; mean annual evapotranspiration 948.9～1445.6mm; average relative humidity 64～76％，annual average wind speed 2.2～3.1m/s, maximum wind speed 18～20m/s. maximum depth of frozen ground:167cm～192cm.

Table4-2 Classification of the Maximum Depth of Frozen Ground

Sections	Start and End Mileage (Run-through)	Max. depth of frozen ground (cm)	Remarks
Jilin—Weihuling	CK0+000-CK24+100	192	Jilin
	CK24+100-CK111+470	167	Jiaohe
Weihuling—Antu	CK111+470-CK190+900	184	Dunhua
	CK190+900-CK241+755	171	Antu
Antu-Hunchun	CK241+755-CK290+233	168	Yanji
	CK290+233-CK334+670	181	Tumen
	CK334+670-终点	172	Hunchun

4.1.5 Engineering Geology and Hydrogeology

4.1.5.1 Engineering Geology

Apart from soft soil and mollisol distributed in some areas, the strata of Songhuajiang river terraces at Jilin, Jiaohe basin, Dunhua basin, Antu basin, Yanji basin and Tumen basin are mainly quaternary sandy soil, crushed stone soil, with underlying sandstone, shale and other clastic rocks，quaternary magmatic rocks erupts in some areas, most of the line will be built as roadbed or bridge, the condition of engineering geology is good. The strata of low and gentle hilly areas near the various basins are mainly mudstone, sandstone, conglomerate, breccias, shale, andesite of Jurassic System and other soft clastic bearing small amount of stiff rocks，fault structure was developed, rock mass was relatively broken, side slopes are liable to weathering and erosion and problems like expansive soil, landslide along stratified layer etc exist locally, most of the line will be built as bridge, road and a small section of tunnel, the condition of engineering geology is poor. Lithologies in medium-low mountain area are mainly stiff rocks like granite and basalt，Permian sandstone and conglomerate sporadically distributed, the line passes through in form of tunnel, engineering geology is good.

4.1.5.2 Hydrogeology

Ground water in low mountains and hilly areas along the line are mainly quaternary loose rock pore water and bedrock fissure water, apparent water exists locally. Ground water table in mountain valleys and hilly basins is shallow, generally 2～10m，ground water table in low mountains and hilly areas is deep, mostly between 5～20m, seasonal variation of ground water is between 0.5～5.0m.

The types of ground water in Songhuajiang alluvial plain and valley basin along the line are mainly quaternary loose rock pore water, some are confined aquifers. Generally ground water table is between 0.0～5.0m, seasonal variation 0.5～2.0m. Bedrock fissure water exists in deep layer.

Generally, surface water and ground water in areas along the project won't erode concrete construction, only at some sections erosion of grade H1 may occur on concrete and steel structure.

4.1.6 Animal and plant resources

1. Plant resources

As regards of plant flora, this area belongs to flora region of northeast of China, the same region as that of adjacent Amur Oblast and coastal region of far east Russia and north part of Korean peninsula. There are a variety of special plants in this area, representative specie of tree is Pinus koraiensis, the other species include conifer species, such as A-bies holophylla，taxaceae, ThujakoraiensisNakai, Larix olgensis etc., Acer triflorum，lavender basswood, little lavender basswood, Acer tegmentosum Maxim, and broadleaved tree species like Acer triflorum，lavender basswood, little lavender basswood, Acer tegmentosum Maxim, FraxinusmandshuricaRupr., Acer mandshuricum, Albizia kalkora, Juglans mandshuricaMaxim, Amur cork tree, Korea poplar Populus koreana etc., wide varieties of broadleaved tree exist in this region, some of them are

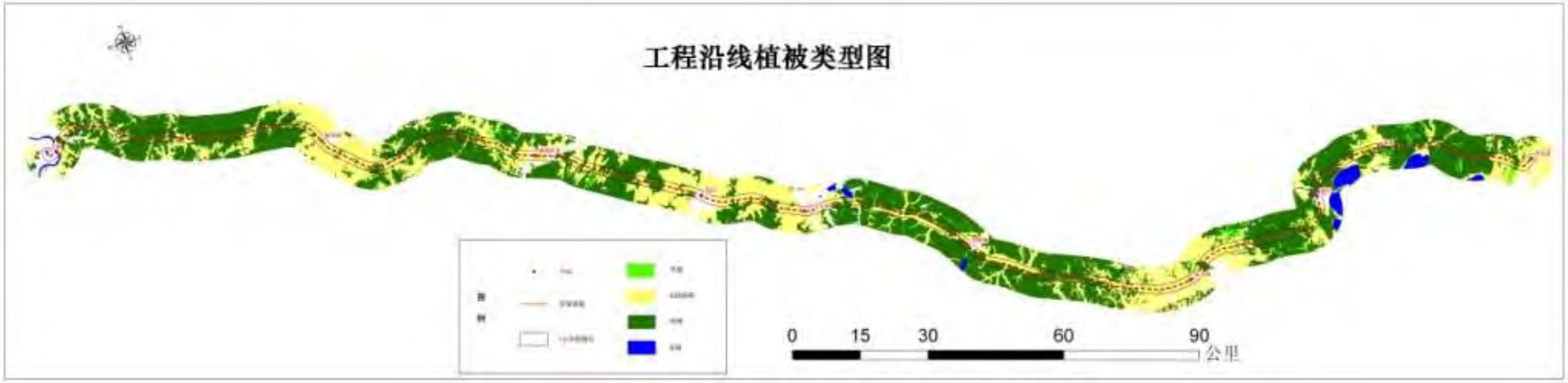


Figure 4-2 Vegetation Characteristics along the Proposed Railway Alignment

epibiotic species of Tertiary ages, such as Juglans mandshuricaMaxim，Amur cork tree，Manchurian etc., plus potentilla reptans like ampelopsis brevipedunculata, Chinese magnolcavine fruit, not including typical herbaceous plant like ginseng, all these show the history of this region, it belongs to the Tertiary flora. This feature not only related to humid subtropical climate in geological history of this area and affected slightly by ice, but also to present maritime climate and the action of warm and humid monsoon in summer, so epibiotic species of Tertiary ages preserved, grown up and become the feature of south plant (subtropical) of this region. In addition, some kamchatka-okinawa plant exist here and there in this region，such as picea, Abies fargesii and other north species.

Zonal native vegetation in the evaluated scope is Korean pine and conifer broad leaved mixed forests. Being influenced by manual activities including felling, the existing forests are primarily nature secondary forest and man-made forest, and also coniferous forest, mixed coniferous broad leaved forest and deciduous broad-leaved forest, except little native vegetation remaining in individual hilltop. The forest form is single-storied stand, and the forest species are mostly Quercus mongolica, Populus davidiana, birch, elm, maple, basswood, willow, Fraxinus mandshurica and Juglans mandshurica. Man-made forest is featured by larch, with major trees of Korean pine, Japanese red pine, spruce, fir, Pinus sylvestris var.mongolica, Pinus thunbergii, etc. Moreover, other breeds include Maackia amurensis, hawthorn, Malus baccata, sorb, Prunus padus, Rhamnus spp, Lonicera japonica, Lespedeza bicolor and hazelnut, as well as vegetation of sedge family, gramineae family and compositae family, etc. Economic vegetation includes Panax ginseng, Acanthopanax Senticosus, Gastrodia elata, Schisandra spp, Platycodon grandiflora, Angelica sinensis, Pteridium aquitinum, Osmunda japonica, Vitis amurensis and Actinidia arguta, etc.

The agriculture along the line develops, and the river plain is predominated by paddy field, in which rice grows. Foothill, gentle slope and platform are predominated by dry field, in which corn, soybean, tomato, etc. In some hillside lands in Yanbian Prefecture, a wide area of fruit trees is planted in sunny slope with sufficient water.

Vegetation along the alignment is characterized in Figure 4-2.

2. Animal resources

Because this area has many forests and provides animals with relatively ideal habitation and reproduction places, there are many kinds of animals distributed in the area. Although the area is featured by temperate-zone animal area with more breeds (i.e. northern species), the distribution zone of southern-species birds may extend to this subregion. The animals of northern species are represented by Ochotona alpine, Lepus mandshuricus, sable and brown bear, and animals of southern species extending their habitats to the subregion include tiger, common goral, deer, etc. Birds of northern species include bonasa, Lyrurus tetrix, lark, etc, and birds of southern species extending their habitats to the subregion include Eurystomus orientalis, Halcyon pileata, Halcyon coromanda, Pericrocotus divaricatus, Oriolus chinensis, Ardea purpurea, Egretta alba, Gallinula chloropus, etc. The area has fishes of typical northern species including Diagramma pictus, Hucho taimen and lota, and also numerous southern species including Saurogobio, and Xenocypris argentea, etc.

There are numerous benthic organisms, such as tubifex, tubificidae, shells and mussels, living in the waters within the Three-lake Reserve Area in Songhua River, and there are also more than 40

kinds of fishes including chub, bighead carp, carp, bastard carp, mandarin fish, etc. Partial hills has animals of black bear, boar, fox, deer, sable, roe deer, pheasant, tree chicken, Maartes flavigula, Mustela sibirica, forest frog, etc.

There are more than 150 kinds of higher animals in the Provincial Nature Reserves for Matsutake In Mingyue. Among of these animals, there are 28 kinds of beasts including black bear, red fox, wolf, raccoon, badger, leopard cat, sable, Mustela sibirica, Mustela altaica, red deer, roe deer, Lepus mandshuricus and squirrel, etc, 101 kinds of birds including goshawk, common buzzard, Circus melanoleucus, Merlin Falcon, Falco vespertinus, Common Kestrel, Bonasa bonasia, Phasianus colchicus, Streptopelia orientalis, Cuculus fugax, Cuculus micropterus, Cuculus canorus, Cuculus saturatus, Strix uralensis, Otus sunia, Halcyon coromanda, Eurystomus orientalis, hoopoe, Picus canus, Dendrocopos major, Dendrocopos leucotos, Dendrocopos minor, Pericrocotus divaricatus, Garrulus glandarius, Cyanopica cyana, magpie, Corvus macrorhynchos, Corvus corone and Phylloscopus proregulus, 8 kinds of reptiles including Eremias argus, Takydromus septentrionalis, Elaphe dione, Elaphe rufodorsata, Elaphe schrenckii and Agkistrodon halys, and 8 kinds of amphibious animals including Rana chensinensis, Hyla arborea, Japanese tree frog, Bufo gargarizans and Bornbina orientalis, etc.

In the national fisheries species resources reserve area for salmon in Mijiang River in Huichun, there are nationally protective fishes, such as migration fishes of salmon (Oncorhynchus masou, Oncorhynchus gorbuscha, Oncorhynchus keta) and cold-water fishes of Brachymystax lenok, Leuciscus brandti, Lampetra japonicus, Salvelinus malma, etc.

4.1.7 Present Situation of Water and Soil Loss

The line passed through by Jilin city and Yanbian Prefecture in Jilin Province. According to *Notice about Classification of Major Area Preventive against Water and Soil Loss* (JZF (1999) 30)) issued by People's Government of Jilin Province, the line passes by the areas including Dunhua City and Antu County classified as major protective areas, Yanji City, Tumen City and Longjing City classified as major supervision areas, and Jilin City, Jiaohe City and Huichun City classified as major treatment areas.

There is approximately 6000km^2 area subjected to water and soil loss in Jilin City, which accounts for 20% of total area of this city. The annual average soil erosion in Jilin City is up to 13.65m ton and the soil erosion modulus is 503t/(km^2·a). There is approximately 3607km^2 area subjected to water and soil loss in Yanbian Prefecture accounting for 8.3% of total area of this prefecture, and the soil erosion modulus is 1182t/(km^2·a).

Soil eroson characteristics along the proposed railway alignment is presented in Figure 4-3

4.2 Overview of Social Environment

4.2.1 Overview of Administrative Division, Population and Economy

Jilin City is located at the Mountain Changbai backland of Northeast China, and faces water in three directions and is surrounded by mountains. The city is adjacent to Korean Autonomous Prefecture in the east, to Changchun City and Siping City in the west, to Heilongjiang Province in

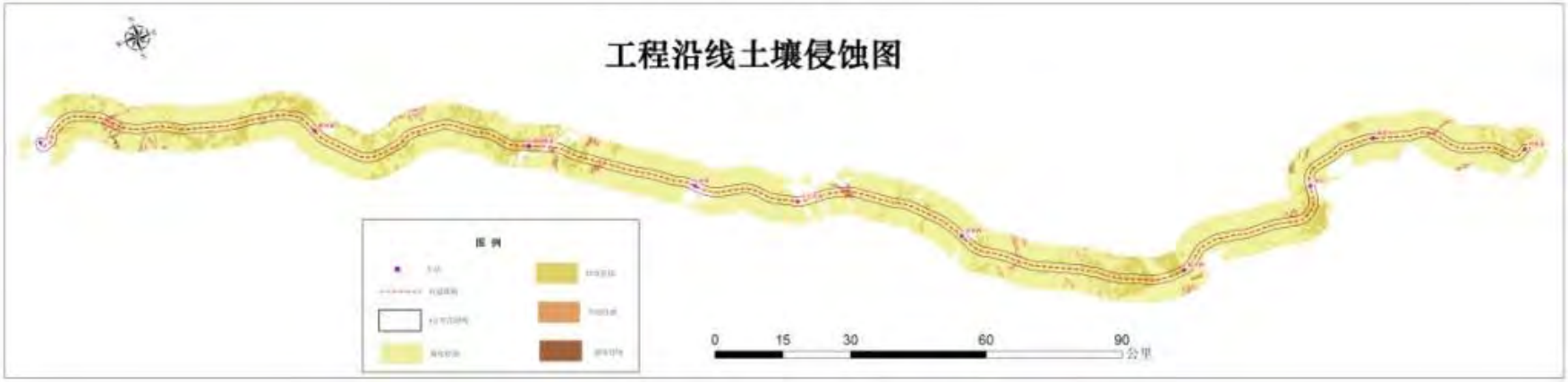


Figure 4-3 Soil Erosion Characteristics along the Proposed Railway Alignment

the north, and to Liaoyuan City, Tonghua City and Baishan City in the south. The city is the second largest city in Jilin Province, and also the unique city in China that has the same name with its superior province. The city has jurisdiction over 4 districts (Changyi District, Chuanying District, Longtan District and Fengman District) and 5 counties or county-level cities (Yongji County, Shulan City, Panshi City, Jiaohe City and Huadian City), and it has total area of $2.71\times10^4 km^2$ and population density of 160 per km^2. At the end of 2008, total population of the whole city was up to 4.34 million, and the GDP was CNY 130 billion with three industries' proportion of 12.87:48.86:38.27. The city has fast economic development, and its GDP per capita is higher than that of China's national average.

Yanbian Korean Autonomous Prefecture is located on the boundary of China, Russia and North Korea, hailed as Golden Triangle in Northeast Asia. The Prefecture is adjacent to Russia in the east (with border line of 246km), and to North Korea in the south (with border line of 522.5km). The Prefecture is major habitat of Korean people in China, and the population of Korean people accounts for 38% of the total people in the Prefecture and 43% of total Korean people in China. The Prefecture has jurisdiction over 6 county-level cities (Yanji City, Tumen City, Dunhua City, Longjing City, Huichun City and Helong City) and 2 counties (Antu County and Wangqing County). The Prefecture has total area of $4.27\times10^4 km^2$ approximately accounting for one quarter of total area of Jilin Province, with population density of 51 per km^2. At the end of 2008, total population in the whole Prefecture was up to 2.19 million, and the GDP was CNY 38 billion with three industries' proportion of 12.75:45.6:41.68. The Prefecture has slow economic development, and its GDP per capita is only 77% that of China's national average. The social and economic indexes of areas along the line in 2008 are detailed in Table 4-3.

Table 4-3 Summary of Social and Economic Indexes of Areas along the Line in 2008

Indexes	Unit	Jilin City	Yanbian Korean Autonomous Prefecture	Total	National	Areas along the line/national (%)
Land area	$10^4 km^2$	2.71	4.27	6.98	960	0.73
Total population	Ten thousand persons	434	219	652	132802	0.49
Population density	Person / square kilometers	160	51	93	138	67.56
GDP	CNY 100 million	1300	380	1680	300670	0.56
First industry	CNY 100 million	167	48	216	34000	0.63
Second industry	CNY 100 million	635	173	808	146183	0.55
Third industry	CNY 100 million	498	158	656	120487	0.54
GDP per capita	Yuan	29986	17357	25752	22640	113.74

Note: data source: statistical bulletin of areas in 2008

Administrative pertinent information is presented in Figure 4-4.

Figure 4-4 Administrative Areas along the Proposed Railway Alignment

4.2.2 Distribution and Development of Resources

4.2.2.1 Mineral Resources

There are rich natural resources in the areas along the line, and the personal average occupancy of resources of land, waterpower, mines, forests and wild animals and plants is higher than that of China's national average. Especially, there is a great amount of reserves of waterpower sources, such as rivers and lakes including Songhua River, Mudan River and Tumen River, and Songhua Lake. Mineral resources include coal, oil, iron ore, natural gas, oil shale, gold, silver, limestone, perlite, mineral water and quartz sand, etc.

4.2.2.2 Tourism Resources

There are unique tourism resources in the areas along the line. Jilin has famous tourist resorts attracting a great number of tourists at home and abroad, which include Rime Miracle; Deer Paddock in Mountain Longtan; Inscriptions on Cliffs in Ming Dynasty; Songhua Lake, the first summer lake in China; Jilin No.1 Stone Meteorite - the “visitor” from outer space, the best resort of the world. The Yanbian Korean Autonomous Prefecture has four classic tourist products of magical natural Landscape at Mountain Changbai, colorful Korean folkways, mysterious border feature of three countries, and outstanding ice and snow landscape at Tumen River. In 2008, the areas along the line received 16,989 million domestic tourists and 0.323 million foreign tourists; the tourist revenue was CNY 13.48 billion, earning foreign exchange of 86.082 million US$.

4.2.3 Present Situation and Development of Industry and Agriculture

The areas along the line have advantages of rich resources, and establish their complete industrial system including chemicals, automobile, metallurgy, coal, electric power, construction materials, forests, textile, pharmaceuticals and food, etc. In 2008, industrial enterprises of designated size in the areas along the line completed CNY 57.14 billion of industrial value added. Industrial enterprises of designated size in Jilin City completed CNY 43.78 billion of industrial value added, with current-price increase of 30.2% (comparable-price increase of 17.3%). Large industrial enterprises completed 376.6×10^4t of raw coal output with an increase of 24.9% over the same period of previous year, 293.4×10^4t of steel with an increase of 8.9%, 434.1×10^4t of cement with an increase of 15.9%, 12.7 billion kWh of power generation with a decrease of 1.5%. Industrial enterprises above designated size in Yanbian Korean Autonomous Prefecture completed 13.36 billion of industrial value added, with an increase of 20.0% over the previous year calculated in the same caliber; in 2008 the whole prefecture realized 9.68 billion of value added in respect of food, pharmaceuticals, forests and energy minerals industries, with an increase of 18.9% over the previous year, and the value added accounts for 72.4% of industrial value-added above designated size.

Agriculture in the areas along the line involves production of grains and vegetables including rice, corn and soybean, etc, and in 2008 the total value in respect of agriculture, forest, stock-raising and fishery industries was up to CNY 33.61 billion. In the same year, Jilin City realized CNY

11.71 billion of agricultural industry value with an increase of 16.6%, and 457.7×10^4t of grains with an increase of 17.1%, in which rice accounts for 116.1×10^4t with an increase of 4.2%, corns accounts for 309.5×10^4t with an increase of 20.3% and soybean accounts for 23.5×10^4t with an increase of 59.1%; in 2008 Yanbian Korean Autonomous Prefecture realized CNY 7.89 billion of total value in respect of agriculture, forest, stock-raising and fishery industries, with an increase of 9.7% over the previous year, and 105.2×10^4t of gains with an increase of 12.1% over the previous year, reaching the newly highest in its history after a good grain harvest for continuously five years.

4.2.4 Present Situation and Development of Transportation

At present, a comprehensive transportation system of railway, highway, waterway and aviation is established initially in the areas along the line.

Railway: Main railways in the areas include transverse railways of Chang-Tu, Tu-Hui, Yan-Bai and longitudinal railways of Shen-Ji, Ji-Shu, La-Bin, Mu-Tu, Long-Feng, He-Long and Chao-Kai. In 2007, the capacity of passengers by railway in Jilin City was up to 8.11 million, and the capacity of freightage by railway was up to 1737×10^4t; the capacity of passengers by railway in Yanbian Korean Autonomous Prefecture was up to 5.8 million, and the capacity of freight by railway was up to 546×10^4t.

Highway: The areas along the line are passed by national highways of G302, G201 and G202, as well as Chang-tu Express Highway. In 2008, the turnover of passengers by highway in Jilin City was up to 2.09 billion km with an increase of 22.5% over the same period of the previous year, and the turnover of freightage was up to 19.6×10^8tkm with an increase of 37.9%; the capacity of freightage by highway in Yanbian Korean Autonomous Prefecture was up to 3428×10^4t with an increase of 4.3% over the same period of the previous year, and the capacity of passengers by highway was up to 37.52 million with an increase of 6.3%.

Civil aviation: Jilin City and Changchun City share Changchun Longjia International Airport, and flights to Beijing, Shanghai and Guangzhou have been opened. Ertaizi Airport - original civil and military airport – is presently a 4C civil airport, mainly providing three airlines from Jilin to Beijing, Shanghai and Guangzhou. Yanji Airport is established as an international airport, in which many airlines from domestic cities to Seoul in Korea are opened.

Waterway: Internal water transportation concentrates at the upstream of Songhua River. Because the Songhua River has a short high-water period and a long freezing period, the transportation over the River is limited. The wharf of Fengman Port in Jilin City has been built and put into operation. In 2008, the turnover of freightage by waterway in Jilin City was up to 10×10^4t km, and the turnover of passengers was up to of 19.45m km with an increase of 23.5% over the same period of the previous year.

4.3 Present Situation of Environmental Quality

4.3.1 Ecological Environment

Jilin city belongs to lower hill country, and its southeast area is occupied by overlapping mountains, with rich vegetation and precipitation and developed rivers. Yanbian Prefecture is located at the Changbai Mountains, and its terrain declines to the southeast from southwest,

northwest and northeast.

The areas along the line are highly covered by forests, with good ecological environment. The areas have many ecological-sensitive zones and partial zones cannot be avoided completely, especially for the Class-two Water Source Reserves in Songhua River, Graveyard in Mountain Maoer, City in Mountain Longtan, Three-lake Reserves in Songhua River, Provincial Nature Reserves for Matsutake in Mingyue of Antu County, and National Fisheries Species Resources Reserves for Salmon in Mijiang River, etc.

Land use pattern along the proposed railway alignment is presented in Figure 4-4.

4.3.2 Sound Environment

According to the environmental quality bulletin (2009) issued by the Environment Protection Bureaus of Jilin City and Yanbian Prefecture, the equivalent sound level of environmental noise from downtown of Jilin City is 54.4 dB(A) with noise sources mainly consisting of transportation and living noises, and the average equivalent sound level of noise from transportation of the city is 69.8 dB(A); the equivalent sound level of environmental noise from downtown of Yanbian Prefecture is 52.4 dB(A), and the average equivalent sound level of noise from transportation of the city is 68 dB(A). The sound environment condition of rural area along the line is good, with noise source mainly consisting of living noise.

4.3.3 Water Environment

The surface river system develops, mainly involving the water systems of Songhua River and Tumen River.

Within the water system of Songhua River, the areas along the line are river source and upstream of Mudan River. Two-way Baihe River forms from Tianchi of Mountain Changbai at the river source to Liangjiangtun of Antu County, and the River meets the Gudong River near Liangjiangtun to form two-way Songhua River, which is the upstream of main stream of Songhua River. The main stream of Songhua River has good water quality, and among of 12 monitoring sections, 10 sections from Baishan Bridge and Linjiang Bridge and so on are of class-III water quality, and the remaining 2 sections from Zhenjiangkou and Xidazuizi are of class-IV water quality. The water quality of rivers in Songhua River Basin along the line is essentially class-III.

Tumen River is sourced from eastern foothill of main peak of Mountain Changbai, and passes by Helong, Longjing, Tumen and Huichun. Main branches of the River include Hongqi River, Hailan River, Buerhatong River, Gaya River and Huichun River. Among of 5 monitoring sections from main stream of Tumen River, 2 sections from Chongshan and Nanping are of class-II and class-IV water quality, 2 sections from Tumen and Quanhe are of class-V water quality, and the section from the east of Tumen River is of inferiorly class-V water quality.

4.3.4 Atmospheric Environment

According to the environmental quality bulletin of Jilin City and Yanbian Prefecture in 2009, the annual average concentrations of SO_2, NO_2 and PM_{10} in the downtown of Jilin City are respectively 0.020mg/m^3, and 0.033mg/m^3 and 0.095mg/m^3, and they meet class-II criterion of *Ambient Air Quality Standard* (3095-1996) with main contaminant of PM_{10}; the annual average concentrations of SO_2, NO_2 and PM_{10} in the downtown of Yanbian Prefecture are respectively

0.028mg/m^3, and 0.034mg/m^3 and 0.088mg/m^3, and they meet class-II criterion of *Ambient Air Quality Standard* (3095-1996) with main contaminant of PM_{10}.

5. Ecological Environment Impact Evaluation

5.1 Introduction

5.1.1 Scope of Evaluation

Scope of this ecological environment impact evaluation is determined by maintaining the ecological integrity of the proposed area and protecting the sensitive ecological objectives, as follows:

Within the range of 300m away from the outer tracks of the line, range of ecological sensitive area shall be extended based on actual situation.

Within the range of 100m away from the boundary of construction fields, fetching areas and spoil ground and other temporary sites.

Within the range of 100m away from the both sides of the central line of construction access roads.

5.1.2 Contents of Evaluation

Main contents of this ecological environment evaluation include:

1） Current ecological environment situation investigation and evaluation within the construction areas;

2） Evaluation of impacts of this project on vegetation resources alongside the line;

3） Evaluation of impacts of this project on wild animals alongside the line;

4） Evaluation of impacts of this project on land resources alongside the line;

5） Evaluation and analysis of impacts of bridge and tunnel projects on environment;

6） Evaluation and analysis of impacts of temporary projects on environment;

7） Analysis of possible soil and water loss caused by the project;

8） Evaluation of impacts of this project on important ecological sensitive areas alongside the line;

5.1.3 Evaluation Methods

Qualitative and quantitative methods will be used for the evaluation based on field investigation and data collection.

Based on field investigation and research and data collection, with the aid of remote sensing (RS), geographic information system (GIS) and Global Positioning System (GPS) and other technical methods, combing with related information of land resources along the line, current ecological situation investigation analyzes the ecological system, vegetation type and distribution, land utilization situation, soil and water loss and other facts, and forecast and evaluate impacts of the project on ecological environment and sensitive protection objectives.

Remote sensing image data processing: ① quality and phase of remote sensing image have great impact on precision and accuracy of vegetation data readings, so remote sensing images with same phases, having similar solar angles, while cloudless in the evaluation area and surface features in rich and clear information. ② using data of attitude and satellite position attached to the remote sensing images for system correction, and then using ground control points for geometry correction. ③ with the aid of GPS, GIS and Arcview, build a direct interpretation symbol between prototype of surface features and satellite images based on field survey and information collected. Using land group analysis to create interpretation symbol and extract relative ecological environmental data of the evaluation area by supervising, analyzing and human interpretation. ④ with the help of GIS software, automatically get block number and area of different types and vegetation types, and classify, analyze and count the data. ⑤Using the software Arcview, Photoshop and CorelDraw to complete map editing of the ecological evaluation.

Soil and water loss forecasting uses analogy method to analyze soil and water loss impacts. 'Soil erosion modulus' index is used to evaluate possible soil erosion caused by project construction.

5.2 Ecological Environment Current Situation Investigation and Forecasting Evaluation

5.2.1 Regional Ecological Function Zoning

This project locates in Jilin Province starting from Jilin City in the west to Huichun City of Yanbian Korean Autonomous Prefecture in the east. It passes through the Chanyi District, Longtan District and Jiaohe City within the area of Jilin City, and the Dunhua City, Antu County, Yanji City, Tumen City and Huichun City within the Yanbian Korean Autonomous Prefecture. The operating railway line totals 365.352km of which 113.543km within the boundary of Jilin City and 251.809km within YanJi. The area the line passing through belongs to middle and low Taihang mountain area, with relatively flat valley basin distributed among the area. The terrain alongside the line is mainly hilly and basin. From the northwest to southeast, the line successively passes Songhua River alluvial plain, Laoyeling erosion in hilly areas, Jiaohe basin, Wei Hu Ling erosion in the low mountains, Dunhua basin, Haerbaling low mountains, canyon area of the Buerha river, Yanji Basin, the Buerha River Canyon, low mountains and hilly areas on the left shore of Tumen Jiang, and Huichun Basin. The areas the line passing through are rich in water with many rivers, which belong to the Songhua River and the Tumen River system.

According to the ecological function zoning of Jilin Province. In Class I zoning, the line is located Changbai Mountain ecological zone in eastern Jilin, a temperate mixed coniferous zone, having the most abundant biological resources in Jilin Province. Total forest area covers 631.67km2 amounting 72.3% of that of Jilin Province. Plants belong to Changbai flora, mixed forest with pine broadleaves and needles is the climax community for zonal vegetation. In Class II zoning, the area along the line respectively belongs to Eastern Jilin ecological sub-regions in hilly forest, Changbai Mountain lava middle-low forestry ecological sub-zone, and Tu-Sui middle-low forestry fruit ecological sun-zone. In Class III zoning, it respectively belongs to the Songhua Lake flood regulation and storage and landscape protection ecological functional zone, the Lafa River basin water reservation and forestry ecological functional area, middle-low mountains water conversation and forestry ecological functional area in upper Mudanjiang, water reservation and

forestry ecological functional area of the Buerhatong River basin, Yanji town and forestry & farming & fruit ecological functional area, and ecological tourism and forestry & farming & fruit ecological functional area of Huichun Valley.

According to the ecological functional area zoning of Jilin Province, corresponding policy and development of different ecological areas are as follows:

- The **Songhua Lake** flood regulation and storage and landscape protection ecological functional zone: (1) Strengthen the Songhua Lake ecological environment and the recovery of mixed coniferous forest to conserve water resources, reserve soil and water and clear environment. (2) increase efforts to control the environment of Jilin chemical industrial zone, promote recycling economy and ecological industry, increase research funding to study the recycling of water and reduce effluent emissions. (3) it is prohibited to let heavy pollution enterprises settle down in this area. (4) exploit tourism resources in this area, develop Jilin Scenic Tour featured by Songhua Lake and drive economic development in this area.
- The **Lafa River** basin water reservation and forestry ecological functional area: (1) Plan forest rationally, establish forest age structure, tree structured mixed coniferous forest ecosystems. Develop forest economy. (2) use water resources rationally, regulate surface water and atmospheric precipitation as small watershed, control the occurrence of flood to reduce losses. (3) adjust crop planting structure, foster high-yield crop varieties resisting to low temperature, make full use of the flat river valley terraces and where having relatively abundant water and heat conditions to develop special eco-agriculture. (4) rationally develop and protect the tourism resources, mineral resources in this area and strictly control the number and size of artificial architectures in the tourism area.
- Middle-low mountains water conversation and forestry ecological functional area in **upper Mudanjiang**: (1) Water conservation and soil conservation. Focus on protecting quality of water and forest ecosystem in upper Mudanjiang. Strictly control forest harvesting, restore forest ecosystem and their functions. (2) establish city eco-economy zone, rationally develop and use underground water resources, and prevent 'three wastes' polluting surface water. (3) moderately develop agricultural land, control non-point source pollution and soil erosion. (4) rationally develop and nurture medicinal raw material base, develop and grow the medicine production base that has begun to take shape.
- Water reservation and forestry ecological functional area of the **Buerhatong River basin**: (1) strengthen soil and water conservation and water reserving forest construction, strictly control excessive harvesting of trees, return farmland to forest. (2) avoid excessive farmland reclamation, prevent soil and water loss to preserve water resources. (3) increase nursery, cultivate high-quality species, protect gene pool and biodiversity. (4) control 'three wastes' discharge in town, and quantity of pesticide and chemical fertilizer to protect water quality of the Buerhatong River. (5) strengthen construction of tricholoma matsutake protection area in Longjing Tianfo Mountain. (6) develop ecological agriculture and ecological forest & fruit industry using the advantages of regional resources.
- **Yanji town and forestry & farming & fruit ecological functional area**: (1) Protect urban ecosystems, strengthen the comprehensive management of urban environment and improve regional environmental quality. (2) Strengthen the forestry construction, control soil and water loss, improve the comprehensive treatment rate of wastewater and water quality of Tumen Jiang. (3) develop ecological agriculture and special forest industry using the advantage of climate. (4) construction of enterprises with heavy pollution and sewage discharge is prohibited.
- **Ecological tourism and forestry & farming & fruit ecological functional area of Huichun Valley**: (1) return farmland to forest, speed up the recovery of biodiversity and construction of mixed coniferous landscape in the hilly area, functioning as soil and water conservation, water conservation and flood storage. (2) speed up the construction of Huichun as a border trade port, transfer the resources advantages into eco-industrial advantages as soon as possible, and develop border tourism and tourism agriculture. (3) control utilization of chemical fertilizer and pesticide and develop ecological agriculture.

Summary of Involved Ecological Function Zoning alongside the Line and Coordination Analysis

Scope of railway mileage	Ecological function zoning	Ecological requirement	Coordination analysis
DK0～DK30	The Songhua Lake flood regulation and storage and landscape protection ecological functional zone	Strengthen the Songhua Lake ecological environment and the recovery of mixed coniferous forest; it is prohibited to let heavy pollution enterprises settle down in this area	Sewage from stations along the line is discharged after conforming to standards or entered the city sewage pipe network. Strengthen greening on both sides of the line. Non-heavy polluting industry of the railway project meets the regional eco-functional requirements.
DK30～DK110	The Lafa River basin water reservation and forestry ecological functional area	Plan forest rationally, establish forest age structure, tree structured mixed coniferous forest ecosystems	Construction shall minimize the occupation of forest land, mostly use tunnels and bridges. Distribute tree species along the embankment slope, strengthen greening of the stations along the line and under bridges. Meet the regional eco-functional requirements
DK110～DK190	Middle-low mountains water conversation and forestry ecological functional area in upper Mudanjiang	Focus on protecting quality of water and forest ecosystem in upper Mudanjiang. Strictly control forest harvesting	Construction shall minimize the occupation of forest land and the deforestation. Forest trees within the permanent occupied land shall be moved or used for greening along the line. Sewage from stations along the line is discharged after conforming to standards or entered the city sewage pipe network to protect water quality in upper Mudanjiang. Meet the regional eco-functional requirements.
DK190～DK255	Water reservation and forestry ecological functional area of the Buerhatong River basin	strengthen soil and water conservation and water reserving forest construction, strictly control excessive harvesting of trees, return farmland to forest; protect water quality of the Buerhatong River	Construction shall minimize the occupation of forest land and the deforestation. Strengthen greening on both sides of the line. Sewage from stations along the line is discharged after conforming to standards or entered the city sewage pipe network to protect water quality of Buerhatong River. Meet the regional eco-functional requirements.
DK255～DK295	Yanji town and forestry & farming & fruit ecological functional area	Protect urban ecosystems; control soil and water loss; construction of enterprises with heavy pollution and sewage discharge is prohibited	Strictly control the scope and scale of the land the project occupied. Take positive measures to minimize soil and water loss. Non-heavy polluting industry of the railway project meet the regional eco-functional requirements.

DK295～DK361	Ecological tourism and forestry & farming & fruit ecological functional area of Huichun Valley	return farmland to forest, speed up the recovery of biodiversity and construction of mixed coniferous landscape in the hilly area	Strengthen greening on both sides of the slope, avoid choosing one single species. Select mixed conifer and broadleaf better for planting providing better landscape. Build better look landscape green belt on both sides of the line. Meet the regional eco-functional requirements.

5.2.2 Analysis of Land Use and Cover Characteristics

It is the basis for ecological impact evaluation to find out the status of land use within the evaluated area. Using TM image information, based on remote sensing (RS) and geographic information system (GIS), build a direct interpretation symbol between prototype of surface features and satellite images based on field survey and text and image information collected. Using land group analysis to create interpretation symbol and explain land use situation of the evaluation area by supervising, analyzing and human interpretation. Land use types of the evaluation area are mainly: forest land, farmland, land for construction, grassland, unused land and tidal flat land (see *Figure: 5-2-1*). Most of them are forest land and farmland. Grassland, unused land and tidal flat land are few.

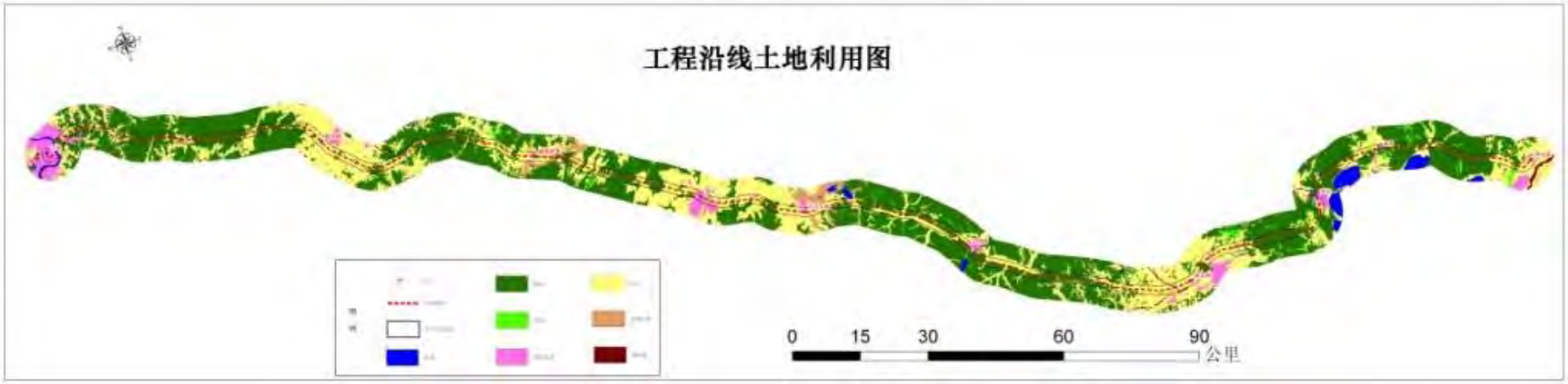


Figure 5-2-1(a) Land Use along the Proposed Railway Alignment

Figure 5-2-1(b): Pictures of Land Use Types alongside the Line

Areas of various land use types within the range of 300m on both sides of the line are listed in Table 5-2-1.

Table 5-2-1: Current Situation of Land Use Within the Evaluation Area

Land Use Type	Area (hm^2)	Percent (%)	Number of Patches	Percent of Number of Patches (%)
Forest land	12138.3	49.86%	50	20.41%
Farmland	10072.2	41.37%	73	29.9%
Grassland	425.6	1.75%	19	7.84%
Land for construction	1206	4.95%	88	36.28%
Unused land	413.4	1.69%	8	3.1%
Water area	91	0.38%	6	2.47%
Total	24346.5	100%	244	100%

The wetland alongside the line is mainly distributed in the valley in two types of freshwater marshes and shrub swamps. Herb of freshwater marshes is carex and Carex meyeriana, and herb of shrub swamp is Spiraea Salicifolia and Sorbaria kirilowii, distributed in the valley from Haerba Ling to Dashitou within the range of CK184~CK190+300. Type line of this section is bridge, total three bridges 1024m. All bridges use standard beams with a span of 32m and 32 bridge piers. The project passes through the above regions in the form of bridges to ensure runoff within the wetland flowing smoothly which will not block energy flow and logistics flow and affect the stability and integrity of the wetland. The impact of projects on wetland is that excavation of the pier requires occupation of wetlands, causing a certain degree of damage. According to preliminary estimation, there will be 32 bridge piers that might damage **830m^2** wetlands. It is recommended to transplant the 830m2 wetlands within the construction area to a chosen suitable site for protection, the costs may be incurred from the construction.

5.2.3Current Situation of Vegetation Resources alongside the Line

1. Characteristics of flora

   In terms of florae, the plants in the region belong to that of the Northeastern China. There are many unique plants in the region. The trees are represented by the red pine. Other trees include abies holophylla maxim, taxales, thuja koraiensis, changbai larch,etc. Among the broad-leaf species are acer triflorum, purple flower bass, small purple flower bass, Manchu triple maple, Manchurian ash, Manchurian maple, lebbektree, Manchurian walnut, cork-tree, Korean poplar and so on. These broad-leaf species are in a great variety, and some belong to the tertiary relic species, such as Manchurian walnut, cork-tree, Manchurian ash, etc. . The above species, together with the vine amur grape and schizandra sinensis, etc., not mention that the typical herbal plant like ginseng not counted in yet, are sufficient to demonstrate this flora is ancient, belonging to the tertiary florae system. This phenomena is not only due to the humid subtropical climate in this region in the geologic history but also less glacial influence. Also, under the effect of both modern maritime climate and the warm and humid monsoon in

the summer, these tertiary relic species can survive and have growth and development, thereby adding southern（subtropical）plant characteristics to this region. Besides, this region is also mixed with the Kamchatka-Okhotsk's floral element, such as some northern tree species--picea, fir, etc.

2. overview of vegetation cover in the scope of assessment

The zonal native vegetation in the region along the line is the red pine mixed broadleaf-conifer forest. Except little indigenous vegetation still exist on very few hill tops due to influences of human activities such as logging, etc., the existing forest lands are mainly natural secondary forest and man-made forest like needle forest, needle-broad-leave mixed forest and deciduous broad-leaved forest, mainly in the regular forest forms. They are mainly Mongolian oak, aspen, birch, ulmus, acer, bass, willow, Manchurian ash, Manchurian walnut, etc. The principal species of the man-made forest, mainly formed by larch, are red pine, Japanese red pine, picea, fir, Mongolian scotch pine, Japanese black pine, etc. Besides, there are lebbektree , hawthorn, malus baccatasorbit, bird cherry, rhamus, woodbine, lespedeza, hazel and sedge family, graminaceae, oonopsis , etc. The economic plants mainly include ginseng, manyprickle acanthopanax, rhizoma gastrodiae, Chinese magnoliavine, balloonflower, angelica, turkey foot fern, osmunda cinnamomea, amur grape, bower actinidia fruit, etc.

The agriculture along the line is developed. The flat lands along the river are mostly the paddy field growing rice. Mountain side, gentle slope and terrace land are mostly the dry land mainly growing crops like maize, soybean and potato. A large areas of fruit trees are grown in the sunny slopes with rich water sources on some hills and hillside fields in Yanbian Korean Autonomous Prefecture.

According to the investigation and survey findings on the woods in the sensitive area and the sample ares in other regions, no antique and precious trees are found yet. If such trees are found in construction, they should be reported to the competent authorities in time according to the requirements of the relevant state laws and regulations and protected or transplanted as required.

According the spot survey along the line, the ecological public welfare forests are mostly distributed in the following stretches: DK4~DK9, DK45～DK55 and DK135～DK140, mainly larch woods and mixed broadleaf-conifer woods, usually on the upper parts of the mountain where it is less affected by man's activities due to inconvenient traffic. This project goes through the above areas mostly in the form of tunnel with the tunneling length taking above 70% of the total length, therefore causing less effect on the ecological public welfare forests.

3. Survey of vegetation cover in the sample areas

In order to better understand the ecological status of both the Three Lakes Provincial-Level

Reserve on Songhua Jiang River and An Tu Ming Yue Pine Mushroom Nature Reserve as well as the engineering construction's influence on them, in the environmental appraisal, the owner commissioned the forestry survey & design institute of Jilin Province to prepare the special evaluation report for the above two sensitive area. In this regard, the inventory survey on vegetation cover inside the above sensitive areas is mainly based on the woods general investigation.

For the non-sensitive areas along the line, the investigator chose different forest lands to carry out the sample area survey(see Figure 5-2-2) based on florea characteristics while considering the distribution pattern of the vegetation cover in the engineering zone along the line, including Mongolian oak, larch, aspen, birch, ulmus, lime, Manchurian ash, Manchurian walnut, red pine, Japanese Red pine, picea, fir, etc. The size of the sample area for arborous layer is 20m×30m. The log scaling is done for measurement of diameter at breast height and tree height, and the biological mass of the arborous layer in sample area is calculated by the relative growth equation. The size of the shrub-layer's sample areas is 5m× 5m, and the size of the herbaceous layer's sample area is 1m×1m. Refer to Table 4-2-2 for the investigation and survey results of the biological mass for the forest lands along the line, and Table 5-2-3 for those about the biological mass for the farmland vegetation cover along the line. See Table 5-2-4～5-2-12 for details about sample areas' results.

Generally, the plant species along the line are similar without visible change, and the agricultural vegetation cover takes a big proportion in basin plain region while forest cover in high proportion in hills and mountainous region. The state-level and provincial-level wild plants along the line are mainly distributed in Three-Lake Provincial-Level Reserve on Songhua Jiang and Pine Mushroom Provincial-Level Nature Reserve, and only one kind of wild plant（Manchurian ash）under state key protection was found in the sample area survey for non-sensitive area.

According to the survey results of the sensitive areas and the sample areas' survey results of common areas, the wild plants under state key protection in the project area are red pine, Manchurian ash, cork-tree, Manchurian walnut, Amur linden and Wild groundnut, mostly in sporadic distribution. Red pine, Amur linden, Manchurian ash, cork-tree and Japanese red pine are not found in aggregated distribution. Distribution pattern of the wild plants under state key protection in the project area is listed in the table below.

Summary on distribution of wild plants under the state key protection in the project area

Name of species	Protection category	Latin name	Habitat characteristic	Number(tree trunk)	Distribution zone
Red pine	State Category	*Pinus koraiensis*	Scattered or aggregated in the	3538	DK29+492~ DK80+330, DK199~DK240

	II		mixed broadleaf-conifer forest		
Manchurian ash	State Category II	*Fraxinus mandshurica*	Scattered in the mixed broadleaf-conifer forest	74	DK26+040~ DK80+430, DK199~DK240
Cork-tree	State Category II	*Phellodendron amurensis*	Scattered in the mixed broadleaf-conifer forest	20	DK28+635~ DK29+160, DK199~DK240
Amur linden	State Category II	*Tilia amurensis*	Mixed broadleaf-conifer forest	39	DK31+280~ DK31+335, DK199~DK240
Wild groundnut	State Category II	*Glycine soja*	Aggregated on forest roadside or hillside prairie	55	DK31+917~ DK32+150
Manchurian walnut	State Category II	*Juglans mandshurica*	Scattered in the mixed broadleaf-conifer forest	67	DK29+500~ DK80+000
Total				3793	

Figure 5-2-2 Survey of vegetation cover along the line

Table 5-2-2 Sample Survey Results of Forestry

Type of forestry	location	Altitude（m）	Shade density（%）	Average diameter at breast height(cm)(cm)	Average height of tree layer(cm)	Biomass of tree layer（t/hm2）	Biobass of Shrub layer（t/hm2）	Biobass of herb layer（t/hm2）	Total biomass (t/hm2)
Q. mongolica forest	Yanjishuinan Village	260	0.9	15.5	13.8	102.3	13.6	1.14	117.0
Willow stand	Tumenquanshui Tun	183	0.8	16.3	14.1	111.4	1.5	0.9	113.8
Populus davidiana	Longjinglaotougou	273	0.6	12.2	6.4	28.3	3.6	0.7	32.6
betula sp	Antudasihtou	538	0.7	14.3	5.5	109.2	1.1	2.3	112.6
larch tree forest	Dunhuaqiuligou	502	0.8	16.8	13.6	161.5	5.2	1.4	168.1
spruce forest	Dunhuaweihuling	535	0.9	14.5	14.2	156.2	2.1	1.1	159.4
fir forest	Jiaohehuangsongdian	490	0.8	12.4	15.4	132.8	1.9	0.7	135.4
Elm Forest	Jiaohebaishi Mountain	336	0.7	13	9.3	99.8	3.2	1.3	104.3
Bass forest	Jilin Longtan Xiaodonggou	223	0.6	16.5	10.7	116.3	1.5	0.9	118.7

Table 5-2-3 Sample Survey Results of Farmland

Type of forestry	location	Altitude（m）	Average Cover（%）	Average height (cm)	Biomass(t/hm2)
Corn	Yanji Bronze Statue of Buddha	153	95	1.9	13.6
Soya Bean	Dunhua Dachuan Tun	168	95	0.6	11.2
potato	Tumenshimen	230	90	0.4	9.8
Rice	Huichun Jianshe Tun	77	85	0.5	8.5

Table 5-2-4 Sample of Q. mongolica Forest

Location: Shuinan Village of Yanji City Altitute: 260m Slope：25° Slope aspect:NW30°
Geographic coordinates: 129.62°E, 42.92°N Tree layer: Quadrat size: 20×30 m2 Shed density: 90%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Mongolian oak	arbor	secondary forest	13.8	15.5	102.3
Corylus mandshurica	arbor	secondary vegetation	3	7	7.6
Ulmus macrocarpa	shrub	secondary vegetation	2.5	3	6.0
Melampyrum roseum	herbage	secondary vegetation	1		0.64

Yam	herbage	secondary vegetation	1.5		0.5

Table 5-2-5 Sample of Willow Stand

Location: Tumenquanshui Tun Altitute: 183m Slope：35° Slope aspect: SE35°
Geographic coordinates: 129.79°E, 42.93°N Tree layer: Quadrat size: 20×30 m2 Shed density: 80%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Willow stand	arbor	secondary forest	14.1	16.3	111.4
Corylus mandshurica	shrub	secondary vegetation	4	5	0.9
Crataegus dahurica	shrub	secondary vegetation	3	4	0.6
Carex pilosa	herbage	secondary vegetation	1		0.9

Table 5-2-6 Sample of Populus Davidiana

Location: Longjin city laotougou Altitute: 273m Slope：20° Slope aspect: NE31°
Geographic coordinates: 129.23°E, 42.93°N Tree layer: Quadrat size: 20×30 m2 Shed density: 60%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Aspen	Arbor	Secondary forest	6.4	12.2	28.3
Spiraea ussuriensis	Shrub	Secondary vegetation	1.5	1.5	2
lespedeza	Shrub	Secondary vegetation	4.4	2.0	1.6
agrimony	Herbage	Secondary vegetation	0.6		0.4
Eriophorum	Herbage	Secondary vegetation	1		0.3

Table 5-2-7 Sample of Birch

Location: antudashitou town Altitute: 538m Slope：15° Slope aspect: SW26°°
Geographic coordinates: 128.47°E, 43.29°N Tree layer: Quadrat size: 20×30 m2 Shed density: 70%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Aspen	Arbor	Secondary forest	5.5	14.3	109.2
lespedeza	Shrub	Secondary vegetation	4.6	1.3	0.6
Spiraea salicifolia L.	Shrub	Secondary vegetation	3.5	2.0	0.5
Sanguisorba filiformis	Herbage	Secondary vegetation	0.6		1.0
Maianthemum bifolium	Herbage	Secondary vegetation	1.5		1.3

Table 5-2-8 Sample of Larch forest

Location: Dunhuaqiuligou town Altitute: 502m Slope：10° Slope aspect: NE32°
Geographic coordinates: 128.14°E, 43.50°N Tree layer: Quadrat size: 20×30 m2 Shed density: 80%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Larch	Arbor	Secondary forest	13.6	16.8	161.5
Lonicera japonica	Shrub	Secondary vegetation	3.6	1.2	2.9
Spiraea salicifolia L.	Shrub	Secondary vegetation	3.0	2.0	2.3
Thalictrum squarrosum	Herbage	Secondary vegetation	0.8		0.8
Saussurea sp	Herbage	Secondary vegetation	0.7		0.4

Table 5-2-9 Sample of Spruce forest

Location: Dunhuaweihuling town Altitute: 535m Slope：18° Slope aspect: NE22° Geographic coordinates: 127.82°E, 43.55°N Tree layer: Quadrat size: 20×30 m2 Shed density: 90%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Spruce	Arbor	Secondary forest	14.2	16.5	156.2
Lonicera japonica	Shrub	Secondary vegetation	2.0	1.2	1.0
Birdcherry	Shrub	Secondary vegetation	2.5	2.0	1.1
Oxalis tuberosa	Herbage	Secondary vegetation	0.5		1.1

Table 5-2-10 Sample of Fir Forest

Location: Jiaohehuangsongdian town Altitute: 490m Slope：12° Slope aspect: NE15° Geographic coordinates: 127.74°E, 43.59°N Tree layer: Quadrat size: 20×30 m2 Shed density: 80%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Fir	Arbor	Secondary forest	15.4	12.4	132.8
Pyrus decora	Shrub	Secondary vegetation	3.0	1.5	1.0
Lonicea caerulea L.	Shrub	Secondary vegetation	2.6	1.6	0.9
Mitella nuda	Herbage	Secondary vegetation	0.6		0.7

Table 5-2-11 Smaple of Elm Forest

Location: Jiaohebaoshishan town Altitute: 336m Slope：30° Slope aspect: NW35° Geographic coordinates: 127.44°E, 43.63°N Tree layer: Quadrat size: 20×30 m2 Shed density: 70%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Elm	Arbor	Secondary forest	9.3	13.0	99.8
Erberry	Shrub	Secondary vegetation	3.6	2.3	2.1
Acanthopanax Senticosus	Shrub	Secondary vegetation	3.0	2.6	1.1
Sege	Herbage	Secondary vegetation	0.7		1.3

Table 5-2-12 Sample of Bass Forest

Location: Jilinlongtanxiaodonggou town Altitute: 223m Slope：10° Slope aspect: NE22°
Geographic coordinates: 126.70°E, 43.76°N Tree layer: Quadrat size: 20×30 m2 Shed density: 60%

Dominate species	Layer	Type	Average height(m)	Mean DBH (cm)	Biomass(t/hm2)
Bass	Arbor	Secondary forest	10.7	16.5	116.3
Spiraea salicifolia L.	Shrub	Secondary vegetation	3.5	1.8	0.8
False spiraea	Shrub	Secondary vegetation	2.8	2.0	0.7
Twoleaf beadruby herb	Herbage	Secondary vegetation	0.7		0.9

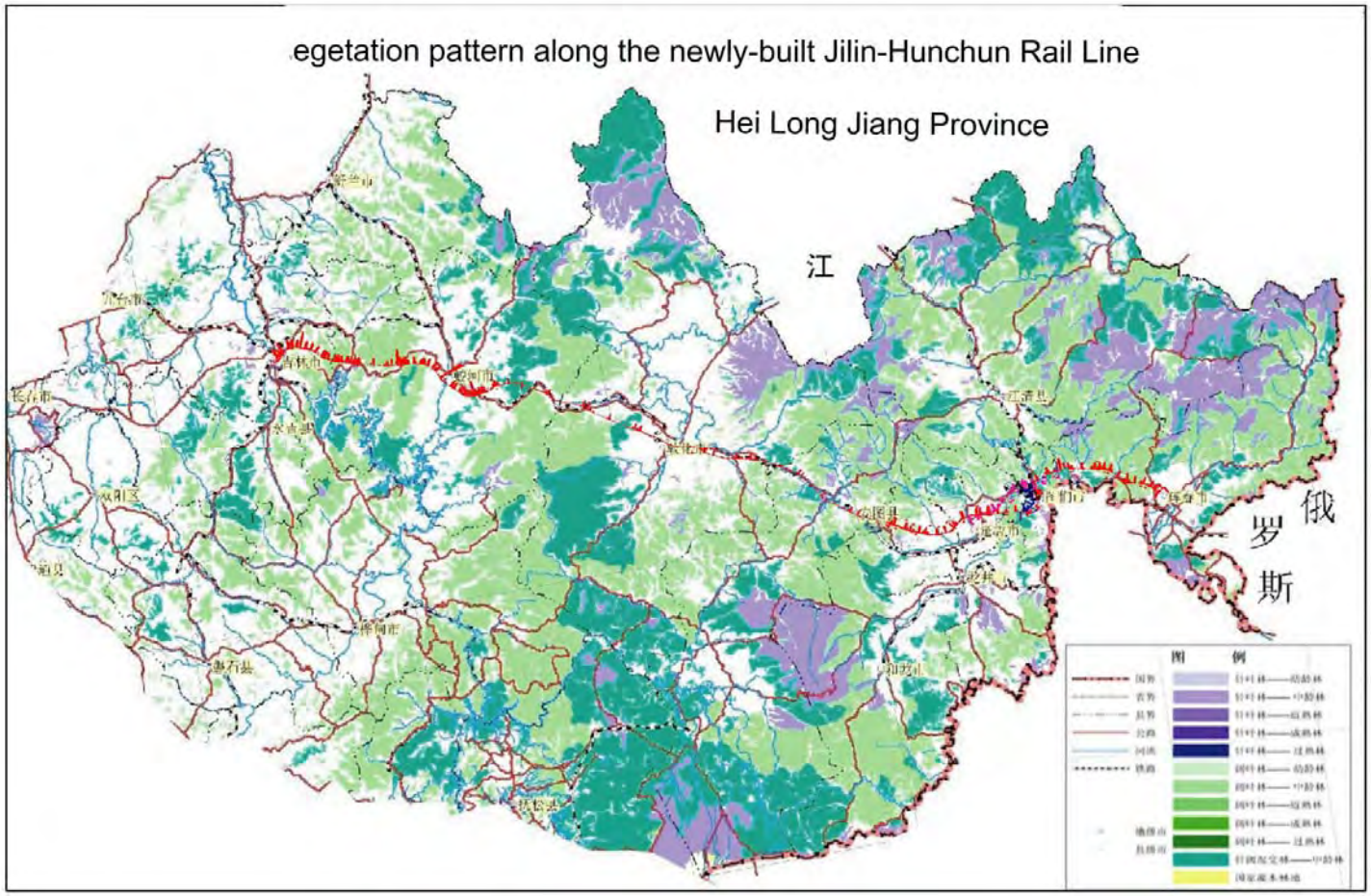


Figure 5-2-3 Vegetation Pattern along the Railway Alignmetn

5.2.4 Current Situation of Wild Animal Resources alongside the Line and Impacts Analysis

As there are many forests in this region, which provides perfect habitats and multiplyin place to the animals, a number of animal species are distributed here. Although this region has the characteristic of more animals in extratropical zone, i.e. , more Northern types of animals, the distribution region of the southern-type birds is also extended to this region. The beasts of the northern species are represented by alpine pika , rabbit of northeast China, sable, Ursus arctos, etc. The southern-type beasts extended to this subregion include tiger, goral, spotted deer , etc. The northern type birds include hazel grouse, blackcock, skylark, etc. and the southern type ones extended to this subregion include eurystomus orientalis, halcyon pileata, halcyon coromanda, pericrocotus divaricatus, driolus chinensis, ardea purpurea, ardea alba, gallinula chloropus, etc. The fish distribution includes both the typical northern-type species, like brachymystax lenok, Hucho taimen, burbot, etc. and numerous southern-type ones, like saurogobio dabryi, xenocypris argentea, etc.

- There are many benthonic organism in the water area in the **Three-Lake Provincial-Level Reserve on Songhua Jiang**, like tubifex, Limnodrilus, ancylus fluviatilis, mussel, etc. , which keep more than 40 species of fishes like chub, big-head carp, carp, golden carp, mandarin fish, etc. In some mountain forests are black bear, wild boar, fox , spotted deer, sable, capreolus pygargus, blackcock, tetrao urogallus, yellow-throated marten, yellow weasel, rana temporaria, etc.
- In the **Ming Yue pine mushroom provincial-level nature reserve**, there are more than 150 kinds of higher animals including 28 kinds of beasts, like black bear, red fox, wolf, raccoon dog, meles meles, tiger-cat, sable, yellow weasel, alpine weasel, red deer, capreolus pygargus, rabbit of Northeast China and squirrel. There are 101 kinds of birds, like goshawk, buteo buteo, circus melanoleucos, falco columbarius, falco vespertinus, kestrel, hazel grouse, ring necked pheasant, streptopelia orientalis, cuculus fugax, cuckoo, cuculus micropterus, cuculus canorus, cuculus saturatus, ural owl, otus scops, ruddy kingfisher, eurystomus orientalis, upupa epops, picus canus gmelin, great spotted woodpecker, picoides leucotos, picoides minor, pericrocotus divaricatus, garrulus glandarius, cyanopica cyana, pie, large-billed crow, carrion crow, phylloscopus proregulus, etc.There are eight kinds of reptiles, like eremias argus, takydromus septentrionalis, dione rat-snake, elaphe rufodorsata, elaphe schrenckii, pit viper , etc. There are eight kinds of amphibious animals, like Chinese frog, hyla immaculata, hyla of northeast China , bufo bufo gargarizans , oriental fire bellied toad, etc.
- There are fishes under state special protection in the ***Hun Chun Mi Jiang He Oriental Salmon State-Level Aquatic Germplasm Resources Reserve,*** like migration

fishes--salmon（cherry salmon, humpbacked salmon, oriental salmon）, and cold-water fishes--brachymytax lenok pallas, tribolodon brandti, lamprey-eel ,salvelinus malma, etc.

According to the survey and assessment, there are total 20 kinds of State Category II Key Special Protected Animals, including 15 kinds of birds like mandarin duck, goshawk, eurasian sparrowhawk, accipiter virgatus, buteo buteo, buteo hemilasius, buteo lagopus, circus melanoleucos, circus cyaneus, eurasian hobby, falco vespertinus , kestrel, ural owl, asio flammeus, and hazel grouse. There are five kinds of beasts like red deer, black bear, wild boar, capreolus pygargus and lynx .

Table 5-2-13 Summary on the species of the wildlife under state special protection in the ecological sensitive area along the line

Name of species	Latin name	Distribution	Protection category
Zuraw stepowy	*Anthropoides virgo*	Songhua Jiang Three-Lake Nature Reserve	State Catogery II
White-naped Crane	*Grus vipio*	Songhua Jiang Three-Lake Nature	State Catogery II
Common crane	*Grus grus*	Songhua Jiang Three-Lake Nature	State Catogery II
Mandarin duck	*Aix galericulata*	Songhua Jiang Three-Lake Nature	State Catogery II
Red deer	*Cervus elaphus*	Songhua jiang Three-lake Provincial-Level Reserve; Ming Yue Pine Mushroom Nature Reserve and Mt. Wei Wu Ling and Mt. Ha Er Ba Ling Region	State Catogery II
Black bear	*Selenarctos thibetanus*	Songhua jiang Three-lake Provincial-Level Reserve; Ming Yue Pine Mushroom Nature Reserve and Mt. Wei	State Catogery II

Name of species	Latin name	Distribution	Protection category
		Wu Ling and Mt. Ha Er Ba Ling Region	
Goshawk	*Accipiter gentilis*	Ming Yue Pine Mushroom Nature Reserve	State Catogery II
Kestrel	*Falco tinnunculus*	Ming Yue Pine Mushroom Nature Reserve	State Catogery II
Hazel grouse	*Tetrastes bonasia*	Ming Yue Pine Mushroom Nature Reserve	State Catogery II
Ural Owl	*Strix uralensis*	Ming Yue Pine Mushroom Nature Reserve	State Catogery II

In most area of the region along the line, villages, people and traffic lines are relatively aggregated with more human activities. So this gives tense disturbance to the wildlife whose population are less here and distributed in narrow zone. This region is dominated by the ecological landscapes of farmland and forest land and short of extensive natural forests, and on both sides of the railway are small area of man-made forests. The beast resources are scare in the scope of appraisal along the line, and there are no big beast inhabitation. According to the field survey, visit and data records, the number of wildlife in the appraisal area is small and the species with reasonable quantity of individuals is not found yet, nor particular fixed habitat for certain kind of animal. The beast under state key protection is not found in the field survey either.

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5.2.5 The current situation of water loss and soil erosion along the line

This line goes through Jilin Municipality of Jilin Province and Yan Bian Prefecture. The soil and water losses along the line are dominated by the water erosion with the intensities mostly as minimal and slight. For the difference in topography, less intensity for basin plain and more tense for mountanious and hilly region. For the difference in land use, the tensity of loss in farmland is bigger than those in forests land and grasslands. For regional distribution, the area and intensity of Jinlin Municipality is less than those in Yan Bian Prefecture.Refer to Table 5-2-14 for the soil and water losses within one kilometer on both sides of the project line.

Table 5-2-14 Summary on the soil and water losses along the project's route

Erosion intensity	Area （hm2）	Proportion of area （%）	Number of patches	Proportion of patch number（%）
Minimal	57664	82.8	336	73.36
Slight	10301.29	14.7	85	18.56
Moderate	1638.5	2.475	34	7.42
Severe	17.5	0.025	3	0.66
Total	69621.29	100	458	100

According to Jilin Province's Government's “Bulletin on Division of Key Preventive Zones Against Soil and Water Losses”（Ji Zheng Fa （1999）no. 30）, the following areas where the line goes through on the list: Dun Hua Municipaltiy and An Tu County as the key protective zones, and Yan Ji Municipalty, Tu Men Municipality and Long Jing as key supervision zones, and Ji Lin Municipality's urban area, Jiao He Municiplaty and Hun Chun Municipality as key harnesing zones.Total area of the soil and water losses in Jilin Municiplaity is nearly 6000km2, taking about 20% of the city's total land area. Nearly 3607km2 of soil erosion in Yan Bian, taking about 8.3% of its total land area. According to soil erosion type zoning nationwide, the permitted intensity along the line is 200t/km2·a

5.2.6 The current situation and evaluation of integrity of the ecological system

Status of the ecosystem integrity is to be assessed in terms of production capacity and stability of the natural system in the region where the railway is planned to be built. This is because the core of the regional natural system is organism and the organism is capable of adapting to the environmental change and reproduction, which can remedy the disturbed natural system and maintain its balanced state in fluctuation. When the man's disturbance exceeds the biologic remedy(regulation) capacity, the natural system will lose its capacity of maintaining its balance, causing the system to decline from higher level to lower one. Therefore the production capacity and stable condition will be taken as factors of first choice for identification of uncontamination ecological impact.

1. Survey and assessment of the vegetation cover’s productivity

   The vegetational productivity and the biological mass in the appraisal area can be reckoned by survey on the biological mass of typical vegetation pattern and the vegetation chart along the line. Refer to Table 5-2-15.

Table 5-2-15 Statistics of the net productivity and biological mass for the vegetation patterns on both sides of the line

Vegetation pattern	Area(km^2)	Average net productivity [t/(hm^2.a)]	Average biological mass（kg/m^2）	Total biological mass（10,000t）
Forest land	121.38	8.15	12.5	163.8
Farmland	100.72	7.1	1.1	
Grassland	4.26	4.67	1.5	
Construction land	12.06	0.13	0.3	
Water body	0.91	0.01	0.2	
Total	239.33	7.21	6.85	

Note： Average net productivity in the table based on smith, 1976.

From the above Table, the average productivity in the appraisal area is 7.21t/hm2.a, far above the bearing capacity threshold for the ecosystem of this class: 1.82t/hm2.a（see Odum, 1959 for details）, therefore this ecosystem has strong bearing capacity and can endure the disturbance at a quite level. But as the productivity is average and some areas' productivity levels may be below 1.82t/hm2.a, man's incessant exploration and construction is bound to reduce them gradually. Therefore, in order to maintain the appraisal area's productivity at the current level, the destroyed vegetation cover must be ecologically restored in time

2. The natural system’s stable condition

As the average net primary productivity of the vegetation cover in the region where the railway is to be built is at high level and the region also has rich and diverse biologic resources and vegetation patterns, therefore its ecosystem is strong both in restoring stability and resisting stability and has strong stability. Nonetheless, due to human disturbance in the last years, the ecological environment in this region has been slowly declining. To mitigate the human influence, the engineering construction must follow the order of nature with the natural vegetation under careful protection. Only in this way can the project be completed with less or no destruction to local ecological environment to realize the harmony of environmental protection and economic development

5.2.7Assessment of the ecological quality of the landscape

The forest eco-system, farmland ecosystem and urban ecosystem in the area under assessment are regularly arranged and formed in a certain order. Therefore, this area has become the carrier of the ecosystems, which is within the landscape ecosystem. The quality of the landscape ecosystem is subject to the complicated interactions between the natural environment,

organisms and the human society in the area. From the point of view of the landscape ecological structure and functions matching, the reasonability of the construction depends on the maintenance of the ecological integrity of the ecosystem in the area.

The landscape ecosystem is composed of the patches, corridors and matrix. Matrix is the geographical background of the landscape, an important element of the landscape and largely determines whether the function of the landscape is good or poor. Therefore, when the attribute of the matrix of an area is determined, the area can be evaluated for its ecological integrity.

There are three criteria for determining the matrix: a large relative area, a high connectivity degree and with dynamic control function.

At present, the matrix of a landscape is determined by calculating the importance value of vegetation in the traditional ecology to get the superiority or dominance value of a patch in the landscape. The dominance value is calculated from 3 parameters, namely density (Rd), frequency (Rf) and landscape proportion (Lp). The 3 parameters have good reflection to the first two criteria in the determination of the matrix. The expression of the third criterion is not clear enough. However, according to the procedures for determination of the matrix in the landscape, when the first two criteria are relatively clear for assessment, the patch type which is considered with a large relative area and high connectivity degree can be taken as the matrix with the function to regulate the eco-environment quality we are looking for.

The mathematical expression for calculation of the dominance value is as follows:

Density, $R_d = \frac{Numberofpa\quad tches\ ,i}{Tota\ \ \ln\ umberofpat\quad ches} \times 100\%$

Frequency, $R_f = \frac{Numberofplotsfortheappearanceofthepatch,i}{Tota\ln umberofplots} \times 100\%$

Landscape proportion, $L_p = \frac{Areaofpatch,i}{Totalareaofsampleplots} \times 100\%$

Dominance, $Do = \frac{(Rd + Rf)/2 + Lp}{2} \times 100\%$，(See Xiao Duning, 1991)

The dominance value calculated for patches in the area selected for the railway are listed in Table 5-2-16.

Table 5-2-16 The dominance values of patches in areas neighboring the line

Patch type	Rd (%)	Rf (%)	Lp (%)	Do (%)
forest land	21.2	49.5	48.2	41.8
Grassland	8.1	3.6	4.0	4.9
Arable land	30.9	41.2	40.1	38.1
Land for	37.3	5.2	6.9	14.1

construction				
Water body	2.5	0.5	0.8	1.2

The data in Table 5-2-16 indicate that in the dominance values of patches in the area where the railway runs through, Do of the forest land is the highest, up to 41.8%, followed by the arable land, which is 38.1%. This means that the forest land and the arable land are the major components for the control of the eco-environment quality in the area. As the arable lands in the area where the railway runs through is of low arability, most of them have only one planting season and the erosion of soils in the farmlands is weak, coupled with the vegetation on the forest land in the area has a high productivity, so that the eco-environment quality in the area is quite good.

5.2.8 Impact on the vegetation ecosystem along the line

1. Prediction of the impact on the ecological integrity

After the project is implemented, the production capacity and stability in the area under evaluation will be changed and therefore the ecological integrity in the area will be affected.

① Change in the production capacity and biomass in natural system

Based on the area of the land to be used for the project, the loss of biomass and productivity in the natural system in the area under evaluation can be calculated. For details, see Table 5-2-17.

Table 5-2-17 Reduction of biomass and productivity in the area where the railway runs through

Vegetation to be used	Area to be used permanently (hm^2)	Average net productivity [t/(hm^2.a)]	Average biomass(kg/m^2)	Average net productivity loss t/(hm^2.a)]	Biomass loss(t)
Forest land	458.1	8.15	12.5	0.30	642,000
Arable land	485.54	7.1	1.1		
Unused land	32.46	3.5	1.1		
Land for construction	190.12	0.13	0.3		
Water area	7.56	0.01	0.2		
Total	1,173.78	6.2	5.4		

After the railway is put into operation, the average production capacity of the natural system in the area will be reduced by 0.30 t/hm2.a, from the current 7.21 t/hm2.a to 6.91 t/hm2.a, a decrease of 4.2% from the original level. The reduction is small and the affection is not significant.

The impact of the construction on the vegetation resources along the line mainly is the loss of biomass within the construction area during the construction period. After the natural recovery

period starts, the vegetation on such areas as subgrade slope, stations and yards, and temporary works will be restored gradually. The loss of biomass in this assessment is calculated by the following formula:

$$W = W_0 + S \times F \times A \quad (4\text{-}2\text{-}1)$$

W: Total loss of biomass (t);
W_0: Biomass in the original landscape (t);
S: Annual net productivity ($t/hm^2.a$);
F: Vegetation area(hm^2);
A: Time period (a).

According to the field survey combined with the gathered information on the areas along the line, the loss of biomass in the original landscape within the land to be used for the project is 63.5×104 t; the annual net productivity loss of the vegetation in the original landscape within the construction area is 7,319 t/a. Therefore the total loss of biomass due to the construction is the sum of the losses of the organisms in the original landscape and the production during the construction period, which amount to 64.2×104t.

The loss of biomass within the construction area is mainly the loss of vegetation concentrated on the surface in the range of the subgrade, subgrade slope concrete blocks, bridge piers, buildings and other permanent structures. However, it is estimated that 7.5×104t of biomass can be repaired per year after measures are implemented such as the restoration of the vegetation on the subgrade slope after the construction is complete, greening the areas of stations and yards and the recovery of vegetation on the temporary works, which will minimize the loss of biomass due to the construct

② The change in the stability of the natural system in the area under assessment

A. Analysis of the recovery stability

The change of the natural system's recovery stability is assessed by the vegetation biomass and the net primary productivity. It can be seen from the above analysis that after the project is implemented, the change of biomass and the net primary productivity of the natural system in the area under assessment is not significant. Therefore, the impact on the stability of the natural system's recovery is small and it is endurable to the natural system in the area under assessment.

B. Resistance stability analysis

The measurement of the stability of resistance to the natural system is made by the change level of the vegetation heterogeneity. This project will only change the usage of a small portion of the land within the area under assessment while the usage of most part of the land will remain unchanged. Therefore, the implementation and operation of the project will not have significant impact on the heterogeneity level of the matrix components in the natural system in the area under assessment, so that there will be no significant affection on the

stability of the resistance to the natural system in the area.

(2) Prediction of the affection on the ecological quality of the landscape

After the project is implemented, part of the land usage pattern in the area will be changed and the area of various vegetation types and the number of patches will be changed accordingly. The corresponding parameters can be derived by the software ERDAS and the dominance of various patches can be calculated. For details, see Table 5-2-18.

Table 5-2-18 The change of dominance of various patches after the implementation of the project

Type of patch	Rd (%)	Rf (%)	Lp (%)	Do (%)
Forest land	19.2	47.3	46.3	39.8
Grassland	8.1	3.8	4	5
Arable land	28.5	38.6	39.5	36.5
Land for construction	40.3	9.5	9.4	17.2
Water body	3.9	0.8	0.8	1.6

It can been seen from the above table that after the implementation of the project, the dominance of the land for construction which has adverse effect on the ecosystem is increased by 3.1%, to 17.2% while the environmental resources patch forest land and arable land's dominance decreases slightly, but the dominance of both is 76.3%. It is still very large. After the implementation of the project, although the ecological quality of the landscape declines, it will never change the eco-environmental quality of the landscape in the area.

5.2.9 Analysis of the impact of the construction on the potential range of Siberian tigers' activities

1. Information about the activities of Northeast China tigers in Jilin Province

The Northeast China Tiger, also known as Siberian tiger, whose scientific name is Panthera tigris altaica, is originated from the northeastern Asia, specifically the Siberia of Russia, Korea and the Northeast of China. They have existed and evolved for three million years. Northeast China tiger is the largest subspecies in the Felidae family. An adult male tiger reaches up to 3 meters in total length with a tail of about 1 meter, weighs up to around 350 kg. Its hairs appear brown in summer, but straw yellow in winter. Its back and sides feature a pattern of dark vertical stripes, two of them are nearly in the shape of weeping willow leaf. Its head is big and round. On its forehead, the dark transverse stripes connected at their middle resemble the Chinese character of "King," so it is nicknamed the "King of Jungle." Northeast China tiger is the animal under China's First Class protection and is enlisted in the Convention on International Trade in Endangered Species of Wild Fauna and Floras. As the natural habitat on which the Northeast tigers rely to survive continues to be reduced due to the pressure of population, economic activities of human being and other factors, their distribution and range of activities continue to shrink. According to the data of surveys by the

forestry department of Jilin province and the information gathered by the experts in the Northeast China tiger, the Northeast China tigers' potential activity areas in Jilin are mainly the following 3 areas, as shown in the figure 5-2-4(a) below.

Figure 5-2-4 (a) Potential ranges of the Northeast China tiger's activity

Legend	
1	The southern Zhang Guangcai mountain range of the tigers' activity
2	The Harba mountain range area of the tigers activity
3	The Dalongling area of activity
Red line	The railway to be built

(1) The **southern Zhang Guangcai mountain range** of the tigers' activity: It is located in the northmost of Dunhua; to the north and east, it borders Heilongjiang Province; to the southmost, it borders Dunhua's Tuanshanzi, Duling forest, Malugou forest, Badayang and Jiaohe's Shuangshan of Jilin; to the west is the area along Qianjin and Yushugou. The administrative divisions include Emu in Dunhua, Zuizi township of Dashan and Jiaohe's Huangsongdian and Qianjin in Jilin with an area of 3,020 km2 with the zonal vegetation largely composed of pinus and broad-leaved mixed forest. About 3 Northeast China tigers are supposed roving there. No physical substance of Northeast China tiger has been found by the foresty departments and the Northeast China tiger research institutes in the area, but only some of the signs of their activities, such as footprints.

(2) The **Harba mountain** range area of the tigers activity: It is located in the northwest of Wangqing county in Yanbian prefecture and western Dunhua and includes the border region of Yanji and Antu in the north. To the north is the border of the Harba mountain

range and Heilongjiang Province; to the east are the Gaya river and its branch Chunyang Creek in Wangqing county. To the southmost, it borders Baicaogou of Wangqing—Tuntian of Yianji, Lishu—Erqing of Antu and the northwest area; to the west is Chousonggou in the Dahei mountain range of Dunhua, The administrative divisions include Chunyang, Tianqiao mountain range, Daxinggou and Baicaogou in Wangqing；Sandaowan of Yanji, Changxing of Antu county and part of Shitou township of Dunhua. The area is 1,900 km2 with the vegetation mainly composed of the road-leaved Korean pine forest and the secondary broad-leaved, mixed deciduous forest. On the foot of the mountain there is a small area of the Quercus mongolica forest, which is the habitat of one Northeast China tiger.

(3) The **Dalongling area** of activity: it is located in Hunchun of Yanbian and eastern Wangqing county, to the east is the mountain range of Hunchun which boarders Russia，to the north is the hill of Dalongling laboring Heilongjiang Province. To the southwest is the upper reaches of the Suifen river and Hunchun river. The administrative districts include Jingxin, Banshi, Yangpao, Madida and Chunhua in Hunchun and Fuxing township of Wangqing county. The area covers 3740 km2 with vegetation mainly composed of the broad-leaved mixed forest and the secondary oak trees. The area is the most favorable habit of tigers in Jilin which number 4-6.

A more recent and scientific reference regarding potential tiger habitats in northeast China is *Technical Report on the Identification of Potential Tiger Habitat in the Changbaishan Ecosystem, Northeast China* (http://www.wwf.de/downloads/publikationsdatenbank/ddd/33661/, published in January 2010), a joint research by WWF, WCS, Northeast Normal University, KORA and the University of Montana. The WWF report provided mored detailed and area-specific information on the evidence record, and potential habitats based on modeling, and recommendations of priority protection areas for potential habitats. According to the figures,

- The top left figure (figure 3) shows locations of tiger (red dots) derived from the 2005 Amur Tiger Survey in Russia, and surveys in China from the late 1990s. According to the records, the locations are basically to the north and east of the project.
- The top right figure (figure 5) shows the primary highways and secondary raods in Changbaishan area. The proposed railway line will go through the existing transport corridor as indicated in the middle horizontal line.
- The bottom left figure (figure 16) indicates model –averaged tiger habitat for the Changbaishan and Russian far east study areas. Various models were averaged to represent the best estimate of predicted tiger habitat quality. Apparently within and in the vicity of the Jinlin-Hunchun transport corridor, the potential for tiger habitat is close to zero (*red area*)
- The bottom right figure (figure 21) indicates the four priority Tiger Conservation Priority Areas in the Changbaishan Landscape. Area 3 is the South Zhangguangcailing.

Figure 3. The Changbaishan landscape and the southern Sikhote-Alin Mountain ecosystem, with locations of tigers (red dots) derived from the 2005 Amur Tiger Survey in Russia, and surveys in China from the late 1990s.

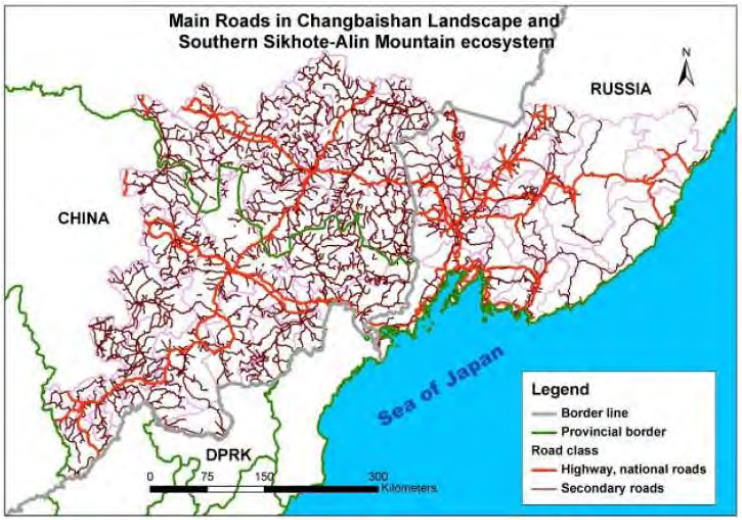


Figure 5. Primary (highways) and secondary roads in the Changbaishan Landscape and Southern Sikhote Alin Mountain Ecosystem (unpaved logging roads not shown).

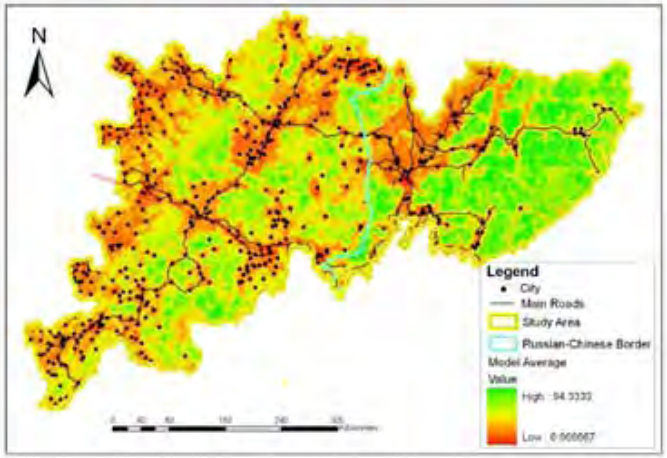


Figure 16. Model-averaged Amur tiger habitat for the Changbaishan-and Russian Far East study areas. Results of the RSF, ENFA and Expert Model were averaged to represent the best estimate of predicted tiger habitat quality.

Figure 21. The four priority Tiger Conservation Priority Areas in the Changbaishan Landscape.

Figure 5-2-4(b) WWF joint Study on Potential Tiger Habitat in Northeast China

2. The positional relation of the proposed railway with the location of the range of the Northeast China tiger's potential activity

The proposed railway is to run through southern border of the Zhang Guangcai mountain range, far away from the tigers' activity range in the Harba and Dalongling mountain areas, more than 30 km from the nearest edge of the Harba mountain range where the tigers move around and over 20 km from the closest border of the tigers' activity range of Mount. Dalongling. The proposed railway will run through the southern Zhang Guangcai mountain range of the tigers' activity as long as about 30 km from DK85 to DK115. There are tunnels such as Chaoyanggou, Houtaiping mountain range, Ailin, Shimen, Qianlishu No.1, Sandaokou and Weihu mountain range and main bridges such as Erdaogou extra-large bridge, Xiaoduozi No.1 bridge and Erdaokou extra-large bridge. The total length of the tunnels is about 13.4 km and their depths range from 45 to 200 m. The total length of bridges is about 5.4 km. The net height of the bridges is more than 8 m. 62.7% of the tunnels cross road sections. There is 11.2 km of subgrade, which is designed with a total of 57 culverts. The height of subgrade is generally 5m.

Figure 5-2-5 shows the location relationship between the proposed railway alignment and the Southern Zhangguangcai Mountain, as well as surrounding environmental settings and onsite photos.

Figure 5-2-5 Location Relationship between the Railway Alignment and Pontential Tiger Range in Southern Zhuangguangcai Mountain

According to the Figure 5-2-5, the proposed railway alignment section DK85-DK115 that will cross the potential Tiger Range in Southern Zhuangguangcai Mountain presents the following features.

- DK85-DK107 is located in the south of existing railway and highways, namely, this area has been fragmented by existing linear works and the proposed railway line will be at the very edge of and even farther from the potential tiger activity range.
- DK 107-DK122 is located in the north of existing railway and highways, making the railway line relatively closer to the potential tiger activity core area. Field survey, as shown in the photos in Figure 5-2-5, indicates that this area is relatively developed, with prevalent farmland, villages and dense rural raods.

The location of the bridges for the project in the Northeast China tigers' potential activity area in the southern Zhang Guangcai mountain range is indicated as follows:

No.	Description	Central Mileage	Total Length (m)	Structure Type of the Bridge
1	Erdaogou extra-large bridge	DK87+286.70	962.8	29-32 m simply-supported box girder
2	Laoyuegou bridge No.1	DK100+650.45	178	5-32 m simple-supported beam
3	Laoyuegou bridge No.2	DK101+149.30	308.8	9-32 m simple-supported beam
4	Xiaoduozi bridge No.1	DK101+934.76	587.1	1-24 m simple-supported beam+13-32 m simple-supported beam + 1-24 m simple-supported beam +3-32 m simple-supported beam
5	Xiaoduozi bridge No.2	DK102+666.15	472.3	14-32 m simple-supported beam
6	Xiatun bridge at Xiaomalugou	DK104+173.05	276.1	8-32 m simple-supported beam
7	Xiatun bridge at Damalugou	DK105+598.05	276.1	8-32 m simple-supported beam
8	Erdaokou extra-large bridge	DK106+980.00	2,140	10-32 m simple-supported beam-(40+72+40) continuous beam +1-32msimple-supported beam
9	Qianhe bridge	DK110+290.15	210.7	6-32msimple-supported beam
Total			5,411.9	

The location of the tunnels for the project in the Northeast China tigers' potential activity area in the southern Zhang Guangcai mountain range is shown as follows:

No.	Description	Entrance Mileage	Central Mileage	Exit Mileage	Total Length (m)	The Maximum Depth of the Tunnel(m)	Distribution of the Sensitive Points at the Top and Tunnel Portal
1	Ailin tunnel	DK91+308	DK91+984	DK92+660	1,352	More than 100	No sensitive point

2	Shimen tunnel	DK91+283	DK94+358	DK97+432	6,149	More than 170	There are sensitive points 178 m from the entrance
3	Qianlishu tunnel No.1	DK98+012	DK98+521	DK99+030	1,018	68	No sensitive point
4	Qianlishu tunnel No.2	DK99+597	DK99+764	DK99+931	334	55	No sensitive point
5	Qianlishu tunnel No.3	DK100+139	DK100+341	DK100+542	403	45	No sensitive point
6	Sandaokou tunnel	DK108+530	DK109+035	DK109+540	1,010	65	No sensitive point
7	Weihu mountain range tunnel	DK110+970	DK112+525	DK114+079	3,109	More than 100	There are sensitive points 270 m from the exit
Total					13,375		

3. Analysis of the impact of the project on the Northeast China tigers' activity

At present, the Northeast China tigers are mainly crossing over and migrating from the China-Russia border from Russia. It has been found that 4 Northeast China tiger habitats are located on the border of China and Russia. The 3 areas in Jilin province are only the Northeast China tigers' potential activity range. The Northeast China tigers are likely to pass by these areas in their migration. The Northeast China tigers' activity range is large, mainly living in the places where there is forest, scrubs and bushes, because the Northeast China tigers have to take the cover of bushes and shrubs to quietly close to the prey and get food, As a large amount of forests have been cut down and the living environment of wild animals has been destroyed. In the shallow mountain areas and those areas where there are frequent human activities, it is hard to find wild animals. Therefore, the possibility of Northeast China tiger moving about in these areas is small. According to wildlife experts, Northeast China tigers' habitats are mainly deep in forest.

Sections DK85-DK115 of this project is located in the Northeast China tigers' activity area in the Zhang Guangcai mountain range. On both sides of the railway largely are natural secondary forests. As there are the 302 national highway, the Changjitu expressway and Jituhun railway, human activities are frequent. This will narrow the Northeast China tigers' moving and foraging range. The possibility of the Northeast China tigers' passing through this area is small. The bridge to tunnel ratio for this project is up to 62.7%, which can basically satisfy Northeast China tigers' passage. Most of the bridges and tunnels can be used as Northeast China tigers' passage. This will largely reduce the impact of the railway construction on the Northeast China tigers' potential activity range.

① First of all, in the design of the project, the railway bridges in the Northeast China tigers' potential activity area can be used as Northeast China tigers and other animals' passage, such as the Erdaogou extra-large bridge, which is designed with 29 holes, each hole's span is 32 m. There are many tunnels in the area, which have a large depth. Therefore, on the top of the tunnels, there are bio-corridors to satisfy the tigers' passage needs.

② In the construction, the tunnel will be constructed from both ends. No inclined shafts and

temporary installations will be established in dense forest to reduce their impact to the Northeast China tigers' roaming and foraging. Secondly, avoid construction and operation at night to reduce the interference in the tigers' potential activities.

③ Strengthen the management of construction and operation

First of all, during the construction period, strengthen the education of the construction units and workers and raise their awareness of protecting the animals. Secondly, try to use the low-noise, low vibration construction equipment for construction. Do not construct and operate at night. Actively cooperate with the forestry departments to protect the animals. Once the tiger's footmark, droppings, hairs and other signs of activity are found on the construction site and adjacent areas, it should be reported to the wild animal protection department to take scientific measures for protection immediately. During the operation of the railway, the monitoring system is set up outside the fence of the key sections to monitor the possible activities of the tigers. Once a tiger is found, it must be reported to the authority to take measures immediately. Further more, try not to siren in the section where the tiger is likely to migrate and move about to reduce interference.

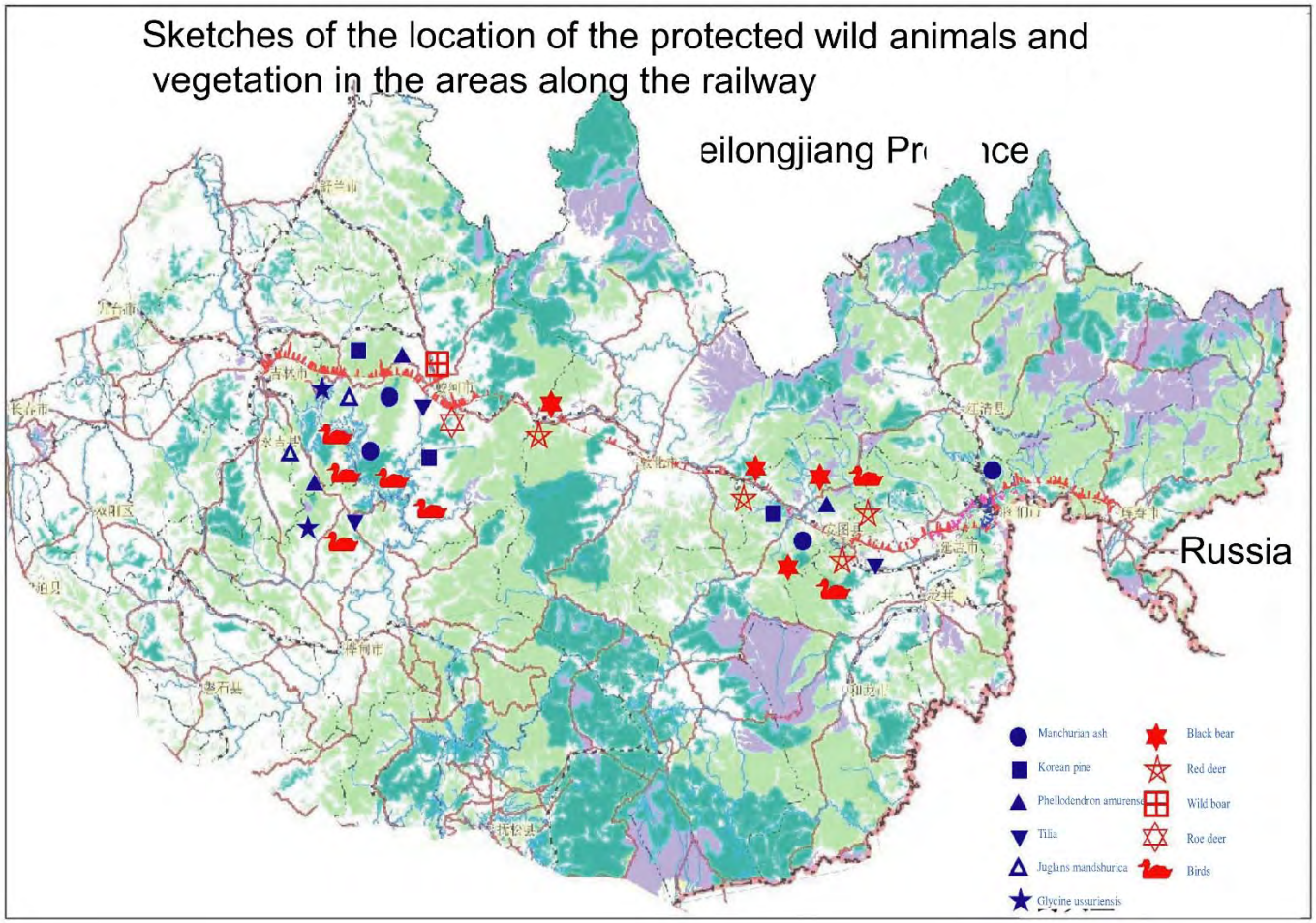


Figure 5-2-6 Location of Protected Wild Animals and Vegetation along the Proposed Railway Alignmetn

5.3 Assessment of the impact of the land resources along the line

5.3.1 Utilization of the land

Major land utilization types along the line include farmland, forest land, urban land, construction land, non-exploitated land (Figure 5-3-1), in which the forest land and farmland's area is big and grassland is small. The farmland is mainly dry land growing maize, potato, and soybean. The wild grassland takes a large proportion in the grassland, and more timber forest and less production forest on forest land.

See Table 5-3-1 for the present land use in the region along the line.

The forest lands along the line are mainly the secondary forest. Along the line a landscape is realized as the forest belts along the rivers, roads in shadow of trees, villages and towns in tree plantation and woods network on farmlands. But along the line there are more timber forests and less shelter forests and production forest, more pure forest, less mixed forest, more young-middle aged forest, less pre-mature forest, and heterogeneity inside forests not high.

Table 5-3-1 Status of land use in the region along the line Unit: hm^2

Unit		Table of present land use along the line （hm2）						Total
		Farmland	Forest land	Grassland	Building plot	Unused land	Water area	
Jilin Municipaltiy of Jilin Province	Chang Yi District	37.3	45.0	1.6	3.0	1.0	0.0	87.9
	Feng Man District	41.7	50.2	1.8	7.5	2.6	0.0	103.8
	Long Tan District	1814.7	2187.0	76.7	271.6	93.1	13.0	4456.1
	Jiao He City	6231.4	7509.6	263.3	73.3	25.1	33.9	14136.7
Tan Bian Prefecture of Jilin Province	Dun Hua City	10356.2	12480.6	437.6	1428.0	489.5	0.0	25191.8
	An Tu County	3073.7	3704.2	129.9	293.0	100.4	40.1	7341.3
	Long Jing City	825.8	995.2	34.9	17.1	5.9	11.2	1890.1
	Yan Ji City	4139.1	4988.2	174.9	821.5	281.6	84.8	10490.0

	Tu Men City	2683.5	3234.0	113.4	584.9	200.5	24.2	6840.4
	Hun Chun City	1012.5	1220.2	42.8	118.2	40.5	65.3	2499.6
Total		30216.6	36415.0	1276.7	3618.1	1240.1	272.9	73039.4

Land use characteristics along the line：more forest lands and farmlands and less grasslands and water bodies, continual optimizing of the agricultural land structure, high land utilization and reclamation.

Open issues in land use along the line: total farmland inventory insufficient, land shortage in terms of supply and demand, increasingly tense among competition between agricultural land use and non-agricultural construction land use, and generally low level of land utilization.

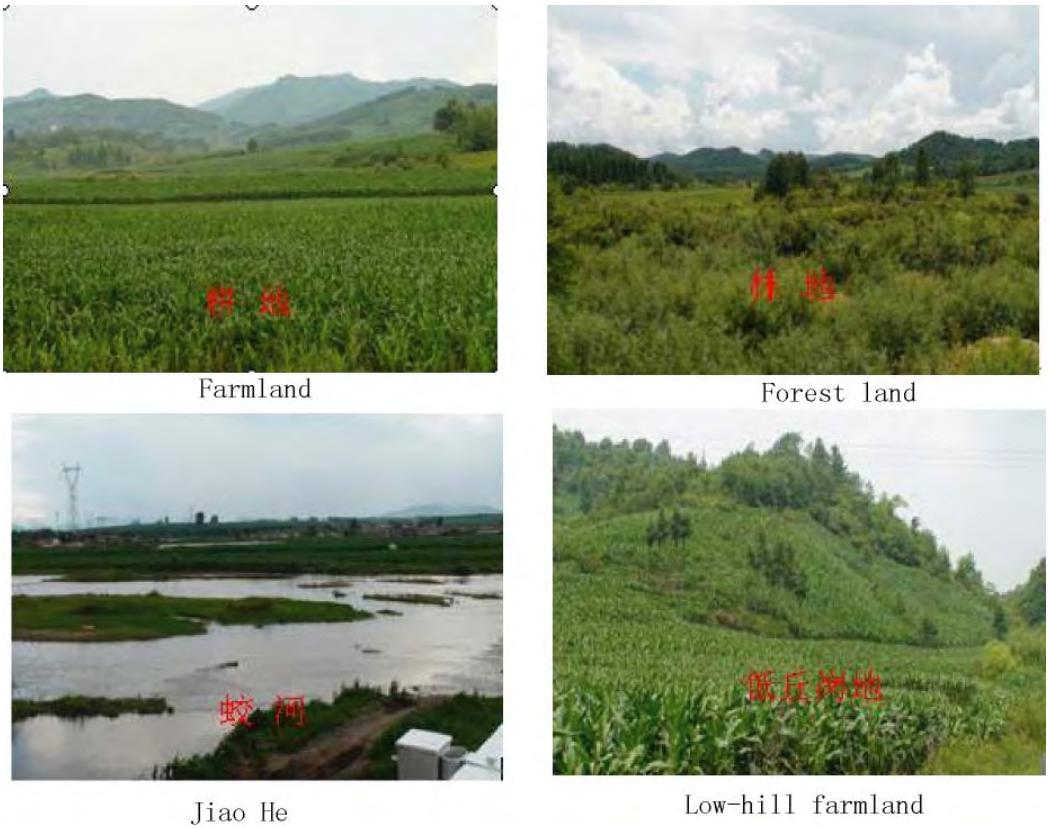


Figure 5-3-1 Pictures of the present land resources along the line

5.3.2 Impact on land utilization and measures

The land to be used for this project is classified into two kinds: permanent and temporary. The lands for temporary use include the lands for borrow pit and dump area, for the stacking of construction materials and for other uses. The lands for the permanent construction use are the lands occupied for the main work of the railway. Once the land is acquired, the change of the original land functions will almost remain throughout the construction period and operation period.

The land for temporary use, however, will be returned to the local after completion of the main construction work. The change of its function is mainly concentrated in the construction period. After the completion of the construction, most of the land can be gradually restored to its original function by taking appropriate measures.

The area of land for the permanent use for the whole line is 1,173.78 hm2 in total, of which 943.64 hm2 is paddy field, dry land, forest land and other land for agricultural use, which is made up for 42.6% of the total area of the acquired land, .190.12 hm2 is the land for construction such as for residence, accounting for 8.6% of the total area of the acquired land. After the implementation of the project, the original usage of the land will be partially or totally lost and the land's productivity will be destroyed, which will cause some affection on the local agricultural production. Besides, The land for the borrow pit, materials yard and other land for temporary use will occupy 1,043.1 hm2. The lands used are largely arable land, forest land and land for construction. This will also cause certain affection on the land resources along the line.

The project will use 485.54 hm2 of arable land, including 388.4 hm2 of the basic farmland. The use of the arable land for the construction will cause some reduction in the grain production in the areas along the line.

The use of land for the railway construction will inevitably cause some affection on the agricultural ecosystem along the line. However, as the land to be used for the project is evenly distributed in a narrow strip running through the areas along the line, which has a limited influence on the transverse of the line. The proportion of the amount of the land to be used for the project to the total amount of the land for agricultural use in the prefectures where the line runs through is very small. The agricultural production pattern in the whole area will not be substantially changed during the construction and after the completion of the railway.

5.3.3 Impact on the basic farmland and mitigation measures

(1) Summary

The basic farmlands in the areas where the line runs through are mainly distributed in Jiaohe, Dunhua, Yanji and Hunchun. There is a wide spread in Jiaohe and Dunhua. For details, see Table 5-3-2. The local governments have given the special protection for the basic farmland in the protective area marked in accordance with the regulations, continued to improve the infrastructure, and made great efforts to increase the productivity in the area, established relevant protective rules and strictly controlled the procedures for the transfer of the basic farmlands so that the basic farmlands in the protective area are effectively protected.

Table 5-3-2 Information about the basic farmlands along the line

Unit: hm^2

Prefectures		Information about the basic farmlands along the line (hm^2)	
		Basic farmland area	Percentage, %
Jilin city of Jilin province	Changyi district	33.0	0.12
	Fengman district	36.9	0.14
	Longtan district	1,623.8	6.08

	Jiaohe	5,499.2	20.59
Yanbian prefecture of Jilin province	Dunhua city	9,134.1	34.20
	Antu county	2,716.8	10.17
	Longjing city	729.9	2.73
	Yanji city	3,658.5	13.70
	Tumen city	2,379.7	8.91
	Hunchun city	897.4	3.36
Total		26,708.0	100

About 388.4 hm2 of the basic farmlands will be permanently used for the whole line, It is very small compared to the total area of the farmland in the protective areas in the prefectures along the line，and they are scattered along the railway.

(2) The protective plan for the basic farmlands

In the design, the use of a farmland by splitting it must be minimized when acquired for permanent use. The line is basically parallel to the existing line or the Changtuhun expressway. When a basic farmland cannot be bypassed and is required to be used, the appropriate protective measures will be taken to keep the amount of the basic farmlands along the line stable, specifically including:

① Apply for approval of and modify the relevant plans in accordance with the law: according Article 15 of the Regulation on Protection of Basic Farmlands, after a basic farmland protection area is defined by law, any organizations and individuals shall not change or occupy it. When the basic farmland can not be bypassed in the selection of the site for a national key construction project and its occupation is necessary, it must be approved by the State Council. The basic farmland can be only used for the project upon approval by the State Council in accordance with the law and the rules for the land license. The local government should modify the general plan for land use in accordance with such approval.

② Top soil protection: According to the provisions of Article 16 of the Regulation on Protection of Basic Farmlands, the organization that use the basic farmland should use the surface soils of the used basic farmland for the newly reclaimed land for cultivation or for the improvement of soils in the poor land or other arable land according the requirements of the local governments at the county or above levels. Therefore, it is required in this assessment that the construction unit must peel the surface soils off the used arable land before the excavation of earth and stone, and take measures for piling and stocking them in an area. The peeling thickness is 20-30 cm. The soils are kept in the designated place during the construction period. After the project is completed, they will be used for restoration of the land for cultivation or as covering soils for vegetation recovery. The temporarily discarded soils shall be piled under the bridge to the greatest extent as possible to prevent them from interfering construction.

③ Balance the use and compensation: The basic farmlands should be protected and

managed in accordance with the State Council's Regulation on Protection of Basic Farmlands and the Law of Land Administration of the People's Republic of China. The organization who acquires that land must pay compensations such as for the acquired land, its attachment, young crops and relocation. The occupied basic farmland shall be compensated according to the applicable national regulations and rules. The construction unit is responsible for reclaiming the land for farm use to make up for the used farmland. In principle, the area of the reclaimed land must be equal to the area of the arable land used for construction purposes. If the construction unit cannot make the reclamation, it should pay the basic farmland reclamation fee based on the used land area, which shall be used specially for the reclamation for new arable land. According to the real situation of the utilization of land along the line in this project, it is recommended that the construction unit pay the basic farmland reclamation fee as compensation. The budgetary estimate for this project has includes the compensation of about RMB 160,000,000.

④ Restoration of the arable land: The arable land temporarily used for this project totals 478.2 hm2. Most of them are dry land and paddy field. After completion of the project, the best efforts shall be made to the turn the temporarily used land that meet the conditions for the restoration into the farmland with the surface soils peeled previously to make up the arable land resources.

⑤ Make full use of the reserved resources and keep the total amount in balance: 83％-88％ of the total area of arable lands along the line in this project is under the basic farmland protection. However, there are 12-16％ of the total have not been included in the basic farmland protection plan. After the implementation of the project, those arable lands that have not been designated as the basic farmland shall be included in the basic farmland category based on their merits on the case by case basis. Besides, there are a certain amount of unused land spread over the areas where the line passes through, which make up 5.6％ of the total land area. There is also some amount of waste grassland with a thick layer of soils. The possibility of developing and utilizing them is great and there is potential for land reclamation, which provides a strong support to the protection of the basic farmland.

⑥ Allocate land resources in the province to keep the total amount in balance: According to the adjustment between the use and makeup of the arable lands along the line over the past years, if it is difficult to achieve a balance in the use and makeup of the arable land in the four cities, three districts and one county in Jilin and Yanbian along the line, it is recommended that the allocation of land resources in other areas in Jilin province shall be made to keep the total amount of the arable land in balance and ensure the amount of the basic farmland is stable. The specific adjustment plan shall be made in accordance with the requirements in the pre-examination report on the land for this project as approved by the Ministry of Land and Resources. After these protective measures are taken, the impact of the project construction on the basic farmlands along the line can be controlled to a limited range.

5.4 Bridge and Tunnel Works Environment Influence

5.4.1 Bridge Work Environmental Influence

（1）General

The project has a total number of 104 super large, large, medium and small bridges of 88611.11m, 24.25％of the project length; there are small bridges and culverts of 560, 2.47/km, excluding the length of the bridges and tunnels. The distribution of the super large and large bridges of the project are shown as in the table 5-4-1.

（2）Influence on the Watercourse Erosion

The bridge project impact on the watercourse hydrology were shown in two aspects: one was that the bridge pier and abutment construction would take the watercourse, reduce the flowing section to some extent and increase the velocity of flow at the bridge position; the other was that the reduced flowing section and increased velocity of flow reinforced the partial erosion on the riverbed and bank at the lower reaches and raised erosion degree and the content of the suspending substance in the water.

The area along the project bridges were flat with the rivers and channels crossed with each other, and lower river bedding, but the rivers and channels were narrower in width and gentle in water flow. In accordance with the similar project anti-flood assessment results, the flood frequency of once every hundred year was used to calculate the influence of the pier and abutment on the riverway flowing section and water blocking in front of the bridges at the upper reaches, the partial erosion at the beddingof the lower reaches. The water blockage was mostly below 1m, having little influence and could be neglected. But during the cofferdam building, the disturbance of the foundation works on the riverbed would increase the content of suspending matter in nearby water at the working areas. Based on the actual construction conditions of railway bridge piers in water, the affected areas were generally within the 50~100m around the bridge piers in water, the affected areas were generally within the 50~100m around the bridge pier working places, the background value and the suspension content in water were basically the same beyond 50~100m, not affected by the construction.

（3）Analysis of the Influence on the Road Traffic and Flood Moving

The project adopted the complete interchange design. The interchanges were designed for both old and planned roads crossed with the project, the water flowing passages were arranged for crossing the natural rivers, ditches and irrigation channels under the principle of a culvert for a ditch and a bridge for a river. The bridges worked for both road interchanges and animal movement.

The drainage ditches were placed parallel to the slope foot of the embankment on both sides, leading to the railway bridges and culverts in connection with the natural ditches to form the slow flowing passages on both sides and to ensure the communication of the ground surface runoff on the both sides of the railway. The ground surface flow was sufficiently considered for the arrangement of the drainage ditches, bridges and culverts. The bridges and culverts were both designed at flood frequency of once every hundred year and the drainage ditches had the suffcient water passing capacity at the time of construction.

The drainage system of the bridges, culverts and subgrades eliminated the blockage to the ground surface runoff, reduced the influence of the project on the ecological water to the maxium degree; in the mean time, met the needs of the agricultural manufacture, transportation and life of the residents along the project and movement and traffic requirment of the fowl and livestock.

（4）Influence on the Farmland Drainage and Irrigation System along the Project

The Songhuajiang River alluvion plain area, valley and basin areas along the project were the farming land concentrated area. The mode of the irrigation was: the waterland at the river valley plain along the trunk stream were irrigated naturally with the compensation from the medium and small reservoirs along the trunk and branch stream. The waterland at the plain along the branch rivervalley plain got water from the small reservoirs and ponds. The irrigation channels were densely distributed, mostly in company with the field working paths, needing the construction of irrigation culverts.

In order to reduce the railway contruction influence on the agriculture and irrigation works and on the basis of the the sufficient investigation, the bridges were rationally arranged, bridges and culverts were placed for the old ditches, taking less farmland and building more bridges and culverts. The project was designed with the principles of a bridge for a river, a culvert for a ditch and a culvert for a water meeting area; some cutting sections unable for the culvert used the backward siphon or aqueduct bridge to ensure no damage on the old ditches and reservoirs; the old farmland irrigation facilities or flood drainage ditches damaged or occupied by the subgrade were recovered by the original standards, reconstruction was made for the project occupied irrigation works with the criterial no lower than the original standards. By means of the above measures, the original irrigation system was functionally maintained and the sustainable agricultural development along the project was ensured.

It was proposed that, in the following working stage, the design units and the people in the know of the villages along the project should make a careful investigation and get to know the local agricultural irrigation system requirement and optimize the design to guarantee the number and location of the railway bridges and culverts meeting the agricultural requirement along the alignment. In the process of the following construction, especially the construction of the culverts or subgrade over the irrigation ditches, the temporary and transitional measures should be considered, the construction should not be scheduled in the irrigation seasons to guarantee the normal agriculture production along the project.

By means of the above measures, the impact of the project on the local agricultural system was minor.

(5)Influence on the Marine Organisms

In the construction period, the suspending substance in water might increase the pier foundation work, working camp production and life sewage discharge; the petroleum content in the river might raise due to the oil leakage from the underwater works. The above factors should lead to the reduce in the algae, floating creatures, and underwater animals and affect the marine organism bait material source amount. Besides, the noise and vibration of the construction machinery might place an impact on the fish living environment and lead to the reducing of its movement area or group migration. However, the affect of this kind was confined to the working period, especially the pier and abutment construction phase. The cofferdam was adopt by the design for the pier

works, so the construction of it had only local and temporary disturbance to the riverbed. Because the other works as pier and foundation construction would all be done within the cofferdam, the little impact would be placed on the water quality, and accordingly on the creatures in water so long as the construction could be under strict management, works could be done by the proper procedures and no dumping of the soil and slag in the river, the project should not have much sand and cement loss in view of the large bridge construction experience home and abroad. The construction on the bridge was away from the water, there might be the leakage of some material in the river during the transportation, but in comparison with the underwater construction, the affect on the hydrolife could be less.

This assessment focused on the analysis of construction influence on the fish resources in the Songhua River, Jiao River, Peony/Mudan River and Gaya River.

① **Fish Distribution in the above-mentioned Rivers**

On the basis of the relative data provided by the Jilin Aquatic Science and Research Institute and Yanbian Korean Minority Autonomous Prefecture Fishery Supervision and Management Station, the fish resources in Songhua River, Jiao River, Peony/Mudan River and Gaya River along the project were basically the economic fish like crucian, carp, catfish. The reproduction period of carp and crucian are in May and June mainly, catfish in June and July; other protective fish was found fine scale fish only, appeared at the mouth of Gaya River and Tumen River in 1990's, its distribution was as in the table 5-1-1(1):

Table 5-1-1（1） Fish Resource Distribution Summary in Relative Rivers

No	River Name	General	Major Common Fish	Note
1	Songh-hua River	66 sorts of fish resource in Songhua River, belonging to 8 items and 15 families, mainly economic fish; of which,mostly carp fish of 43 kinds by 43%; then loach of 5 kinds by 8%; predominant kinds are chub, catfish and crucian	Crucian, carp, catfish, yellow head fish, ear-like fish, grass fish and club fish, etc.	
2	Jiao River	27 kinds, 4 items and 9 families, mainly economic fish; mostly carp of 9 kinds by 33.3%; then loach family of 4 kinds by 14.8%; predominant kinds: carp, catfish and crucian	Common perch, crucian, carp, catfish, yellow head fish, earlike fish, grass fish, club fish, etc	
3	Peony River	37 sorts, 6 items and 13 families, mainly economic fish; mostly carp; predominant	River codfigh, elegant fish, dog fish, crucian, carp, catfish, chub, silver fish,Mongolia red fish;	90km of Jingbo River-Heishi Power Station of Peony River has fish

		kinds: carp, crucian and elegant fish	crucian, carp and catfish in the river-crossing cities	moving passage and prawn, over 40km of the project line away from the above area
4	Gaya River	39 kinds, 6 items and 12 families, mainly economic fish; mostly carp family of 13 kinds by 33.3%; then loach family of 4 kinds by 10.3%; trout family of 6 kinds by 15.4%; a little smelt and throrn back family; predominant kinds: carp and crucian	Crucian, carp, catfish, Yaluo fish, yellow head fish, earlike fish, grass fish, club fish, etc.	fine scale fish found at the mouth of Gaya Riverto Tumen River in 1990's

The major features of the relative fish:

Crucian: the important economic fish with the normal weight of 200-300g, swimming against the river, high time of spawn in the mid-May of about half a month, mostly in the floating grass of the shollow area close to the bank, laying adhesive egg to the floating grass.

Carp: dwelling most at the lower reaches of the river, high adaptability, omnivorous, eating mainly underwater insects, with the spawning section similar to the carp for about 20 days.

Catfish: meat eating kind, swimming mostly at night and finding food in the shollow water, staying in the floating grass, eating majorly small fish and underwater insects, egg laying location and period similar to the crucian in June and July;

Fine scale fine: inhabiting in the cold valley stream. In the early spring, moving to the upper reaches of Tumen River and mountain stream, when the river melt, it returned to the bottom of the river for winter. The mid and last 10 days of every April and May, swarming to the egg laying place, spawning lasting to the first 10 days of June under the lower water temperature. Eating mainly the meat, such as underwater insects and larva of mayfly, flicking mosquito and hairy wing larva, eating small fish and testa. It distributes at the upper reaches of Tumen River and its branches and spawns at the upper reaches of Mijiang River.

② **Project Situation over Songhua River, Jiao River, Peony River and Gaya River**

The specific conditions of Jilin-Huichun Express Railway over Songhua River, Jiao River, Peony River and Gaya River are as follow in the table: 5-1-1(2):

Table 5-1-1(2）Distribution Summary of Projects over Relative Rivers

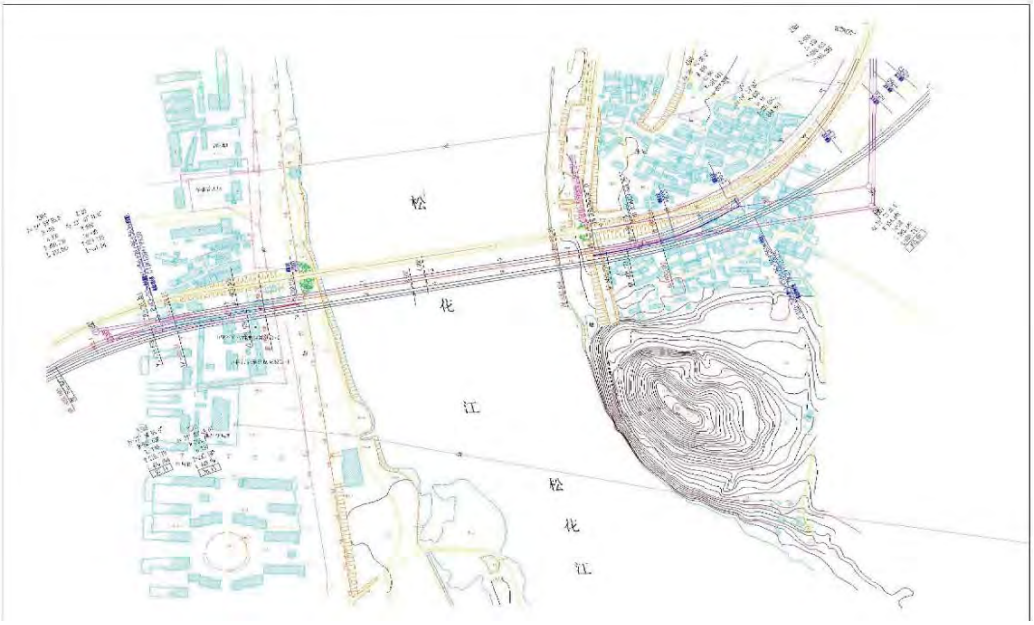
No	Name	Chainage	Length	Bridge Structure Type	Water Name	Underwater Pier Number	Note
1	Songh-ua River Super	DK03+360 ~DK3+680	220	18-32m simple supported box girder+1-(56+96+96+56) m continous	Peony River	underwater pier 335m，6 piers；width	Basically crossed to river, no

	Large Bridge			beam+15-32m simple supported box girder +1-24m simple supported box girder +9-32m simple supported box girder +1-(32+48+32)m continous beam+32-32m simple supported box girder		in dry period 160m，（56+96+96+56）continous beam, 1 underwater pier	floating grass applicable for spawning on both banks
2	Jial River Super Large Bridge	DK68+980~DK69+080	100	29-32m simple supported box girder+1-(32+48+32)m continous beam+39-32m simple supported box girder+2-24m simple supported box girder+10-32m simple supported box girder+1-(32+48+32)m continous beam+5-24m simple supported box girder	Jiao River	underwater pier 140m，5 piers；width in dry period 80m，（32+48+32）continous beam 1 underwater pier	Basically crossed to river, floating grass scattered on both sides
3	Peony River Super Large Bridge	DK156+580~DK157+760	180	4-32m simple supported girder+1-24m simple supported girder+5-32m simple supported girder+1-(32+48+32)continous beam+6-32m simple supported girder+1-24m simple supported girder+14-32m simple supported girder+1-(40+56+40)m continous beam+34-32m simple supported girder+1-(32+48+32)m continous beam+8-32m simple supported girder	Peony River	underwater pier 180m，6 piers；width in dry period 100m，（40+56+40）continous beam，2 underwater pier	Basically crossed to river, located at the suburban area of Dunhua City, no floating grass applicable for spawning on the both banks
4	Gaya River Super Large Bridge	DK308+190~DK308+440	250	15-32m simple supported girder+2-24m simple supported girder+19-32m simple supported girder	Gaya River	underwater pier 260m，10 piers；width in dry period150m，5 underwater pier	650 degree to the Tumen County, no floating grass applicable for spawning on the

							both banks

The trends of the project over the above rivers are shown in sequence of Songhua River, Jiao River, Peony River, Gaya River as follows:

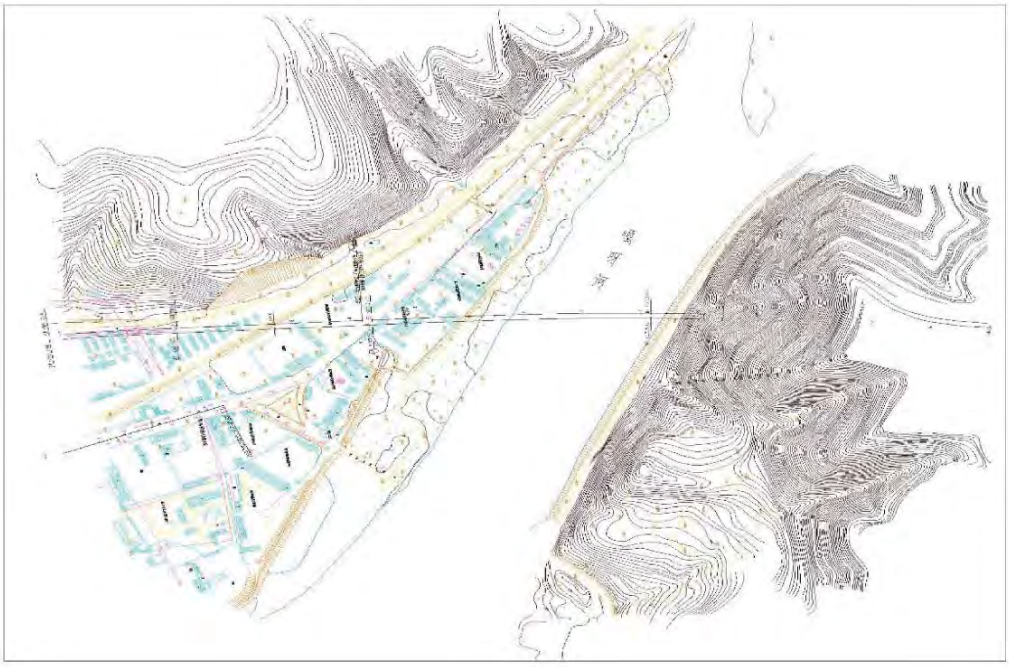
Project Alignment over Songhuajiang River



Project Alignment over Jiao River

Figure of Railway Line Running Above Mudan River

Figure of Railway Line Running Above Gaya River



③ **Major Influence Analysis**

The economic fish distributed in Songhua River, Jiao River, Peony River and Gaya River is mostly natural. No concentrated and protective spawning plant, baiting plant under the responsibility of the the divisions in charge at the project locations over the above rivers. The floating grass suitable for the egg laying is only scattered beside the Jiao River super large bridge. The certain impact could be placed on the its natural movement and

inhabitancy. The major impacts were illustrated as follows:

First, the underwater pier foundation excavation affecting the partial riverbed

Based on the parameter from the design unit, the earth and rock works of 1 pier foundation was up to 3146m3, foundation pit refilling was about 2300 m3, waste earth of about 846m3.The excavation of earthrock and rockwork would certainly cause some damage to the original riverbed and surrounding environment, cause the soil erosion and affect fish egg laying, moving and living environment.

Second, impact from the working garbage

Second, bridge pier concrete casting(land bridge pier concrete casting could flow in the river due to the runoff effect) could leak in the river through sullage, dust and water solution to cause the increase of suspending matter in water and petroleum increase owe to the construction machinery oil; working staff life sewage led to the partial river water quality change. All those factors could lead to the water pollution originally sufficient for the fish protection and reproduction.

Third, the underwater pier would take the river course permanently, causing certain impact on the fish migration. The project bridges were mostly perpendicular to the rivers, 1 underwater pier foundation diameter could be limited within 4m, its area was 140m2, taking less percentage of rivercourse. The impact should basically recovered in 2 years.

Fourth, construction Noise

The construcion noise could bring fish of reproduction and migration the evasion reponse.

Fifth, the above 4 aspects were mainly happened during construction period. The train noise would be the main factor affecting the fish migration during the operation period, but the influence degree was still not quantified so far.

Major Ecological Resuming Measures and Investment

In view of the analysis above, the impacts of the project over Songhua River, Jiao River, Peony River and Gaya River were mainly: underwater pier occupation of the rivercourse, underwater pier construction influence on the water quality and riverbed, the noise impact on the fish migration during construction and operation period, working rubbish discharge impact on the river. The according protective and compensation methods should be taken as follows:

One, reinforcing the construction progress and procedures, the underwater construction should be arranged in dry season in principle and avoid the fish migration period.

Second,strengthening the construction period management and supervision, no sewage and rubbish discharge at random, put them at appointed location and in line with the discharge standard; requiring the waste water discharge when being up to the criteria after settlement and other necessary measures, the garbage collected and treated at fixed places, no discharge to the river.

Third, dredging, recovering the fish migration passage

By the end of the construction, arranging a timely dredging and resuming of the river course within the construction affected area, clearing up the construction garbage, slug and placing

river cobble to resume the riverbed appearance and clearing the riverbed whin in need to ensure the smooth migration of migratory fish.

Fourth, the loss estimation of the fish resources affected by the contruction

The loss amount included the underwater pier construction caused fish resource loss and upper parts of bridges construction incurred loss. The influence was majorly from the migratory fish evasion to the working noise and underwater pier permanent occupation of the rivercourse. Based on the data from the relative units, evasion ration was estimated by 20% and fish egg by the 0.1-0.15/each; permanent rivercourse occupation loss by the actual area taken plus the compensation cost;

Loss calculation formula: F（10k YMB）=∑ni=1(resource amount×reproductivity×mature percentage×evasion ratio×fish spawn price)

Table 5-1-1（3）Pier Building Induced Fish Loss Estimation in Relative Rivers

No.	Species	Resource Amount（t）	reproductivity（10k piece/kg）	Mature Individual Ratio（%）	Evasion Ratio（%）	Fish Egg Loss（10k pieces）	Economic Loss（10k RMB）
1	Crucian	3	9	80	20	4320	25.9
2	Carp	1.1	7	80	20	1232	7.4
3	Catfish	1.4	6	80	20	1344	13.4
4	Grass fish	7	9	50	20	6300	37.8
5	Chub	1.2	9	50	20	1080	6.5
6	Club fish	0.55	3	10	20	33	0.7
total							91.7

The resource amount listed in the table was for female and calculated by half the total resource amount.

By calculation, the direct loss of the river fish resource during the underwater (pier) construction was 1.131 million, according to this result, the bridge upper part building caused fish loss was 325,000 RMB Yuan.

Bridges placement took the rivercourse area, according to the fish noise evasion nature and loss amount by 10m near the bridge, the loss amount was 15,000 RMB Yuan.

The total loss of the above was about（91.7+32.5+1.5）=125.7.

In accordance with the relative state stipulation, the construction party should pay the compensation cost for the fish resource restorage by quantity refering to the checked and ratified loss and normally using the equivalent amount. The loss compensation amount was 1.257 million RMB Yuan.The provincial Fishery Bureau should use the compensation cost to restore the fish resource to maintain the original ecological status, organizing the fish multipilication release amount within the above rivers and make up the natural loss by manual work to make sure no construction influence on the relative fish group number. The

multipilication release should be done according to the stipultion of the Agricultural Ministry and implemented under the supervision of the provincial environment protection department.

1. Important Bridge Influence Analysis

1) Songhua River Super Large Bridge General

The Songhua River super large bridges passed downtown of Jilin City, mainly: SongJiang Eastern Road, No.2 Songhua River, Bingjiang Eastern Road and newly built Changtu, Longshu Liaison Line. The bridge span placement was all under control at the above controlled points with the consideration of the city road delimitation and No.2 Songhua River Voyage requirement, the level of which was IV sea-route of Helong River water system, the net navigation height was required to be 8m, the net single width of single-way navigation to be 50m and 100m for the bi-way navigation and maxium navigation water level of 188.5m.

Newly built railway bridge was located at about 30m of the upper reaches of the old railway bridge, considering the navigation need and less deep water foundation and the span requirement of the old bridges, the prestressed concrete continous girder of (56+96+96+56)m was used to go over the main navigation route and others adopting the prestressed concrete simple supported box girder of 31.5m. Songjiang Eastern road and Bingjiang Eastern road are located along the both side of No.2 Songhua River, proposed to adopt the simple supported box girder of 31.5m and the prestressed concrete continuous beam of (32+48+32)m. The newly built Changtu and Longshu Liaison line went under the bridge and filled at the crossing section, proposed the prestressed concrete continuous beam of (40+64+40)m.

The entire bridge adopted the bi-line round end solid piers, bi-line hollow abutment and pile foundation. The pile foundation used the bored and casted piles; the concrete pier and abutment employed the site concrete casting method, the large span continuous beam used cantilever casting method, the small span and equal height continuous girders casted with bracket at site, the normal span simple supported box girder were precasted and installed at the same period.

The underwater piers and foundation going over the No.2 Songhua River used bi-wall steel cofferdam and sealed with concrete and set underwater construction platform, pier foundation by the bank was constructed with the artificial island cofferdam. The negotiation with the municipal administrative departments should be made for the construction, adopting the reliable measures to ensure the sea-route and construction safety. For the road going through cities, the proper communication would be needed with the city planning departments to adopt the reliable and to ensure the operation and construction safety, pier foundation construction and pit excavation should be supported. In order to reduce the construction influence on the road traffic, the regular span prestressed concrete simple supported box girders of this bridge were placed with the bridge erection machine, prestressed concrete continuous box girder used cantilever casting construction.

2) Influence Analysis and Protection Proposal

① Influence Analysis

The underwater foundation of this project was constructed with boring pile foundation and steel cofferdam. The underwater foundation jobs include the procedures such as steel protective barrel positioning, settlement, hole boring, lower steel bar cage and concrete casting.

The soil inside the barrel should be cleared for the steel protective barrel sinking; during the hole boring process, the slurry was needed to protect the wall and to maintain the stability of the hole wall. Those works were done within the cofferdam, which seperated the water inside and outside the cofferdam, the waste would not discharge, having less impact on the river. The slurry induced in the pier building should be treated in the recycling sinking pond on the platform and the settlement boats in river, the settled slurry should not be discharged in the river, but placed at the stipulated location after dehydrating on the bank, the settled sewage should be used for the road sprinkling, not to drain in the river. Due to the high content of the sand, it was proposed to reuse the gravel and rock washing water after the sinking treatment in the settlement tank. Thus, pier foundation construction should have no obvious bad affect on the water quality.

There might be small amount of slurry leakage during the loading and transportation process, which could increase the suspending matter content. Based on the anologue data analysis, adopting the cofferdam construction technique, the increased SS amount was no more than 50mg/L at 100m of the lower reaches of the working site, so the working slurry had not much impact on Songhua River.

② **Protection Suggestion**

The major protential pollutive substance of the bridge foundation affecting the water was the project slag like slurry. the relative stipulation should be strictly followed to carry it out of the river area and adopt certain protective measures. The storage location should be chosen following the discussion with local government, environment bureau and water bureau. The transportation process should be supervised by the supervisor, no random littering to minimize the slag impact on the water quality and avoid the adverse impact of the slag heap on the flood control.

The major cofferdam should adopt the struction with smaller section to minimize the occupation of rivercourse and its disturbance to flood discharge. The cofferdam island building for the underwater pier construction reduced the water flowing section, it was proposed to make a rational working schedule and work in the dry seasons and build steel cofferdam for the piers to reduce to the slurry pollution to the waters. By the end of the work, demolishing the temporary works to give way to the smooth water flowing, and keeping the working machinery clean to avoid water pollution.

No beam-precasting base and camp should be set within the watercourse range, no working and life sewage discharging in the river. The working waste should be piled away from the water, all kinds of materials should be kept under the rain shelter. The open channel, sand sinking well and protective wall should be available to avoid the material to be washed into the river. The life garbage during the construction should be cleaned everyday and collected together. Food rubbish should be piled for the natural fertilizer, other garbage be carried to the waste yard.

No direct drainage of working and life sewage to the river. Discharging the working sewage with suspending matters should be drained after the treatment. The simple sewage disposal facilities should be built for the waste water and life sewage.

By the end of the construction, a timely cleaning of working site should be followed, making sure of no project waste or facilities left within the river course to minimize the project affect on the river. A timely ecological environment restorage should be given, avoid the soil loss impact on the water environment.

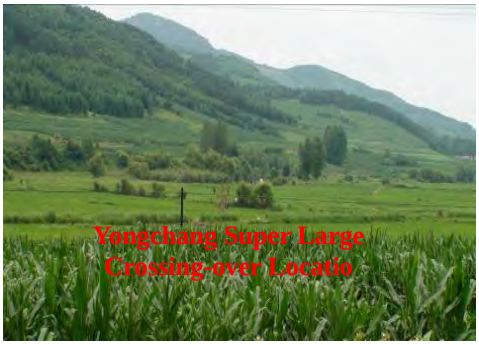


Figure 5-4-1 Some Bridge Location Photos

Table 5-4-1（4） Project Super Large and Large Bridge Distribution Summary

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
1	Large Bridge Crossing North Jiefang Road	DK01+487.75	442.30	5-32m simple supported box girder+2-24m simple supported box girder+1-(60+100+60)m continous beam		
2	Songhua River Super Large Bridge	DK03+220.92	2887.67	18-32m simple supported box girder+1-(56+96+96+56)m continous beam+15-32m simple supported box girder+1-24m simple supported box girder+9-32m simple supported box girder+1-(32+48+32)m continous beam+32-32m simple supported box girder	Songhua River	River width 335m，6 piers
3	Tiantai Super Large Bridge	DK06+411.98	1034.60	13-32m simple supported box girder+3-24m simple supported box girder+16-32m simple supported box girder		
4	Easten Huang Mt. Juzhi No. 1 Super Large Bridge	DK09+227.90	669.73	20-32m simple supported box girder		
5	Easten Huang Mt. Juzhi No. 2 Super Large Bridge	DK10+244.18	505.93	15-32m simple supported box girder		
6	Gaojiawazhi Large Bridge	DK11+751.72	407.54	12-32m simple supported box girder		
7	Xiaochuan Super Large	DK13+023.80	1206.60	19-32m simple supported box girder+1-(40+64+40)m continous beam+15-32m simple supported box girder		
8	Niangniang Temple Ridge Super Large Bridge	DK15+077.45	1224.40	37-32m simple supported box girder		
9	South Sand River Ridge	DK16+951.37	1094.90	33-32m simple supported box girder	Stream	Width 7m，no pier
10	Middle Sand River Team 3 Ridge	DK18+796.15	864.70	26-32m simple supported box girder	Stream	widt10m，no pier

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
11	Grass and Wood Valley No.1 Large Bridge	DK21+588.90	374.20	11-32m simple supported box girder	Resevoir	160m，5 piers
12	Grass and Wood Valley No.2 Large Bridge	DK21+971.80	178.00	5-32m simple supported box girder		
13	Sand River South Valley Large Bridge	DK22+538.16	210.71	6-32m simple supported box girder		
14	Gourd Valley Large Bridge	DK27+007.93	374.45	11-32m simple supported box girder		
15	4 People Class Super Large Bridge	DK27+634.40	570.40	17-32m simple supported box girder		
16	Small Huopeng Valley Large Bridge	DK31+111.35	406.90	12-32m simple supported box girder	Stream	
17	Large Huopeng Valley Super Large Bridge	DK32+677.25	1060.90	32-32m simple supported box girder	Stream	Width of 9m，no pier
18	Large Bridge	DK35+263.96	1028.20	31-32m simple supported box girder	Stream	Width of 21m，no pier
19	Bi-temple Super Large Bridge	DK49+949.75	816.22	2-32m simple supported box girder+1-(32+48+32)m continous beam+19-32m simple supported box girder		
20	Southeast Fork Large Bridge	DK52+936.64	276.43	8-32m simple supported box girder		
21	Taiping Super Large Bridge	DK59+743.90	635.80	19-32m simple supported box girder		
22	West De River Valley Super Large Bridge	DK61+948.95	702.45	21-32m simple supported box girder		
23	East De River Valley Super Large Bridge	DK63+954.41	963.41	29-32m simple supported box girder		
24	Jiao River Super Large Bridge	DK68+764.33	3006.05	29-32m simple supported box girder+1-(32+48+32)m continous beam+39-32m simple supported box	Jiao River	River width of

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
				girder+2-24m simple supported box girder+10-32m simple supported box girder+1-(32+48+32)m continous beam+5-24m simple supported box girder		140m，5 no pier
25	North Valley No.1 Large Bridge	DK73+637.40	178.00	5-32m simple supported box girder		
26	North Valley Super Large Bridge	DK74+827.17	812.00	25-32m simple supported box girder	Stream	8m，no pier
27	Fa River Valley Medium Bridge	DK77+119.10	112.60	3-32m simple supported box girder		
28	South Goutun Super Large Bridge	DK79+183.47	963.41	29-32m simple supported box girder		
29	Small Jiao River (former name: Chaoyang Valley) Super Large Bridge	DK83+326.27	782.54	4-32m simple supported box girder+1-(32+48+32)m continous beam+18-32m simple supported box girder		
30	Erdao Valley Super Large Bridge	DK87+286.70	962.80	29-32m simple supported box girder		
31	Laoyue Valley No.1 Large Bridge	DK100+650.45	178.00	5-32m simple supported girder		
32	Laoyue Valley No.2 Large Bridge	DK101+149.30	308.80	9-32m simple supported girder		
33	Xiaoduozi No.1 Large Bridge	DK101+934.76	587.10	1-24m simple supported girder+13-32m simple supported girder+1-24m simple supported girder+3-32m simple supported girder		
34	Xiaoduozi No. 2 Large Bridge	DK102+666.15	472.30	14-32m simple supported girder		
35	Small Malugouxiatun Large Bridge	DK104+173.05	276.10	8-32m simple supported girder		
36	Large Malugouxiatun Large Bridge	DK105+598.05	276.10	8-32m simple supported girder		
37	Erdaokou Super Large Bridge	DK106+980.00	2140.00	10-32m simple supported girder-（40+72+40）continous beam+1-32m simple supported girder		

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
38	Qianhe Large Bridge	DK110+290.15	210.70	6-32m simple supported girder	Stream	7m，no pier
39	Large Bridge Village Large Bridge	DK119+543.55	341.50	10-32m simple supported girder		
40	Dachuantun No.1 Super Large Bridge	DK120+791.79	1159.00	35-32m simple supported girder	Stream	13m，no pier
41	Dachuantun Large Bridge	DK122+213.50	243.40	7-32m simple supported girder		
42	Dachuantun No.2 Super Large Bridge	DK123+310.65	701.20	21-32m simple supported girder		
43	Dachuantun No. 3 Super Large Bridge	DK124+837.50	765.00	11-32m simple supported girder+(48+80+48)continous beam+2-32m simple supported girder+2-24m simple supported girder+3-32m simple supported girder		
44	West Valley Large Bridge	DK127+233.75	341.50	10-32m simple supported girder		
45	5 People Class Large Bridge	DK130+328.75	341.50	10-32m simple supported girder	Stream	River width of 5.5m，no pier
46	Shuangquanshang Large Bridge	DK131+722.10	374.20	11-32m simple supported girder		
47	Yongqiang Super Large Bridge	DK135+626.40	962.80	29-32m simple supported girder	Stream	river width of 4m，no pier
48	High Pine Tree Super Large Bridge	DK142+135.20	570.40	17-32m simple supported girder		
49	Ping'an Castle Super Large Bridge	DK148+081.75	3593.50	64-32m simple supported girder+（40+64+40）m continous beam+41-32m simple supported girder	Stream	river width of 3.5m，no pier
50	North Railway Super	DK150+953.08	570.56	20-32m simple supported girder		

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
	Large Bridge					
51	Small Stone River Super Large Bridge	DK152+959.16	2550.31	9-32m simple supported girder+1-24m simple supported girder+22-32m simple supported girder+（32+48+32）m continous beam+3-32m simple supported girder+3-24m simple supported girder+7-32m simple supported girder+2-24m simple supported girder+18-32m simple supported girder+（32+48+32）m continous beam+7-32m simple supported girder		
52	Peony Super Large Bridge	DK157+935.00	3170.00	4-32m simple supported girder+1-24m simple supported girder+5-32m simple supported girder+1-(32+48+32)continous beam+6-32m simple supported girder+1-24m simple supported girder+14-32m simple supported girder+1-(40+56+40)m continous beam+34-32m simple supported girder+1-(32+48+32)m continous beam+8-32m simple supported girder	Peony River	180m，6 piers
53	Large Bridge Village Super Large Bridge	DK167+682.82	505.32	15-32m simple supported girder	Stream	13m，no pier
54	Large Stone Super Large Bridge	DK179+651.10	5606.20	22-32m simple supported girder		
55	Qinggouzi Super Large Bridge	DK183+732.60	701.20	21-32m simple supported girder		
56	East Qinggou Super Large Bridge	DK187+308.85	276.10	8-32m simple supported girder		
57	Ha’erba RidgeSuper Large Bridge	DK190+463.35	864.70	26-32m simple supported girder	Stream	19m，no pier
58	Wanwan Valley Super Large Bridge	DK194+104.55	733.90	22-32m simple supported girder		
59	Erdaohezi Large Bridge	DK195+615.52	308.97	9-32m simple supported girder		
60	East Ming Valley Super Large Bridge	DK199+673.89	619.80	1-32m simple supported girder-2-24m simple supported girder+16-32m simple supported girder	Stream	12 pier

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
61	Liangbingzhen No.2 Large Bridge	DK202+838.05	276.10	8-32m simple supported girder		
62	Liangbingzhen No.1 Large Bridge	DK204+697.30	210.70	6-32m simple supported girder	Stream	5m，no pier
63	Fengxi Village Large Bridge	DK206+869.75	308.80	9-32m simple supported girder	Stream	20m，1 piers
64	Puguang Large Bridge	DK208+440.82	178.03	5-32m simple supported girder	Stream	10m，no pier
65	Antu Habu'ertong RiverSuper Large Bridge	DK214+090.77	1437.94	1-32m simple supported girder+2-24m simple supported girder+41-32m simple supported girder	Stream	16m，no pier
66	Jiangjin Valley Super Large Bridge	DK215+307.57	537.98	16-32m simple supported girder	Stream	
67	Antu Super Large Bridge	DK217+675.00	650.00	20-32m simple supported girder	Stream	27m，no pier
68	Chong Mt. Large Bridge	DK221+593.95	178.30	5-32m simple supported girder	Stream	15m，no pier
69	Willow River Large Bridge	DK225+770.30	276.10	8-32m simple supported girder	Stream	18m，no pier
70	Dacheng Village Super Large Bridge	DK230+731.14	1237.40	2-24m simple supported girder+31-32m simple supported girder		
71	Shimen Bu'erhatong River Large Bridge	DK233+578.95	407.15	12-32m simple supported girder	Shimen Bu'erhatong River	40m，1 piers
72	Yushuchuan Large Bridge	DK237+549.59	194.70	6-32m simple supported girder	Stream	4m，no pier
73	Cock Crown Village Large Bridge	DK239+896.50	207.00	6-32m simple supported girder	Stream	23m，no pier
74	Golden Buda Temple Large Bridge	DK246+744.45	341.60	10-32simple supported box girder		
75	Wang Family Kiln	DK248+664.71	243.82	7-32simple supported box girder		

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
	Large Bridge					
76	Yongchang Village Large Bridge	DK249+790.98	178.15	5-32simple supported box girder		
77	Yongchang Team 2 Super Large Bridge	DK251+002.75	1159.20	35-32simple supported box girder	Stream	12m,no pier
78	Long Life Cave Large Bridge	DK254+621.94	341.57	10-32simple supported box girder		
79	Taiping Valley Super Large Bridge	DK256+329.50	1126.70	34-32simple supported box girder	Stream	4m,no pier
80	Mid-east Valley Large Bridge	DK257+692.75	211.20	6-32simple supported box girder		
81	Lihua Village Large Bridge	DK259+928.64	308.97	9-32simple supported box girder	Stream	10m,no pier
82	Chaoyang River Super Large Bridge	DK262+966.04	4135.77	126-32simple supported box girder	Chaoyang River	35m，1 piers
83	Yanji No.1 Medium Bridge	DK265+135.00	16.00	1-8m frame medium bridge		
84	Yanji No.2 Medium Bridge	DK266+858.78	26.95	4-6m frame medium bridge		
85	Fenghuangping No. 1 Large Bridge	DK267+886.28	276.25	8-32simple supported box girder		
86	Fenghuangping No.2 Large Bridge	DK269+167.16	309.02	9-32simple supported box girder		
87	Sleeping Dragon Cave Super Large Bridge	DK270+077.02	537.74	16-32simple supported box girder		
88	Yanji River Super Large Bridge	DK275+081.35	3513.69	22-32m simple supported girder+1-(48+80+48) frame structure +13-32m simple supported girder+1-（32+48+32）continous beam-63-32m simple supported girder	Stream	30m,no pier；7m,no pier
89	Guangji Village Large Bridge	DK279+743.79	877.23	26-32simple supported box girder	Stream	河 7.5m,no pier

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
90	Dongxing Valley Large Bridge	DK282+091.01	211.19	6 -32simple supported box girder	Stream	4.5m,no pier
91	Yanfu Valley Team 1 Large Bridge	DK282+971.74	407.27	12-32simple supported box girder		
92	Mopan Mt. Bu'erhatong River Super Large Bridge	DK283+948.50	1257.49	38-32simple supported box girder	Stream	115m，4 piers
93	Lixing Large Bridge	DK299+032.15	210.96	6 -32simple supported box girder	Stream	24m,no pier
94	Gaya River Super Large Bridge	DK307+920.68	1177.36	15-32m simple supported girder+2-24m simple supported girder+19-32m simple supported girder	Stream	260m，10 piers
95	Qingrong Village Over-expressway Super Large Bridge	DK317+504.56	1402.82	34-32m simple supported girder+(40+64+40)m continous beam+4-32m simple supported girder		
96	Lute Valley Large Bridge	DK319+095.59	374.87	11-32simple supported box girder		
97	South Large Bridge Over-expressway Super Large Bridge	DK321+669.55	2317.90	16-32m simple supported girder+(48+80+48)m continous beam+49-32m simple supported girder		
98	Stone Bridge Large Bridge	DK325+864.98	243.65	7 -32simple supported box girder	Stream	21m,no pier
99	Mi River Super Large Bridge	DK337+622.63	898.96	27-32simple supported box girder	Mijiang River	36m，2 piers
100	Dry Mi River Super Large Bridge	DK339+483.85	1291.39	39-32simple supported box girder	Ganmijiang	113m，4 piers
101	Ying'an River Super Large Bridge	DK353+355.64	1585.01	48-32simple supported box girder	Stream	28m，no pier；25m，no pier
102	Fuxing Team 1 Large Bridge	DK355+987.00	897.48	27-32simple supported box girder		

No.	Name	Central Chainage	Total Length（m）	Bridge Struction Type	Crossing River Name	Underwater Pier Number
103	3 Ridges Large Bridge	DK357+111.40	308.80	9 -32simple supported box girder		
104	Jingbian Super Large Bridge	DK359+248.95	1817.90	55-32simple supported box girder	Stream	15m,no pier

5.4.2 Tunnel Work Environmental Influence

The project has 85 tunnels of 155.144km, up to 42.46％ of the total length （365.352km）of project. The basic information of the overall tunnels are as shown in the table 5-2-2.

5.4.2.2 Environmental Influence Analysis

1) Impacts of Tunnel Construction on Tunnel Top Vegetation Growth

The underground water of low rolling area along the project was mainly No.4 system loose rock pore water and basic rock cranny water with some upper layer stagnant water. Songhua River alluvion plain, river, valley and basin areas along the project had the underground water of mainly No.4 system loose rock pore hidden water, partially having the loading bear capacity. The underground water was mainly supplied by the precipitation.

The tunnel construction period might cause the tunnel top underground water loss so as to have an impact on it. Since no residents lived near the tunnel top, tunnel working water leakage had no impact on the the residential drinking water. The entire project tunnel lining used the waterproof concrete with the anti-leakage level no lower than P8. With the waterproof plank plus the geotextile behind the lining arch wall, the underground water leakage was effectively reduced.

The major tunnel construction impact on the ground surface vegatation was that the taken-away underground water owe to the water surge during working would affect the surface vegatation growing. In accordance with the project tunnel location underground water storage conditions, water characters and hydraulic features, the underground water type was mainly the basic rock cranny water of little amount and supplied by the atmosphere precipitation, the water surge amount was estimated lower, so the tunnel works would not influence the underground water flowing status and not take the underground water at the tunnel location. Besides, the rainfall at the project area was relatively abundant, the vegetation growth got the water mainly from the atmosphere precipitation or plant withered layer or atmosphere stored in the shallow layer soil. Above all, the project tunnel would not place an bad affect on the tunnel top vegetation growth.

2) Analysis on the Tunnel Slag Influence

The newly built tunnels with single cave and dual carriageways were 85, the predicted slag amount was 2285×104m3. Based on the designed earth and rock works balance situation, the utilized amount of the project tunnel was 2285×104m3, discarded slag amount was 2188.5×104m3. If the waste in tunnels could not be moved away in time, unorganized piling and dumping could cause the waste soil washed away and a serious soil erosion, and increase the mud and sand content of the ground surface runoff.

Therefore, the tunnel works were required to have an optimized working organization, and move away the waste in time during excavation. Moving away work should have a temporary protection to avoid the second environment impact of the tunnel slag. The construction should follow the principle of “early getting in and late going out”, try to have less or no excavation of the high slope at the entrance and exit of tunnels, when it was necessary, the protection would be needed for side and high slopes to maintain the vegetation, green environment and water and soil. The slag dump should strictly follow the principle of “retain first, then discard”. Planting grass on the top of the dump top or resuming the cultivation, set the drainage ditch around the dump top and blind permeable pipe ditch to induce the collected water drainage

from the mountain.

3) Analysis of Tunnel Excavation Impact on the Hydrological and Geological Environment

In design, the tunnel adopted the both side ditches, compound waterproof board between the initial support and second lining of the compound lining, setting the blind circular drainage pipe according to the undergroundwater development and water swelling waterstop strip at circular construction seam of the second lining. The faultage structure cranny water with larger surge and ground surface seepage at shallow coverd area should follow the design principle of “block mainly, and discharge properly”.

While excavating the tunnels, if going through the water containing layer or faultage broken belt, larger gathered surge might occur, especially at the joint section of the faultage broken belt and ground water. The surface water might sink and rush into the tunnels, affecting the self-stability of the surrounding rocks and inducing the environment problems as ground surface water level going down or dry.

Because of the sudden water surge during the tunnel excavation and the complicated geology along the project, it was suggested to reinforce the observation and prediction of the tunnel fragile to the water surge to minimize the impact of the tunnel works on the underground and ground surface water. A timely and logical prediction data should be submitted to the departments in charge for a prompt alleviation method. The effective measures should be taken at the area with the possible water surge to minimize the tunnel excavation impact on the water resources along the project.

5.4.2.3 Analysis of the Important Tunnel Impact

(1) Lafa Mt. Tunnel

1) Lafa Mt. Tunnel General

a. Project General

Fala Mt. Tunnel was located between Xinkaihe village of Jiaohe city to Shangmiaozi in Jilin Province at chainage DK36+075～DK45+984 with the total length of 9909m, maximum buried depth of 632m, 2-way and 2-cave tunnel, the entrance road shouder elevation of 312.45m and exit road shouder elevation of 364.57m. The entrance and exit of the tunnel were both at the rolling area, mostly cultivated for tree plantng and vegetation development with the natural gradient of 15～20°.

b. Stratum Lithology

The site survey, drawing and project geological investigation revealed that the there were 3 layers of strata lithology at the bridge location. By the sequences of new and old sediment, the main properties of the strata could be simply illustrated as follows:

Ⅰ the 4thImmature Slope Debris Layer （Q4dl）

Silty clay: taupe, hard plastic, containing small amount of gravel of about 5% with the diameter of 3~5mm, uneven soil quality, having plant root system, lay thickness of 0.0～1.4m, mostly distributed on the slope surface;

Ⅱ（P1f）Bi-overlapped System Fanjiatun Group（P1f）

②1 Slate, grey-grey black, all weathered, mostly in shape of sandy soil.

②2 Slate, grey black, heavily weathered, scale like crystal structure, medium thick layer formation, joint cranny and slab developped, better project geological conditions.

②3 Slate: grey black, slightly weathered, scale like crystal structure, medium thick formation, joint cranny and slab developped, better project geological condition, affected by the tilted back of the Laoye Ridge, strata reversed at N338°∠54°.

III.（γ5）Yan Mt. Period

③1 Granite: khaki, all weathered, original structure all ruined, in the shape of sandy soil, 2~5m thick.

③2 Granite: hoar-pinkish, coarse granule structure, slab formation, joint cranny developped.

③3 Granite: hoar color, slightly weathered, mainly medium coarse formation, joint cranny developped, mineral ingredients were mainly feldspar, quartz, biotite, rock joints were hard and commonly developed as N16°∠81° and N50°∠44°.

④ Lamprophyre: grey, slightly weathered, block structure, hard rock quality, belonging to the intrusive rock vein.

c. Geological Structure

The tunnel was located between the Tiangang-Wuli River big rupture and the tilted sides of Laoye Ridge with the complicated geology, the second lamination series reversed, passing through the fault stratum of Dadingzi-Qidaohezi, 28km in length, having two faults:

F3-1 fault stratum, crossed with the line at about DK41+900 at 45°, inclined angle of about 70°. The lithology of both sides of fault were both Yan Mt. Period granite.

F3 fault, crossed with the line at about DK42+400, perpendicular to the alignment, inclined angle of about 70° . The small mileage trend of fault lithology was Yan Mt. Period granite and large mileage tread was the second lamination system Fanjia Village Group slate.

The tunnel entrance section had the lithology of granite（γ5）with the ordinary joint cranny development. The main joint development was at N16°∠81° and N50°∠44°t , mostly having no filling; the tunnel exit section had the property of the second lamination system Fanjia Village group（P1f）slate, affected by the tilted slopes of Laojie Ridge, stratum reversed at N338°∠54°.

The underground water was bedrock cranny water, affected by the various sorts of weathering and geological action, some joint cranny developped a little, with the larger content of moisture, mainly supplied by the atmosphere precipitation.

Fala Mt. tunnel project geoloty conditions were shown as in the table 4-4-2.

d. Hydrologic Geology Features

The ground surface runoff should be seen in the valley near the tunnel, mostly the snow-melted water; the pond scattered mainly got the water supply from the atmosphere precipitation. The underground water was bedrock cranny water, affected by the all kinds of weathering and geological action, joints developed locally, with larger moisture content and got the water supply from the atmosphere precipitation.

Based on the site investigation and in view with the regional comprehensive analysis, it was estimated

that the most tunnel sections would have less water in the dry seasons. In the water abundant seasons, underground water level would be higher, which could cause the increase of the water surge and even local water breakout.

Using the atmosphere precipitation permeable method to estimate the water surge amount.

Q=2.74×a×W×A
2.74—conversion coefficient；

a—precipitation permeation coefficient, considering the granite stratus value of 0.15 at the granite sections; of which, considering the value of 0.20 due to the impact of fault broken belt and ground surface water collection at DK41+750～DK42+700, and 0.20 at the second lamination system slate layer；

W—annual precipitation（mm）, value: 651.4mm；
A—underground water collection area through the moisture containing body（km^2）；

Table 5-4-2 Water Surge Amount by the Precipitation Permeation Estimation Method

Serial No. by Section	chainage	Water Colletion Area（km2）	Surge Amount（m3/d）	Unit Surge Amount	Area by Wall Rock Water Abundance Degree
I	DK32＋700～DK36＋250	3.70	991	0.22	Mean
II	DK36+250～DK41+700	1.05	281	0.09	Poor
III	DK41+700～DK50+030	5.40	1928	0.36	Mean
Total		10.15	3199.32		

The tunnel body was located at late Hulixi period intrusive granite diorite, Yan Mt. permeable granite, with the water collection area of 10.15km^2 and estimated normal water surge amount of 3199.32m^3/d.

e. Project Geological Condition Analysis

The tunnel located area had the second system Fanjia Village Group slate, scale like crystal struture, medium thickness formation, joint cranny development and fragile rock quality; late Yan Mt. intrusive granite of mainly the medium-coarse granule structure, lump formation, some joint cranny development and harder rock, slate and granite meeting at the fault layer, underground water was mostly bedrock cranny water, developped a little. The fault broken belt had abundant water, needing the a timely strengthened support. The entrance and exit of the tunnel had fully-heavily weathered granite of 5~10m in thickness and joint cranny development. The suggested rate of grade for the side and heading slope was: silty clay：1：1.25～1：1.5, fully weathered granite: 1：1～1：1.25, heavily weathered granite:1：0.75～1：1, the controlled side slope height of 10m. The exit had the fullly-heavily weathered slate of 3～5m in thickness, joint cranny development, the suggested rate of grade for side and heading slope was: silty clay: 1：1.25～1：1.5, fully weathered slate: 1：1.25～1：1.5, heavily weathered granite: 1：1～1：1.25, the controlled side slope height of 8m, avoiding the slope excavation by layers.

2）Impact Analysis and Protection Suggestion

① Impact Analysis on the Tunnel Top Vegetation

The tunnel construction impact on the ground surface vegetation was mainly from the bad effect of the possible water surge. Based on the site investigation, the tunnel located areas had less human movement, the top vegetation growth needed water could be gained naturally; the area has larger rainfall. The tunnel top had the developping vegetation and high coverage degree, together with less human and other animal activities, thicker withered leaves cover, lower ground surface water flow coeffecient, higher rainfall permeability, the soil had the high moisture content and water containing capacity. Calculated with the flow coefficient of 0.3, 40～50％ of natural rainfall retained in the withered fallen matters and soil, counted by the 650mm of annual average rainfall, 0.26～0.33m3 of per unit surface area(per m2) natural rainfall could be used for the tree growth. Assessed by 120m3/mu of woodland water requirement quota, per unit area(per m2) needs water quota of 0.18m3, so the natural rainfall could be sufficient for the tunnel top vegetation growth.

The tunnel water surge occurred mostly at the pore distributed area, but with no much possiblility. According to the investigation and analysis, the tunnel top vegetation growth supply was mainly from the precipition, having no direct connection with the underground water. The surge leakage of this tunnel was largely of the aperture water, basically having no impact on the soil moisture content. Thus, the project tunnel construction had only slight impact on the top vegetation.

② Analysis of the Slag Impact on the Environment

The slag amount of the project tunnel was 192.06×104m3, the improper slag disposal, random piling or dumping, the serious soil erosion might occur during the storm seasons and increase the silt content in the nearby ditches.

The slag dumping pit at the entrance section was proposed at about DK38+200 on the right, with the capacity of 21.7×104m³, occupied the farmland and woodland about 2.7hm2, the average transportation distance was 4km; No.1,2,3 and 4 inclined well dumping pit was on the right of the Miaodonggou dump pit at DK39+000 with the capacity of 153.8×104m³, taking the farmland and woodland about 19.2hm2, the average transportation distance of 6km; The slag dumping pit at the exit section was proposed near right of Hengdaozi Village at DK38+200, with the capacity of 153.8×104m³, occupied the farmland and woodland about 2.1hm2, the average transportation distance of 4km.

The assessment suggested to optimize the working organization, removing the slag in time to reduce the temporary material stacking period in consideration of the project situation; following the principle of “retain first, then discard”, greening the slag top or resuming the farm, setting the drainage ditch around the slag pit top and permeable blind ditch at the bottom to induce to collected water to drain.

③ Analysis of Tunnel Excavation Impact on the Hydrological Geology

The underground water at project tunnel area was the bedrock cranny water, no development, so hydro-geological impact was mainly the impact of the tunnel water surge on the underground water system.

In order to minimize the tunnel construction impact on the hydro-geological environment, it was suggested to take the following measures:

First, the tunnel adopted the both side ditches, compound waterproof board between the initial lining support and second lining of the compound lining, setting the blind circular drainage pipe according to

the undergroundwater development. The water surge and breakout area should follow the design principle of "block mainly, and discharge properly" to maintain the integrity of the underground water course to the maximum extent.

Second, the effective measures should be taken to reinforce the tunnel surge observation and prediction at the areas with possible water surge to minimize the tunnel excavation impact on the water resources along the project.

④ Other Comments

The construction waste water should be seperated as clean and dirty with the sewage facilities placed at tunnel entrance(including auxiliary pit mouth) and used for the road surface sprinkling or discharge.

The tunnel should try to adopt the environment friendly gate, reduce the brushing-off height of the side and heading slope at the opening, make less or no damage on the ground surface vegetaion. During the construction, the construction of the assess roads, sheds and working sites should maintain the natural relief. Upon the completion of the work, the restorage should be made for the damaged side and heading slope and vegetation;

The soundproof facilities should be installed inside working machinery such as air compressors, wind ventilators while having possible conditions; the water curtain should be used to reduce the dust, poisonous and harmful gas from boring and explosive excavation, vehicle transportation, anchor spraying works; sprinkling the road surface regularily to avoid the second dusting from vehicle flow or blast impulsion.

(2) Shuinan Tunnel

1）Shuinan Tunnel General

a. Project General

Shuinan tunnel is located between Shuinan village of Yanbian Tumen City and Lixin village at chainage of DK284+626～DK290+869, 6243m in total length, 405m of maxium buried depth. It was proposed that the tunnel should go through the rolling area, away from villages and residential areas, ground elevation of 177.96m～545.80m, verticle natural slope angle at 20～60°, horizontal natural angle generally at 15～45°, vegetation of mostly weed and trees, a little farmland at entrance and exit.

b.Stratum Lithology

In accordance with the site survey, drawing and project investigation results, the main properties of the stratum lithology by times sequence at tunnel location could be simply stated as follows

①The 4th system Holocene eluvial layer（Q4el+dl）silty clay: grey, purple, browny yellow, hard plastic, local having breccia content in small quantity, 4.0～12m in thickness, distributed mostly in the valley and on the gentle slope;
②1 Jurassic system top and mid-series lava group（αJ2-3）, Andesite completely weathered; grey, purple grey, cryptocrystalline structure, rock weathered as sandy soil, partial content of andesite breccia, 5～35m in thickness;
②2 Jurassic system top and middle lava group（αJ2-3）, andesite heavily weathered; grey, maroon, cryptocrystalline structure, lump formation, joint cranny development, rock mass weathered as broken block, 8～25m in thickness;
③2 Hualixi period granite diorite(γδ4）heavily weathered: grey, grey yellow, medium and coarse granule, joint cranny development, rock weathered as broken shape, 5～45m thick;

③3 Hualixi period granite diorite(γδ4）slightly weathered: grey, medium and coarse granule, the main mineral ingredient having quartz, mica, feldspar, hornblende, hard rock, some joint cranny development;
④1 Hualixi period granite (γδ4）completely weathered: khaki, grey, medium coarse granule, rock weathered as sandy soil, 5～30m thick;
④2 Hualixi period granite diorite(γδ4）heavily weathered: khaki, flesh color, medium coarse granule, rock weathered as sandy soil , joint cranny development, 10～60m thick;

c. Geological Structure

Geological conditions in the project range were not bad with no obvious large fault formation. Shuinan tunnel project geological situation was shown in the figure 4-4-3.

d.Hydro-geological Property

No perennial flowing water within the tunnel range, the valley development had seasonal water with the amount change by seasons. The underground water was bedrock cranny water, some development, getting the water supply from atmosphere precipitation, 10～30m of underground water buried depth.

By the site investigation and data comprehensive analysis, most section of the tunnel had no water in dry seasons, but in water abundant seasons, the underground water level could be high, there was possible water surge increase and even small amount of breakout at fault, erosive broken belt.

Using the atmosphere precipitation permeable method to estimate the water surge amount.

$Q=2.74\times a\times W\times A$

2.74—conversion coefficient；

a—precipitation intrusive coefficient, considering the granite stratus value of 0.15 at the granite sections, 0.18 at the tunnel shallow buried area and intrusive rock edge erosive break-up；

W—annual precipitation（mm）, value: 547.4mm；
A—underground water collection area through the moisture containing body（km^2）；

Table 5-4-3 Water Surge Amount by the Precipitation Permeation Estimation Method

Serial No. by Section	chainage	Water Colletion Area（km2）	Surge Amount（m3/d）
I	DK284＋400～DK287＋600	12	2700
II	DK287＋600～DK290+869	8	2025
Total		20	4725

The tunnel body is located at late Hulixi period intrusive granite, granite diorite and andesite section, with the water collection area of 20km2 and estimated normal water surge amount of 4725m3/d.

e. Project Geological Condition Analysis

The tunnel entrance was all heavily weathered granite, and the exit all heavily weathered andesite, rock was a little fragile, complete weathered layer was in gravel and broken lump, it was thicker, side slope stability was not good and easy to collapse; small amount of silty clay; while excavating cave entrance, the ground surface water should be led to avoid its inflow and reinforce the support measures.

The bedrock of the fault formation belt and lithology contacting belt was fragile, easy to collapse;

cranny water developed to some extent, so the waterproof, drainage and support should be emphasized.

2）Impact Analysis and Protection Suggestion

①Impact Analysis on the Tunnel Top Vegetation

The tunnel construction impact on the ground surface vegetation was mainly shown as the bad effect of the possible water surge on the ground surface vegetation. Based on the site investigation, the tunnel located areas had less human movement, the top vegetation growth needed water could be gained naturally; the area has the larger rainfall, the tunnel top had the developping vegetation and high coverage degree, together with less human and other animal activities, thicker withered leaves cover, lower ground surface water flow coeffecient, higher rainfall permeability, the soil had the high moisture content and water containing capacity. Calculated with the flow coefficient of 0.3, 40～50％ of natural rainfall retained in the withered fallen matters and soil, counted by the 547mm of annual average rainfall, 0.22～0.28m3 of per unit surface area(per m2) natural rainfall could be used for the tree growth. Assessed by 120m3/mu of woodland water requirement quota, per unit area(per m2) needs water quota of 0.18m3, so the natural rainfall could be sufficient for the tunnel top vegetation growth.

According to the investigation and analysis, the tunnel top vegetation growth supply was mainly from the precipitation, having no direct connection with the underground water. The surge leakage of this tunnel was largely of the aperture water, basically having no impact on the soil moisture content. Thus, the project tunnel construction had only slight impact on the top vegetation.

②Analysis on the Slag Impact on the Environment

The slag amount of the project tunnel was $96\times10^4m^3$, the improper slag disposal, random piling or dumping, the serious soil erosion might occur during the storm seasons and increase the silt content in the nearby ditches.

The slag dumping pit at Shuinan tunnel entrance section was proposed at the valley 1300m away on the right at DK288+400, with the capacity of $28\times10^4m^3$, occupied the farmland and woodland about $3.5hm^2$, the average transportation distance was 4km; No.1 inclined well waste pit was at the valley 2700m right away at DK289+700 with the capacity of $25\times10^4m^3$, taking the farmland and woodland about $3.1hhm^2$, the average transportation distance of 3km; No.2 inclined well waste pit was at the valley 2700m right away at DK289+750 with the capacity of $15\times10^4m^3$, taking the farmland and woodland about $1.9hm^2$, the average transportation distance of 3.5km; The slag dumping pit at the Shuinan tunnel exit section was at the valley 1900m right away at DK291+900 with the capacity of $28\times10^4m^3$, taking the farmland and woodland about $3.5hm^2$, the average transportation distance of 4km.

The assessment suggested to optimize the working organization, removing the slag in time to reduce the temporary material stacking period in consideration of the project situation; following the principle of “retain first, then discard”, greening the slag top or resuming the farm, setting the drainage ditch around the slag pit top and permeable blind ditch at the bottom to induce to collected water to drain.

③Analysis of Tunnel Excavation Impact on the Hydrological Geology

The underground water at project tunnel area was the bedrock cranny water, no development, so hydro-geological impact was mainly the impact of the tunnel water surge on the underground water system.

In order to minimize the tunnel construction impact on the hydro-geological environment, it was suggested to take the following measures:

First, the tunnel adopted the both side ditches, compound waterproof board between the initial lining support and second lining of the compound lining, setting the blind circular drainage pipe according to the undergroundwater development. The water surge and breakout area should follow the design principle of “block mainly, and discharge properly” to maintain the integrity of the underground water course to the maximum extent.

Second, the effective measures should be taken to reinforce the tunnel surge observation and prediction at the areas with the possible water surge to minimize the tunnel excavation impact on the water resources along the project.

④Other Comments

The construction waste water should be seperated as clean and dirty with the sewage facilities placed at tunnel entrance(including auxiliary pit mouth) and used for the road surface sprinkling or discharge.

The tunnel should try to adopt the environment friendly gate, reduce the height of the cave side and heading slope, make less or no damage on the ground surface vegetaion. During the construction, the arrangement of the assess roads, sheds and working sites should maintain the natural relief and resume the vegetation on the damaged tunnel entrance side and heading slope;

The sound-proof facilities should be installed to the inside working machinery such as air compressor, wind ventilator while having possible conditions; the water curtain should be used to reduce the dust, poisonous and harmful gas from boring and explosive excavation, vehicle transportation, anchor spraying works; sprinkling the road regularily to avoid the second dusting from vehicle moving or blast impulsion wave.

Figure 5-4-4 Part of the Entrance and Exit Location Photos

Table 5-4-4 Tunnel Condition Summary

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
1	Longtan Mt. Tunnel	DK4+664.75	DK5+280	DK5+894.68	1230	Located at hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; surface covered by the 4th series of immuture slope residue layer; silty clay, underlined 2 overlapped series warm wood strip group: slate with tranformed sandstone, complete weathered-slightly, fragile rock.	99.7	Sensitive point at 100m to the entrance and 200m to the entrance
2	Caomugou Tunnel	DK22+666	DK24+350	DK26+033	3367	Located at hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation development. surface covered by the 4th series of immuture slope residue layer, silty clay hard plastic. Underlined with Hualixi mid-late period: mix-colored granite, all weathered belt in sandy soil; heavily weathered belt in broken lump; slightly weathered belt in column, 4th series, thin cover, underlined with mix-colored granite and thicker weathered layer.	130 以上	No sensitive point
3	Beicigou Tunnel	DK27+953	DK28+292	DK28+631	678	Located at hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation development. surface covered by the thin 4th series of immuture slope residue layer, silty clay hard plastic, 2~5m thick. Underlined with mid-late perio Hualixi d: mix-colored granite, all weathered belt in sandy soil; heavily weathered belt in broken lump; slightly weathered belt in column, 4th series, thin cover.	63	No sensitive point
4	Lanjialing Tunnel	DK29+237	DK29+363	DK29+489	252		30	No sensitive point
5	Huopengou Tunnel	DK31+337	DK31+625	DK31+912	575		67	No sensitive point
6	Qingling Tunnel	DK33+885	DK34+280	DK34+675	790		63	Sensitive point at 260m to the exit

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
7	Fala Mt. Tunnel	DK36+075	DK41+030	DK45+984	9909	Located at hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation development. surface covered by the thin 4th series of immuture slope residue layer, silty clay hard plastic, underlined with early Yan Mt. period: mix-colored granite: granite diorite, complete diorite~slightly weathered. Project geological features: thin 4th series covering layer, underlined with granite diorit, thicker weathered layer. The project features: surface covered by the thin 4th series layer, Underlined with granite diorite, thicker completely weathered layer. Loctoated between Tiangang-5-mile river large rupture and Laojieling inclined slope, tunnel body formation developped, and with broken rock.	269.0 以上	Sensitive point at 160m to the entrance
8	Shuangmiaozi Tunnel	DK46+190	DK47+849	DK49+507	3317	Medium low mountain area. The 4th series of neo-slople alluvion layer: fine and round gravel soil; silty clay, hard plastic. 2 overlapped series Xiaotong Fanjia village group: slate with transformed sandstone, grey black, completely weathered; heavily, slightly weathered, affected by the tilted back of the Laoye Ridge, strata reversed at N338°∠54°.	Over 203	No sensitive point
9	Donglinzi Tunnel	DK51+877	DK52+316	DK52+754	877		155	No sensitive point
10	Dongnancha Tunnel	DK53+081	DK53+571	DK54+060	979	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation development. surface covered by the thin 4th series of immuture slope residue layer, silty clay. Underlined the early Yan Mt. period: granite diorite, completely weathered surface~slightly weathered. Geology features: covered by the thin 4th series layer,	121	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						underlined with granite diorite, thicker completely weathered layer.		
11	Perfume Tunnel	DK54+823	DK57+042	DK59+260	4437	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation development. surface covered by the thin 4th series of immuture slope residue alluvion layer: silty clay. Underlined the early Yan Mt. period: granite diorite, completely weathered surface~slightly weathered. Geology features: covered by the thin 4th series layer, underlined with granite diorite, thicker completely weathered layer.	108	Sensitive point at 266m to the entrance
12	Taiping Tunnel	DK60+152	DK60+454	DK60+756	604		78	No sensitive point
13	Jiaoxi Tunnel	DK65+063	DK65+309	DK65+554	491		255	No sensitive point
14	Fuqiang Tunnel	DK80+252	DK81+369	DK82+485	2233	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; surface covered by the thin 4th series of immuture slope residue alluvion layer: silty clay. Underlined the late Hualixi period : granite (fully weathered)	145	No sensitive point
15	Tangjiagangzi Tunnel	DK83+769	DK84+221	DK84+673	904		55	Sensitive point at 266m to the exit
16	Caoyanggou Tunnel	DK85+029	DK85+613	DK86+196	1167		65	Sensitive point at 280m to the etrance and 230m to the exit
17	Houtaipingling Tunnel	DK86+592	DK86+707	DK86+822	230		43	No sensitive point，
18	Ailing Tunnel	DK91+308	DK91+984	DK92+660	1352		100 以上	No sensitive point
19	Stone Gate Tunnel	DK91+283	DK94+358	DK97+432	6149		170 以上	Sensitive point at 178m to the enrance

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
20	Qianlishu No. 1 Tunnel	DK98+012	DK98+521	DK99+030	1018	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; surface covered by the 4th neo-silty clay: hard plastic. Underlined late Hulixi period granite((fully weathered). Hydro-geological features: small amount of surface water in some valleys, changing with seasons; underground water being bedrock cranny, affected by various of weathering and geological action, some joint cranny developped a little, contenting cranny water, supplied by the atmosphere rainfall.	68	No sensitive point
21	Qianlishu No. 2 Tunnel	DK99+597	DK99+764	DK99+931	334	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; surface covered by the 4th neo-silty clay: hard plastic. Underlined late Hulixi period granite((fully weathered).	55	No sensitive point
22	Qianlishu No. 3 Tunnel	DK100+139	DK100+341	DK100+542	403		45	No sensitive point
23	Sandaotou Tunnel	DK108+530	DK109+035	DK109+540	1010	Located at low hilly area with larger wave and partial alluvion development; woodland on the both sides, partial farmland, vegetation development; no geological formation. surface covered by the 4th neo-powder layer, adhesive soil: hard plastic. Underlined late Hulixi period granite((fully weathered). Partial content of angle, gravel; covered by the 4th immuture slope residue remains layer: silty clay: hard plastic. 10% content of breccia, broken stone, mostly granite, distributed along the whole section, partially broken gravel and earth. Underlined late Hulixi period granite((fully weathered). Partial content of angle, gravel; heavily weathered granite, medium coarse granule struture, lump formation, joint cranny developped; slightly weathered granite, medium coarse granule struture, lump formation, joint cranny developped. Geological features:	65	No sensitive point
24	Weihuling Tunnel	DK110+970	DK112+525	DK114+079	3109		100 以上	Sensitive point at 270m to the exit

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						thinner 4th series covering layer, underlined granite diorite, thicker completely weathered layer.		
25	Dachuan Tunnel	DK125+384	DK125+819	DK126+253	869	Located at the low hilly area, having many “V”-shape valley, with some undulation. Better vegetation cover, having farmlands on valley sides and in the valleys. Surface covered the 4th immuture slope residue remains silty clay: hard plastic, uneven soil, having breccia. Underlined the 3rd upper neo-ship bottom Mt. group basalt: spot structure, lump formation, hard quality, not fragile, slightly weathered; late Halixi period granite: medium coarse spot structure, hard but not fragile, heavily weathered, distributed at the entrance of the Dachuantun Tunnel	120	No sensitive point
26	Sandaoquan No.1 Tunnel	DK126+496	DK126+761	DK127+025	529		60	Sensitive point at 367m to the exit
27	三 Sandaoquan No.2 Tunnel	DK127+482	DK128+810	DK130+138	2656		85	Sensitive point at 355m to the entrance and 388m to the exit
28	Shuangquanshang No.1 Tunnel	DK130+580	DK131+048	DK131+515	935	Located at the low hilly and gulch area with large undulation, having “V”-shape valley. Better vegetation cover, having farmlands in the valley and on the gentle slope, others mainly as woodland. Surface covered by the 4th immuture slope residue remains layer: silty clay: 4th immuture slope residue remains layer: silty clay, uneven soil, having breccia. Partially seen basalt lump gravel. Underlined 4th series renewed platina group basalt: spot structure, lump formation, hard quality, slightly weathered; partial having almond kernel basalt.	92.0	Sensitive point at 300m to the exit
29	Shuangquanshang No. 2 Tunnel	DK131+985	DK132+128	DK132+270	285		44	No sensitive point
30	Mingchuan Tunnel	DK133+112	DK133+816	DK134+519	1407	Located at the low gentlly hilly with large undulation, the gradient degree of 9～200 at tunnel entrance and exit. Surface covered by the 4th immuture slope residue remains layer: silty clay: uneven soil, having basalt, Partially seen basalt lump gravel, distributed mainly hill slope. Underlined 4th renewed platina group: basalt:	50	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						heavily weathered, lump structure, spot formation, joint cranny developped, distributed mainly at low hill top. The 3rd medium neo-tumenzi group: adhesive soil rock, heavily weathered, mud structure, medium thick layer, main content of Mentuo stone. Underground water mainly bedrock cranny water, supplied by the atmosphere precipitation, changing largly with seasons. Having possible water surge at tunnel body construction, necessary protective measures required.		
31	High Pine TreeTunnel	DK143+149	DK143+972	DK144+795	1646	Located at the low hilly and gulch area with gentle undulation, having farmlands, surface covered by the 4th immuture slope residue remains layer: silty clay: hard plastic, uneven soil, seenable angel gravel, partially seen basalt lump gravel. Underlined 4th series renewed platina group basalt: spot structure, lump formation, hard quality, slightly weathered; partial having almond kernel basalt. The 3rd medium neo-tumenzi group with fine sandstione and mudstone, heavily weathered, gravel structure, mud cementation, worse rock formation quality, completely weathered, in sand and soil with partioal adhesive soil rock: thick and fine on the surface, light and turn to loose sand meeting the water; medium thick layer, main content of Mentuo stone. The 3rd medium neo-tumenzi group basalt: lump structure, spot formation, partially pore ditributed, heavily weathered, joint cranny developped.	78	No sensitive point
32	Beiguan Tunnel	DK145+510	DK145+787	DK146+063	553	Located at the low hilly and gulch area with gentle undulation, having farmlands, surface covered by the 4th immuture slope residue remains layer: silty clay: hard plastic, uneven soil, seenable angel gravel, partially seen basalt lump gravel. Underlined 4th series renewed platina	44	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						group basalt: spot structure, lump formation, hard quality, slightly weathered; partial having almond kernel basalt. The 3rd medium neo-tumenzi group with fine sandstione and mudstone, heavily weathered, gravel structure, mud cementation, worse rock formation quality, completely weathered, in sand and soil with partioal adhesive soil rock: thick and fine on the surface, light and turn to loose sand meeting the water; medium thick layer, main content of Mentuo stone. The 3rd medium neo-tumenzi group basalt: lump structure, spot formation, partially pore ditributed, heavily weathered, joint cranny developped.		
33	Teibei Tunnel	DK151+348	DK151+518	DK151+688	340	Located at the low hilly area with gentle undulation, having farmlands, surface covered by the 4th immuture slope residue remains layer: silty clay: hard plastic, uneven soil, seenable angel gravel, partially seen basalt lump gravel. Underlined 4th series renewed platina group basalt: spot structure, lump formation, hard quality, slightly weathered; partial having almond kernel basalt. The 3rd medium neo-tumenzi group with fine sandstione and mudstone, heavily weathered, gravel structure, mud cementation, worse rock formation quality, completely weathered, in sand and soil with partioal adhesive soil rock: thick and fine on the surface, light and turn to loose sand meeting the water; medium thick layer, main content of Mentuo stone.	50	No sensitive point
34	West Mt. Tunnel	DK170+644	DK171+374	DK172+104	1460	Located in the medium & low hilly area, large mountain, tree grown on the mountain slope, ground surface mostly covered in the woodland. No geological development. Underlined with Yan Mt. period granite, completely weathered in soil status with small amount of broken pieces; heavily weathered belt in spot structure, no joint cranny developped, in large lump and broken pieces; slightly weathered belt in spot structure,	103	Sensitive point at 220 in the mid-north
35	Zhengyi Tunnel 1	DK185+615	DK186+359	DK187+103	1488		82	No sensitive point
Zhe	Zhengyi Tunnel	DK187+532	DK187+77	DK188+02	488		51	No sensitive

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
ngyi	2		6	0		joint cranny developped, in large lump and thick layer.		point
37	Ha'erbaling Tunnel 1	DK188+305	DK188+652	DK188+998	693	Located at the medium & low hilly area, tree grown on the mountain slope, ground surface mostly covered in the woodland. No geological development. Underlined with late Hulixi period granite, seemed as spot granite with diorite dike, spot structure, heavily~slightly weathered, joint cranny developped; appearing granite diorite dike, heavily weathered, distributed in parallel perpendicular to the ground, joint cranny developped; the mountain surface layer in broken pieces.	70 以上	No sensitive point
38	Ha'erbalinTunnel 2	DK191+108	DK192+343	DK193+577	2469		125	No sensitive point
39	Nangou Tunnel 1	DK194+498	DK194+892	DK195+285	787		88	Sensitive point at 237m to exit
40	Nangou Tunnel 2	DK195+853	DK196+318	DK196+783	930		100	No sensitive point
41	Beitun Tunnel 1	DK196+955	DK197+856	DK198+757	1802		104	No sensitive point
42	Beitun Tunnel 2	DK198+349	DK198+738	DK199+126	777	Located at the medium & low hilly area, tree grown on the mountain slope, ground surface mostly covered in the woodland. No geological development. Underlined with the granite of Yan Mt. period, seemed as spot structure, heavily~slightly weathered, joint cranny developped; the mountain surface layer in mature fores. The underground surface being bedrock cranny.	69	Sensitive point at 153m to exit
43	Beitun Tunnel 3	DK200+081	DK201+137	DK202+192	2111		142	Sensitive point at 60m to exit
44	Liangbing Tunnel 1	DK202+446	DK202+557	DK202+667	221		42	Sensitive point at 83m to exit
45	LiangbinTunnel 2	DK203+119	DK203+561	DK204+002	883		100	No sensitive point
46	LiangbinTunnel 3	DK204+178	DK204+337	DK204+495	317		55	No sensitive point
47	Fengxi Tunnel 1	DK204+832	DK204+881	DK204+929	97		34	Sensitive point at 270m to exit
48	Fengxi Tunnel 2	DK205+020	DK205+193	DK205+365	345		66	Sensitive point at 278 in the mdi-south
49	Fengxi Tunnel 3	DK205+503	DK206+057	DK206+610	1107		88	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
50	Fengxi Tunnel 4	DK207+217	DK207+635	DK208+052	835		62	No sensitive point
51	Puguang Tunnel	DK208+196	DK208+263	DK208+330	134		48	No sensitive point
52	Gaotai Tunnel	DK208+683	DK210+467	DK212+251	3568		165	No sensitive point
53	Dragon Mt. Tunnel	DK213+218	DK213+287	DK213+355	137		41	Sensitive point within 70m of both sides of the exit
54	9-DragonsTunnel	DK218+004	DK219+604	DK221+203	3199		140 以上	No sensitive point
55	Jingcheng Tunnel	DK227+928	DK228+130	DK228+332	404	Located at the medium and low hilly area and part of alluvion plain with larger undulation, having farmlands in the flat section and woodland at the rolling area, no geological development. Surface covered by the 4th neo-alluvion layer: silty clay: hard plastic, uneven soil, seenable angel gravel; , partially seen basalt lump gravel. The 4th neo-alluvion broken soil and gravel: satuated, densed-medium densed, mostly granite, filled with the coarse round gravel earthworks and earth with sand. Underlined with late Hulixi granite: medium spot structued granule, lump formation, heavily~slightly weathered, joint cranny developped. The underground water being the 4th series covering layer pore water and bedrock cranny water.	65	No sensitive point
56	Dacheng Tunnel	DK229+339	DK229+728	DK230+116	777		88	Sensitive point at 53m to exit
57	5-family Tunnel	DK232+403	DK232+891	DK233+378	975	Ground surface the 4th neo-remains accumulation silty clay, partial content of angle and broken gravel, underlined with biotite granite, biotite granite diorite: lump	120	No sensitive point
58	5-peak Mt.	DK233+775	DK235+61	DK237+45	3676		165	No sensitive

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
	Tunnel		3	1		formation, medium coarse structure, main mineral content of quartz, felpstar, biotite, hornblende, etc. completely weathered in gravel earth status, 5～8m thick; heavily weathered in broken status, 10~20m thick.		point
59	Yushuchuan Tunnel	DK237+641	DK238+730	DK239+818	2177		154	No sensitive point
60	Cock Crown Mt. Tunnel	DK239+976	DK242+311	DK244+646	4670		180 以上	Sensitive point at 220m to exit
61	Qiyang Tunnel	DK244+875	DK245+222	DK245+569	694	Surface covered by the 4th neo-silty clay remains lamination layer, exposed layer thickness of 1.1～3m, containing weathered gravel and rock and plant rooting. The 4th neo-coarse gravel remains lamination layer, exposed layer thickness of 4m, slightly humid, medium dense, mainly with andesite and quartz, edged, granule diameter of 4-10cm, filled mainly adhesive soil of 40%. Underlined with andesite, fully weathered, spop structure, lump formation, weathered as earth containing small amount of broken pieces; heavily weathered, spop structure, lump formation, joint cranny developped a little, broken rock, rock core mostly broken, normal diameter of 3-6cm and maxium diameter of 15cm; slightly weathered, semi-crystal structure, lump formation, joint cranny developped, slightly broken rock, main mineral content of quartz, mica, fully weathered, joint cranny well developped, rock weathered as gravel earht; heavily weathered, joint cranny developped. Slightly weathered, some joint cranny development.	80	No sensitive point
62	Gold-Buda Temple Tunnel	DK247+780	DK247+998	DK248+216	436	Located at rolling area with larger undulation and valley in the valley. Vegetation developped, mainly dry land. Surface covered by the 4th neo-alluvion silty clay: soft plastic, partial content of fine angel gravel; The 4th neo-alluvion fine and round gravel earth, loose-dense, humid-satuated, filled with adhisive earth, mainly distributed in the washed valley. The 4th neo-silty clay: hard plastic, partial content of angel gravel	55	No sensitive point
63	Yongchang Tunnel	DK251+800	DK253+010	DK254+220	2420		101	Sensitive point at 5m0 to exit
64	Fuming Tunnel 1	DK257+085	DK257+325	DK257+565	480		50	Sensitive point at 112m to exit

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						and broken stone, distributed on the hill alongway. Underlined with cretaceous upper mud rock, gravel and rock interlaced layer , mud cementation, fully weathered thickness of 2～8m; heavely weathered thickness of 5～30m.		
65	Fuming Tunnel 2	DK257+923	DK258+749	DK259+575	1652	Located at the rolling area with larger undulatio, alluvion valleys and vegetation developped, mainly having woodlandg farmlands in the flat section and woodland and dry land. Surface covered by the 4th neo-silty clay: hard plastic, cutting secting havign no luster with medium streghth and toughness, with landing soil of 0-0.4m deep, having plant rooting system of 0.0～1.5m, mostly distributed on the slope surface; The 4th neo-fine breccia soil, loose-dense, humid-satuated, normal granule diameter of 3-20mm, 50% content with small broken stone of maxium diameter of 180mm and 0.0～5.5m, distributed on the slope surface, Underlined with cretaceous Longjing group gravel rock, mud rock, layered structure, mud cementation, heavely weathered layer thickness of 15～30m with loose rock; slightly weathered layer with soft rock and medium-high distensibility.	71	No sensitive point
66	Mingxing Tunnel	DK271+040	DK271+490	DK271+940	900		46	Sensitive point at 210m to exit
67	Development Tunnel	DK272+425	DK272+586	DK272+747	322		30	No sensitive point
68	Dongxing Tunnel	DK277+817	DK278+239	DK278+661	844		44	Sensitive point at 135m to exit
69	Fuxing Tunnel	DK280+275	DK280+468	DK280+660	385		33	No sensitive point
70	Guangxing Tunnel	DK280+753	DK281+327	DK281+900	1147		69	No sensitive point
71	Shuinan Tunnel	DK284+626	DK287+748	DK290+869	6243	Surface covered by the 4th neo-silty clay remains layer, partial content of breccia and broken stone. Underlined with granite, granite diorite, lump formation, medium coarse granule struture, main mineral content of quartz, feldspar, biotite, hornblende, etc. fully weathered as gravel earth; heavily weathered as broken pieces, 10~20m thick.	Over 178	No sensitive point
72	Shangdongjing Tunnel	DK291+062	DK294+234	DK297+405	6343	Surface covered the 4th neo-alluvion gravel earth, dense-medium dense, humid~satuated, mainly filled adhesive soil, fine breccia earth, mostly having the 4th neo-remains slope accumulated silty clay, hard plastic,	Over 164	No sensitive point
73	Lifeng Mt. Tunnel	DK297+789	DK298+337	DK298+885	1096		129.9	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
74	Riguang Mt. Tunnel	DK299+247	DK302+308	DK305+369	6122	containing breccia and broken stone, distributed on the hill along the project. Underlined with cretaceous Longjing group mud rock and sand rock, mud cementation, fully weathered layer thickness of 5~15m; heavily weathered layer thickness of 10～40m; the following slightly weathered layer distributed mainly at section of CK298+700-CK298+945, CK299+883-CK300+100, CK300+300-CK303+283; Jurassic system and upper andesite sort: mainly andesite rock, andesite breccia rock, andesite tuff, fully weathered layer of 3-10m; heavely weathered layer thickness of 5-20m; Hualixi period granite diorite, lump formation, mainly contained diorite, quatz, hard rock, 3～10m thick; heavily weathered layer of 8～20m thick. going throung Longjing group stratum of medium-strong distensibility; 2 faults passing through at CK300+100 和 CK302+300.	Over 180	Sensitive point within 70m both sides of exit
75	Hou'an Mt. Tunnel	DK308+542	DK312+507	DK316+471	7929	Surface covered the 4th neo-alluvion breccia earth, dense-medium dense, humid~satuated, mainly filled adhesive soil, fine and coarse breccia earth, distributed most in the valley. The 4th neo-remains slope accumulated silty clay, hard plastic, containing breccia and broken stone, distributed on the hill along the project. Underlined with the 3rd Huichun group mud and sand rock, mud cementation, partial having thin coal layer, fully weathered layer thickness of 5~15m; heavily weathered layer thickness of 10～20m; the following slightly weathered layer with medium-strong distensibility, mainly exposed at section CK315+080-CK315+176, CK319+564-CK320+200. 2 overlapped system down Kedao group Tuff slate and tuff sandstone interlaced layer of 5-10m. Hulixi period granite heavely weathered layer thickness of 5-20m; Hualixi period granite diorite, lump formation, mainly	198	No sensitive point
76	Qingrong Tunnel	DK319+326	DK319+748	DK320+169	843		103	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
						contained diorite, quatz, hard rock, 3～10m thick; heavily weathered layer of 8～20m thick. Slightly weathered layer exposed at section CK320+200～CK321+200. the 3rd coal system stratum, Hou'an Mt. tunnel exit and Qingrong tunnel had gas.		
77	Funing Tunnel	DK323+621	DK324+674	DK325+727	2106	Surface covered the 4th neo-alluvion breccia earth, dense-medium dense, humid~satuated, mainly filled adhesive soil, distributed most in the valley. The 4th neo-remains slope accumulated silty clay, hard plastic, containing breccia and broken stone, distributed on the hill along the project. Underlined with the 3rd Huichun group mud and sand rock, mud cementation, partial having thin coal layer, fully weathered layer thickness of 5~15m; heavily weathered layer thickness of 10 ～ 20m; the slightly weathered layer exposed at section CK323+500 ～ CK325+200. 2 overlapped system down Kedao group tuff slate and tuff sandstone, tuff sand conglomerate, hard, fully heavely weathered layer thickness of 0.5～2m; heavily weathered layer of 3～15 thick. Slightly weathered layer exposed at section CK332+800～CK338+830. Hulixi period granite heavely weathered layer thickness of 5-20m; Hualixi period granite diorite, granite lump formation, hard, fully weathered layer of 3～10m thick; heavily weathered layer of 5～20m thick. Slightly weathered layer exposed at section CK325+200～CK332+800.	75	Sensitive point at 105m to exit
78	Xixiakan Tunnel	DK326+029	DK329+499	DK332+969	6940		Over 180	No sensitive point
79	Mijingxiang Tunnel 1	DK333+140	DK334+090	DK335+039	1899		148	No sensitive point
80	Mijingxiang Tunnel 2	DK335+264	DK336+209	DK337+153	1889		141	No sensitive point
81	Mijingxiang Tunnel 3	DK338+086	DK338+427	DK338+767	681		132	No sensitive point
82	Xiaopanling Tunnel 1	DK340+200	DK343+078	DK345+955	5755	Surface covered the 4th immuture slope residue remains accumulated silty clay, hard plastic, containing breccia and broken stone, distributed on the hill along the project. 2 overlapped system upper Jiefang group sandstone, mud	Over 151	No sensitive point
83	Xiaopanling Tunnel 2	DK346+107	DK347+051	DK347+995	1888		115	No sensitive point

No.	Tunnel Name	Entrance Chainage	Central Chainage	Exit Chainage	Total Length（m）	Project Conditions	Maxium Tunnel Buried Depth（m）	Upper Part & Entrance Sensitive Points Distribution
84	Xiaopanling Tunnel 3	DK348+158	DK350+285	DK352+412	4254	slate, hard, fully heavely weathered layer thickness of 1～3m; heavily weathered layer of 3～10 thick. 2 overlapped system upper Guanmenzuizi group tuff andesite, tuff sandstone, hard, fully heavely weathered layer thickness of 0.5～3m; heavily weathered layer of 1～5m thick. Slightly weathered layer exposed at section CK349+600 ～ CK351+525.	Over 159	No sensitive point
85	Sandaoling Tunnel	DK357+444	DK357+801	DK358+158	714	Surface covered the 4th immuture slope residue remains accumulated silty clay, hard plastic, containing breccia and broken stone, distributed on the hill along the project. Underlined with the 3rd Huichun group mud and sand rock, mud cementation, partial having thin coal layer, fully weathered layer thickness of 5~10m; heavily weathered layer thickness of 5 ～ 150m, having medium-strong distensibility,passing through 3rd coal system stratum and containing gas at tunnel body section.	36	No sensitive point

5.5 Ecological Environment Impacts and Methods of Temporary Works

The project railway temporary works included mainly earthwork (slag) borrow and dumping pits, construction assess, girder precasting and storing plant, mixing station, rail placing base, construction camps, etc.

5.5.1 Rationality Analysis on the Earthwork(slag) Borrow and Dumping Pits

The project went through the medium and low mountainous area of the middle section of Changbai Mt. with the distribution the relative gentle and open valleys and basins. This region had the complicated terrain with plain area, low hilly area and basin, having quite some farmland and woodland, and some unutilized wasteland and dryland. There were 78 earthworks borrow and dumping pits (Table 4-5-1) and 109 slag dumping pits (Table 5-5-3).

Table 5-5-1 Distribution of Sand Cutting Sites and Spoil Grounds along the Line

No.	Name of Sand Cutting Sites and Spoil Grounds	Mileage	Relative Location to the Line		Total quantity ($10,000m^3$)	Status quo
			left-and right-side	lateral distance (m)		
1	Sand Cutting Sites of Longtan Mountain Tunnel Entrance	DK000+000～DK001+280			10	Using tunnel front exit for Waste spoil
2	Tiantai Village Spoil Ground	DK007+000～DK009+000	right		18	woodland
3	Gaojiawazi Village Spoil Ground	DK009+500～DK011+600	left	500～750	9	moorland
4	Zhongsha Village Fourth Team Spoil Ground	DK017+500～DK018+000	right	30～200	9.5	dryland
5	Zhongsha Village Fifth Team Spoil Ground	DK018+000～DK018+500	right	50～200	8.5	dryland
6	Zhongsha Village Fifth Team West Spoil Ground	DK019+400～DK021+400	right	40～150	4.8	arable land
7	Caomugou Spoil Ground	DK022+180～DK022+500	left	50～500	9.7	dryland
8	Nanshahezi Village Spoil Ground	DK025+900～DK026+400	right	50～300	5.5	dryland
9	Lianjiang Village Spoil Ground	DK026+600～DK028+000	right	100～700	4.8	arable land
10	Xiaohuopenggou Southeast sand cutting site	DK031+000～DK031+600	right	1000～1200	7.5	moorland
11	Xiaohuopenggou Northeast Spoil Ground	DK046+000～DK046+250			3.8	dryland
12	Tunnel Entrance sand cutting site	DK032+560～DK036+150	left	300～500	2.6	dryland

No.	Name of Sand Cutting Sites and Spoil Grounds	Mileage	Relative Location to the Line		Total quantity ($10,000m^3$)	Status quo
			left-and right-side	lateral distance (m)		
13	ShuangmiaotunSpoil Ground	DK049+460～DK050+900	left	1250～1500	7.8	dryland
14	Dongnanchatun Spoil Ground	DK053+100～DK053+800	right	1200～1500	2.7	Dominant by dryland
15	Hongqitun Northwest Spoil Ground	DK061+300～DK064+200	left	50～750	49	dryland
16	Hongqitun Southeast Village Spoil Ground	DK061+300～DK064+200	left	500～1000	2.8	dryland
17	Beigou Village Spoil Ground	DK069+380～DK079+200	left	200～750	63.5	dryland
18	Nandatun sand cutting site	DK069+000～DK079+900	left	100～500	89	dryland
19	Fuqiang Village Spoil Ground	DK081+400～DK082+700			2.5	dryland
20	Cunditun sand cutting site	DK082+700～DK088+000	left	3500～4000	7	dryland
21	AIlinxiatun sand cutting site	DK088+000～DK093+000	left	5000～6000	9.7	dryland
22	Laoyuegou First Tunnel Exit sand cutting site	DK099+050.00～DK099+600.0			0.04	
23	Huweiling Tunnel Exit sand cutting site	DK114+280.00～DK117+000.00	left		12.1	
24	Hamotang Village West sand cutting site	DK117+000.00～DK120+100.00	left	5000～6000	12.5	dryland
25	Xinmintun Spoil Ground	DK114+280.00～DK120+000.00	left	2500～3000	5	
26	Sandaoquan Spoil Ground	DK122+700.00～DK124+700.00	left	2000～2500	1.2	
27	Mingchuantun Tunnel Exit sand cutting site	DK134+519.00～DK139+000.00			7.4	
28	Gaosongshu Tunnel Exit sand cutting site	DK139+000.00～DK143+149	left	500～1000	11.73	
29	Liushugou sand cutting site	DK149+900.00～DK150+700.00	left	100～500	12.61	
30	Mechanical and Electric Equipment Factory sand cutting site	DK155+000.00～DK160+000.00			91.21	
31	Funeral Parlor sand cutting site	DK160+000.00～DK161+600.00	left	1500～2000	79	
32	Tunnel Entrance sand cutting site	DK161+600.00～DK164+000.00				
33	Xishantun Tunnel Entrance sand cutting site	DK164+000.00 DK169+212.00				
34	Xishantun Tunnel Exit sand cutting site	DK169+212.00～DK170+696.00				

No.	Name of Sand Cutting Sites and Spoil Grounds	Mileage	Relative Location to the Line		Total quantity (10,000m^3)	Status quo
			left-and right-side	lateral distance (m)		
35	Dashitou Town North sand cutting site	DK170+696.00～DK174+100.00	left			
36	Youyi Village sand cutting site	DK174+100.00～DK180+600.00				
37	Youyi Village South sand cutting site	DK180+600.00～DK181+200.00				
38	Zenegyi First Tunnel Entrance sand cutting site	DK180+000.00～DK185+774.00			6.1	
39	Zengyi Second Tunnel Exit sand cutting site	DK188+019.00～DK191+100.00			3.1	
40	Harbaling Reservoir Spoil Ground	DK214+800.00～DK217+300.00	right	1000	0.8	
41	Longshan Village Spoil Ground	DK214+700.00～DK215+000.00	right	100～550	0.6	
42	Antu County Riverside Spoil Ground	DK215+500.00～DK217+300.00			80	moorland
43	Jiulongtun Spoil Ground	DK215+500.00～DK217+300.00			30	
44	Jiulongtun Tunnel Exit sand cutting site	DK221+200.00～DK223+000.00			4	
45	Jiuyantun Spoil Ground	DK223+000.00 DK226+000.00	right	50～200	3.9	
46	Jingcheng Village Spoil Ground	DK226+000.00～DK228+000.00	right	200～1000	2.5	
47	Dacheng Tunnel Enrance sand cutting site	DK228+400.00～DK229+400.00			1	
48	Dacheng Tunnel Exit sand cutting site	DK230+200.00～DK232+400.00			2.2	
49	Longchengtun Spoil Ground	DK228+400.00～DK229+400.00	left	300～1000	1.2	
50	Wuhutun Spoil Ground	DK230+200.00～DK232+400.00	left	300～1000	1	
51	Jiaonantun sand cutting site	DK244+800～DK245+500	right	3000～3500	0.8	
52	Wangjiayao sand cutting site	DK245+500～DK245+900	right	50～200	9	
53	Guandaotun sand cutting site	DK246+000～DK246+800	right	5000～6500	2	
54	Guanchuantun sand cutting site	DK245+100～DK246+500	right	2500～3000	18	
55	Longdong tun sand cutting site	DK244+800～DK245+500	left	100～300	4	
56	Hecheng Village sand cutting site	DK251+275～DK256+00	right	3000～4500	45	
57	Hecheng Fifth Group	DK256+00～	right	500～2700	1	

No.	Name of Sand Cutting Sites and Spoil Grounds	Mileage	Relative Location to the Line		Total quantity (10,000m^3)	Status quo
			left-and right-side	lateral distance (m)		
	sand cutting site	DK266+500				
58	Yanhe VIllage sand cutting site	DK266+500～DK268+000	left	6000～7000	55	
59	Limin Village sand cutting site	DK268+200～DK276+200	left	7000～8000	33	
60	Shuinan Village sand cutting site	DK279+450～DK288+300	left	200～750	196	
61	Shuanghe Village sand cutting site	DK286+400～DK287+150	right	3500～4000	265	
62	Xinlong Village sand cutting site	DK287+500～DK288+300	right	1000～1500	78	
63	Shangsuo Village sand cutting site	DK288+300～			70	
64	Lixin Village sand cutting site	DK290+000～DK302+890	right	1200～1300	98	
65	Xiaobeigou sand cutting site				97	
66	Guanmen Village sand cutting site	DK328+350～DK330+500	right	50～100	296	
67	Funing Village sand cutting site	～DK355+700			145	
68	Jingbian Village sand cutting site	DK355+700～DK362+200			26	
69	Jinfo Temple Spoil Ground	DK244+800～DK248+100	left	200～500	17.5	woodland
70	Longdongtun Spoil Ground	DK248+100～DK253+500	left	100～300	9.5	山沟
71	Fumindong Spoil Ground	DK253+500～DK278+900	right	50～500	14	dryland
72	Xiaobaeigou Spoil Ground				28	dryland
73	Dongjing Village Spoil Ground	DK278+900～DK292+925	right		47	woodland
74	Xiaoshang Street Spoil Ground				46	woodland
75	Xiaobeigou South Spoil Ground				48	woodland
76	Nanda Village Spoil Ground	DK312+925～DK338+325			27	arable land
77	Fuxin Village Spoil Ground	DK338+325～DK357+200	right	100～500	65.5	woodland
78	Jingbian Village Spoil Ground	DK357+200～DK362+200			22.5	woodland

In accordance with the filling section distribution and earthwork and rockwork balance condition along the project, the assessment made a rationality analysis on the location relationship between earthwork dumping pits and the sensitive areas, and optimized the pit location on the basis of the principle of relatively

concentrated earthwork borrow and dumping to minimize the farmland occupation quantity.

(1) Sensitivity Analysis

In accordance with the situation that the project passed through the Mao'er cultural relic protection area, Longtan Mt. City cultural relic protection area, Songhuajiang 3-lake provincial protection area, Songrong provincial natural protection area, Riguang Woodland Garden and Mijiang River salmon state level aquatic germ plasm protection area and in combination with the pit location arrangement at the feasibility stage, it was found 20 of 78 pits in the feasibility design were located in the above-mentioned ecologically sensitive areas by investigation(see table 5-5-2 for detail). Of which, 1 pit (Longtan Mt. Tunnel Opening Earthwork Borrow Pit) was in Longtan Mt. city cultural relic protection area, 9 in Songhuajiang 3-lake provincial protection area and 10 in Songrong provincial natural protection area.

The pit in Longtan Mt. City cultural relic protection area was located near the Longtan tunnel exit. It was actually the temporary slag dumping storage yard for Longtan tunnel. According to the allocation of earthwork and rockwork, the tunnel slag was all used for the subgrade filling of the section from the start to DK3; it was based in the Longtan Mt. cultural relic protection area construction controlled zone, 1.2km away from the construction controlled zone boundary. The assessment suggested to enhance the construction organization and design to reduce the temporary tunnel slag piling in the first place; then, to ban the arrangement of temporary slag store yard within the cultural relic area.

3 sections of the project passed through the Songhuajiang 3-Lake natural protection area 3 times at chainage DK24+800～DK48+120, DK59+640～DK69+000, DK73+000～DK81+800 respectively, with the bridges and tunnels of 69% . 9 borrow and dumping pits were available in this protection region, all dumping pits. In accordance with the Document "JFP[2010]368 'Jilin Provincial Forest Department, on the Approval of Jilin-huichun Express Railway Passenger Transportation Line through Songhuajing 3-Lake Provincial Protection Area'" of Jilin Provincial Forest Department, this project was required to to have no construction of borrow and dumping pit within the protection area, the above-mentioned pits were located against the Approval, so it was suggested to make an adjustment.

The project passed through the Songrong provincial natural protection zone at chainage DK200+000～DK241+300. There were 13 bridges of 6100m and 17.5 tunnels of 2287m within the protection zone, with percentage of 68.8%, and 1 station, Autu Western Station(（DK215+925.00）, having subgrade of 11,363m long(27.5% of the total length). 10 borrow and dumping pits were available in this protection region, of which, 7 dumping pits and 3 borrow pits which were used to the tunnel slag dumping yards. 10 borrow and dumping pits were distributed within the section from DK215 to DK230, not close to the protection area boundry. In accordance with the Document "JFP[2010]367 'Jilin Provincial Woodland Department, On the Approval of Jilin-huichun Express Railway Passenger Transportation Line through Antumingyue Songrong Protection Area'" of Jilin Provincial Forest Department, this project was required to have no construction of borrow and dumping pit within the protection area, the above-mentioned pits were located against the Approval, so it was suggested to make an adjustment.

(2) Adjustment of Borrow and Dumping Pits

In view of the above analysis, the relative borrow and dumping pits were suggested to adjust out of the Songhuajing 3-Lake Provincial Protection Area and Antumingyue Songrong Protection Area. After a timely communication between the assessment unit and the design unit, the design unit made an adjustment to the borrow and dumping pits based on the allocation of earthwork and rockwork.

The rationality analysis of borrow and dumping pits was as shown in the table 5-5-2（1）. Adjusted borrow and dumping pits was shown in Table 5-5-2(2)

Table 5-5-2（1） Rationality Analysis & Summary of Borrow & Dumping Pits

No.	Pit Names	Chainage	Total Quantiry(10km3)	Status	Landform	Borrow & Dumping Depth（m）	Rationality Analysis
1	Longtan Mt. Tunnel Opening borrow pit(a)	DK000+000～DK001+280	10	Tunnel openning slag		7	Suggested to move out of protective area
2	Tiantai village dumping pit	DK007+000～DK009+000	18	woodland	hill gulch	7	rational
3	Gaojiawazi village dumping pit	DK009+500～DK011+600	9	wasteland	hill gulch	7	rational
4	Zhongsha village team 4 dumping pit	DK017+500～DK018+000	9.5	dry land	hill gulch	7	rational
5	Zhongsha village team 5 dumping pit	DK018+000～DK018+500	8.5	dry land	hill gulch	7	rational
6	Zhongsha village team 5 west dumping pit	DK019+400～DK021+400	4.8	Farmland	hill gulch	7	rational
7	Caomugou dumping pit	DK022+180～DK022+500	9.7	dry land	hill gulch	7	rational
8	South Shahezi villagedumping pit(b)	DK025+900～DK026+400	5.5	dry land	hill gulch	7	suggested to move out of protection area
9	Lianjiang village dumping pit(b)	DK026+600～DK028+000	4.8	Farmland	hill gulch	7	suggested to move out of protection area
10	Xiaohupenggoug southeast borrow pit(b)	DK031+000～DK031+600	7.5	wasteland	gentle hill	7	suggested to move out of protection area
11	Xiaohupenggoug northeast dumping pit(b)	DK046+000～DK046+250	3.8	dry land	hill gulch	7	suggested to move out of protection area
12	Tunnel opening borrow pit	DK032+560～DK036+150	2.6	Tunnel opening slag		7	Suggested to cancel
13	Bi-temple village dumping pit(b)	DK049+460～DK050+900	7.8	dry land	hill gulch	7	suggested to move out of protection

No.	Pit Names	Chainage	Total Quantiry(10km3)	Status	Landform	Borrow & Dumping Depth（m）	Rationality Analysis
							area
14	Dongnancha village dumping pit	DK053+100～DK053+800	2.7	dry land mainly	hill gulch	7	rational
15	Red Flag village northwestdumping pit(b)	DK061+300～DK064+200	49	dry land	hill gulch	7	suggested to move out of protection area
16	North valley village dumping pit(b)	DK069+380～DK079+200	63.5	dry land	hill gulch	7	suggested to move out of protection area
17	Nanda village borrow pit(b)	DK069+000～DK079+900	89	dry land	gentle hill	7	suggested to move out of protection area
18	Fuqiang village dumping pit	DK081+400～DK082+700	2.5	dry land	hill gulch	7	rational
19	Cundi village borrow pit	DK082+700～DK088+000	7	dry land	gentle hill	7	rational
20	Ailinxia village borrow pit	DK088+000～DK093+000	9.7	dry land	Waste quarry	7	rational
21	Laoyuegou No.1 tunnel exit borrow pit	DK099+050.00～DK099+600.0	0.04	tunnel opening slag		10	rational
22	Huweiling tunnel exit borrow pit	DK114+280.00～DK117+000.00	12.1	tunnel opening slag		10	rational
23	Hamatang village west borrow pit	DK117+000.00～DK120+100.00	12.5	dry land	flat	2～4	basically rational
24	Xinming village dumping pit	DK114+280.00～DK120+000.00	5		hill gulch	6	rational
25	Sandaoquan dumping pit	DK122+700.00～DK124+700.00	1.2		hill gulch	6	rational
26	Mingchuan village tunnel exit borrow pit	DK134+519.00～DK139+000.00	7.4	tunnel opening slag		10	rational
27	High pine tree tunnel entrance borrow pit	DK139+000.00～DK143+149	11.73	tunnel opening slag		10	rational
28	Liushugou borrow pit	DK149+900.00～DK150+700.00	12.61		flat	2～4	basically rational
29	Funeral home borrow pit	DK160+000.00～DK161+600.00	79		flat	2～4	basically rational
30	Tunnel entrance borrow pit	DK161+600.00～DK164+000.00		tunnel opening slag		10	rational

No.	Pit Names	Chainage	Total Quantiry(10km3)	Status	Landform	Borrow & Dumping Depth（m）	Rationality Analysis
31	West Mt. village tunnel entrance borrow pit	DK164+000.00 DK169+212.00		tunnel opening slag		10	rational
32	West Mt. village tunnel exit borrow pit	DK169+212.00～DK170+696.00		tunnel opening slag		10	rational
33	Dashitou town north borrow pit	DK170+696.00～DK174+100.00			flat	2～4	basically rational
34	Friendship village quarry borrow pit	DK174+100.00～DK180+600.00			flat	2～4	basically rational
35	Zhengyi 1 tunnel entrance borrow pit	DK180+000.00～DK185+774.00	6.1	tunnel opening slag		10	rational
36	Zhengyi 2 tunnel exit borrow pit	DK188+019.00～DK191+100.00	3.1	tunnel opening slag		10	rational
37	Ha'erbaling resevoir dumping pit(c)	DK214+800.00～DK217+300.00	0.8		hill gulch	6	suggested to move out of protection area
38	Dragon Mt. village dumping pit(c)	DK214+700.00～DK215+000.00	0.6		hill gulch	6	suggested to move out of protection area
39	Antu town river side dumping pit(c)	DK215+500.00～DK217+300.00	80	wasteland	hill gulch	6	suggested to move out of protection area
40	9-dragon village dumping pit(c)	DK215+500.00～DK217+300.00	30		hill gulch	6	suggested to move out of protection area
41	9-dragon tunnel exit borrow pit(c)	DK221+200.00～DK223+000.00	4	tunnel opening slag		10	suggested to move out of protection area
42	9-rock village dumping pit(c)	DK223+000.00 DK226+000.00	3.9		hill gulch	6	suggested to move out of protection area
43	Jingcheng villagedumping pit(c)	DK226+000.00～DK228+000.00	2.5		hill gulch	6	suggested to move out of protection area
44	Dacheng tunnel entrance borrow	DK228+400.00～	1	tunnel opening		10	suggested to move

No.	Pit Names	Chainage	Total Quantiry(10km3)	Status	Landform	Borrow & Dumping Depth（m）	Rationality Analysis
	pit(c)	DK229+400.00		slag			out of protection area
45	Dacheng tunnel exit borrow pit(c)	DK230+200.00～DK232+400.00	2.2	tunnel opening slag		10	suggested to move out of protection area
46	Dragon city 5-family village dumping pit(c)	DK228+400.00～DK229+400.00	1.2		hill gulch	6	suggested to move out of protection area
47	Jiaonan village borrow pit	DK244+800～DK245+500	0.8		gentle hill	7	rational
48	Wangjiayao borrow pit	DK245+500～DK245+900	9		gentle hill	7	rational
49	Guandaotun borrow pit	DK246+000～DK246+800	2		gentle hill	7	rational
50	Dacheng tunnel borrow pit	DK245+100～DK246+500	18		gentle hill	7	rational
51	Longduntong borrow pit	DK244+800～DK245+500	4		gentle hill	7	rational
52	Hecheng village borrow pit	DK251+275～DK256+00	45		gentle hill	7	rational
53	Hecheng group 5 borrow pit	DK256+00～DK266+500	1		gentle hill	7	rational
54	Yanhe village borrow pit	DK266+500～DK268+000	55		gentle hill	7	rational
55	Liming village borrow pit	DK268+200～DK276+200	33		gentle hill	7	rational
56	Water south village borrow pit	DK279+450～DK288+300	196		gentle hill	7	rational
57	Bi-river village borrow pit	DK286+400～DK287+150	265		gentle hill	7	rational
58	Xinglong village borrow pit	DK287+500～DK288+300	78		gentle hill	7	rational
59	Shangsuo village borrow pit	DK288+300～	70		gentle hill	7	rational
60	Lixing village borrow pit	DK290+000～DK302+890	98		gentle hill	7	rational
61	Xiaobeigou borrow pit		97		gentle hill	7	rational
62	Guanmen village borrow pit	DK328+350～DK330+500	296		gentle hill	7	rational
63	Funing village borrow pit	～DK355+700	145		gentle hill	7	rational
64	Jingbian village borrow pit	DK355+700～DK362+200	26		gentle hill	7	rational

No.	Pit Names	Chainage	Total Quantiry(10km3)	Status	Landform	Borrow & Dumping Depth（m）	Rationality Analysis
65	Gold buda temple dumping pit	DK244+800～DK248+100	17.5	woodland	valley	7	rational
66	Longduntun dumping pit	DK248+100～DK253+500	9.5	vale	valley	7	rational
67	fumingdong dumping pit	DK253+500～DK278+900	14	dry land	valley	7	rational
68	Xiaobeigou dumping pit		28	dry land	valley	7	rational
69	Dongjing village dumping pit	DK278+900～DK292+925	47	woodland	valley	7	rational
70	Xiangshang street dumping pit		46	woodland	valley	7	rational
71	Xiaobeigou south dumping pit		48	woodland	valley	7	rational
72	Nanda village dumping pit	DK312+925～DK338+325	27	Farmland	valley	7	rational
73	Fuxing village dumping pit	DK338+325～DK357+200	65.5	woodland	valley	7	rational
74	Jingbian village dumping pit	DK357+200～DK362+200	22.5	woodland	valley	7	rational

Note: (a) Longtan Mt. and Mao'er Mt. cultural relic area; (b)3 lakes of Songhuajiang river, provincial protection areas;(c)Jilin Minmusongrong protection area;(d)Riguang Mt. provincial forest garden

Table 5-5-2（2） Adjustment Summary of Earth Borrow & Dumping Pits

No.	Names	Chainage	Total quantiry (10k m^3)	Adjustment Condition	Environment Assessment Comments
1	Nanshahezi village dumping pit(b)	DK025+900～DK026+400	5.5	3.8km left to DK33+700(1km away from the protective area) and 600m east to Pingtun village, used mostly woodland, 20km transporting distance increased	Suggested to enhance earth and rock works allocation, used for subgrade fill within the service range of left to DK32+300 and southwest slope borrow pit of Pingtun
2	Lianjiang village ing pit(b)	DK026+600～DK028+000	4.8	3.8km left to DK33+700(1km away from the protective area) and 600m east to Pingtun village, used mostly woodland, 20km transporting distance increased	Suggested to enhance earth and rock works allocation, used for subgrade fill within the service range of left to DK32+300 and southwest slope borrow pit of Pingtun
3	Xiaohuopenggou southeast borrow pit(b)	DK031+000～DK031+600	7.5	3.3km left to DK32+300(1km away from the protective area) and southwest side slope to	Suggested to remove this borrow pit and use the nearby subgrade

No.	Names	Chainage	Total quantiry (10k m^3)	Adjustment Condition	Environment Assessment Comments
				Pingtun village, used mostly woodland, 16km transporting distance	waste for earthworks
4	Xiaohuopenggou northeast dumping pit(b)	DK046+000～DK046+250	3.8	3.8km left to DK33+700(1km away from the protective area) and 600m east to Pingtun village, used mostly woodland, 20km transporting distance	
13	Bi-temple village dumping pit(b)	DK049+460～DK050+900	7.8	3.8km left to DK33+700(1km away from the protective area) and 600m east to Pingtun village, used mostly woodland, 20km transporting distance	
5	Red flag village northwest dumping pit(b)	DK061+300～DK064+200	49	South of Zhaojiagou village right, 3.8km left to DK90, used mostly dryland, 28km transporting distance	Suggested to enhance earth and rock works allocation, waste being used for subgrade fill within the service range of Fanjiagou village at DK32+300 to reduce discarded works quantity
6	Beigou village dumping pit(b)	DK069+380～DK079+200	63.5	South of Zhaojiagou village right of 3.8km left to DK90, used mostly dryland, 28km transporting distance	Suggested to enhance earth and rock works allocation, discarded works being used for subgrade fill within the service range of Fanjiagou village at DK88+150 to reduce discarded works quantity
7	Nanda village borrow pit(b)	DK069+000～DK079+900	89	Northeast of Hanjiagou village, 500m left to DK90, used mostly dryland, 28km transporting distance	Suggested to remove this borrow pit and use the nearby subgrade waste for earthworks and rockworks
8	Ha'erbaling resevoir dumping pit(c)	DK214+800.00～DK217+300.00	0.8	4km left to DK196+880 (4km away from the protective area) and 4.5km northeast to Nangou, used mostly woodland, 25km transporting distance	
9	Dragon Mt. dumping pit(c)	DK214+700.00～DK215+000.00	0.6	4km left to DK196+880 (4km away from the protective	

No.	Names	Chainage	Total quantiry (10k m^3)	Adjustment Condition	Environment Assessment Comments
				area) and 4.5km northeast to Nangou, used mostly woodland, 25km transporting distance	
10	Antu town river sidedumping pit(c)	DK215+500.00～DK217+300.00	80	4km left to DK196+880 (4km away from the protective area) and 4.5km northeast to Nangou, used mostly woodland, 25km transporting distance	
11	9-dragon villagedumping pit(c)	DK215+500.00～DK217+300.00	30	4km left to DK196+880 (4km away from the protective area) and 4.5km northeast to Nangou, used mostly woodland, 25km transporting distance	
12	9-dragon village tunnel exit borrow pit(c)	DK221+200.00～DK223+000.00	4	1.5km right to DK241+200 (1km away from the protective area) and northwest slope of Baoxing village, used mostly woodland, 25km transporting distance	Suggested to remove this borrow pit and use the nearby subgrade waste for earthworks and rockworks
13	9-rock villagedumping pit(c)	DK223+000.00 DK226+000.00	3.9	550m right to DK242+750 (1km away from the protective area) and 1km northwest to Baoxing village, used mostly woodland, 25km transporting distance	
14	Jingcheng villagedumping pit(c)	DK226+000.00～DK228+000.00	2.5	550m right to DK242+750 (1km away from the protective area) and 1km northwest to Baoxing village, used mostly woodland, 25km transporting distance	
15	Dacheng tunnel entrance borrow pit(c)	DK228+400.00～DK229+400.00	1	1.5km right to DK241+200 (1km away from the protective area) and northwest slope of Baoxing village, used mostly woodland, 25km transporting distance	Suggested to remove this borrow pit and use the nearby subgrade waste for earthworks and rockworks
16	Dacheng tunnel exit borrow pit(c)	DK230+200.00～DK232+400.00	2.2	1.5km right to DK241+200 (1km away from the protective area) and northwest slope of Baoxing village, used mostly woodland, 25km transporting distance	Suggested to remove this borrow pit and use the nearby subgrade waste for earthworks and rockworks

No.	Names	Chainage	Total quantiry (10k m^3)	Adjustment Condition	Environment Assessment Comments
17	Dragon city 5-family villagedumping pit(c)	DK228+400.00～DK229+400.00	1.2	550m right to DK242+750 (1km away from the protective area) and 1km northwest to Baoxing village, used mostly woodland, 25km transporting distance	

109 slag dumping yards along the project were arranged and distributed on the slope, gentle slope and hillock valley bottom on the both sides of the alignment, taking mostly the woodland and farmland in an area of 324.21hm^2. The total earthwork dump amount was 2518.40×10^4m^3. This assessment made a rationality analysis on the location relationship between earthwork pits and the sensitive areas and optimized the pit location by means of the principle of relatively concentrated earthwork borrow and dumping to minimize the farmland occupation quantity.

（1）1# Longtan Mt. Tunnel slag yard was located in the Longtan Mt. city and Mao’er graveyard cultural relic protection construction controlled zone, suggested to cancal and choose a new location, move out of the cultural relic protection range.

（2）3#～11#、17#～20# slag yards were located in the Songhuajiang 3-Lake provincial natural protection area. In accordance with the Document “JFP[2010]368 ‘Jilin Provincial Forest Department, On the Approval of Jilin-huichun Express Railway Passenger Transportation Line through Songhuajing 3-Lake Provincial Protection Area’” of Jilin Provincial Forest Department, it was required to to have no construction of borrow and dumping pits within the protection area was suggested to make an adjustment on the above-mentioned slag pits location and move them out of the region.

（3）7#～70# slag yards were located in the Jilin Mingmusongrong provincial natural protection area. In accordance with the Document “JFP[2010]367 ‘Jilin Provincial Woodland Department, On the Approval of Jilin-huichun Express Railway Passenger Transportation Line through Antumingyue Songrong Protection Area’” of Jilin Provincial Forest Department, it was required to to have no construction of borrow and dumping pits within the protection area was suggested to make an adjustment on the above-mentioned slag pits location and move them out of the region.

In view of the above analysis, the relative borrow and dumping pits were suggested to adjust out of the Songhuajing 3-Lake Provincial Protection Area and Antumingyue Songrong Protection Area. After a timely communication between the assessment unit and the design unit, the design unit made an adjustment to the borrow and dumping pits based on the allocation of earthwork and rockwork. Adjusted spoil disposal sites is shown in Table 5-5-3(2)

Table 5-5-3（1） Main Project Slag Dumping Pit Distribution and Rationality Analysis

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
1	Longtan Distric	Longtan Mt. tunnel		CK5+100 right	farmland	20.6	1.37	15.00	Used farmland, landform of valley, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located at the construction control zone of Longtan Mt. city and Mao'er Mt. and cemetery cultural relic, suggested to move out of the cultural relic protection range to reduce the impact.	Suggested to choose a ne place
2		Caomugou tunnel	entrance	CK22+300 right	farmland, woodland	28.2	3.55	7.94	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of mainly rockworks, resuming vegetation by greening afte levelling and refarming.
3	Jiaohe River District		exit	CK27+800 right	farmland, woodland	28.2	4.99	7.94	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range
4		Beicigou tunnel	entrance	CK27+800 right	farmland, woodland	11.4				
5		Lanjialing tunnel	entrance	CK29+600 right	woodland	4.2	0.53	7.88	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to cancel and u nearly 10# borrow pit
6		Huopenggou tunnel	exit	CK32+200 left	farmland, woodland	9.7	1.23	7.91	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range
7		Qingling tunnel	entrance	CK34+000 left	farmland, woodland	13.2	1.66	7.95	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
8		Fala Mt. tunnel	entrance	CK38+200 right	farmland, woodland	21.7	2.70	8.04	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range
9			inclined well	CK39+000 right	farmland, woodland	153.7	19.21	8.00	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range
10			exit	CK47+000 right	farmland, woodland	16.7	5.57	7.99	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Suggested to choose a ne place, moved out of protecti range
11		Shangmiaozi tunnel	entrance	CK47+000 right	farmland, woodland	27.8				
12			exit	CK50+600 left	farmland, woodland	27.8	3.48	7.99	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	Tunnel slag of mainly rockworks, resuming vegetation by greening afte levelling and refarming.
13		Donglinzi tunnel	exit	CK53+000 right	farmland, woodland	14.7	2.05	7.16	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River.	enhancing protection
14		Dongnancha tunnel	exit	CK54+100 right	farmland, woodland	16.4	2.05	7.99	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the semiprotection range of Jiaohe city drinking water.	enhancing protection
15		Perfume tunnel	entrance	CK55+800 right	farmland, woodland	21.2	2.63	8.07	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the semiprotection range of Jiaohe city drinking water.	enhancing protection

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
16			inclined well	CK57+200 right	farmland, woodland	35.1	4.39	7.99	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the semiprotection range of Jiaohe city drinking water.	Tunnel slag of mainly rockworks, resuming vegetation by greening afte levelling and refarming.
17			exit	CK60+000 left	farmland, woodland	21	2.66	7.89	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River, suggested to find a new place.	Tunnel slag of mainly rockworks, resuming vegetation by greening afte levelling and refarming.
18		Taiping tunnel	exit	CK60+800 right	farmland, woodland	10.2	1.28	7.97	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River	Suggested to remove, usir the nearby borrow pit 15#
19		Jiaoxi tunnel	exit	CK65+500 left	farmland, woodland	8.2	1.03	7.94	Landform of gentle land, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River	Suggested to remove, usir the nearby borrow pit 17
20		Fuqiang tunnel	entranc e	CK80+500 right	farmland, woodland	18.6	2.33	7.97	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River	Suggested to remove, usir the nearby borrow pit 18# and19#
21	Jiaohe city	Fuqiang tunnel	exit	CK82+500 左侧	farmland, woodland	18.6	2.33	7.97	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, located within the protection range of 3 lakes provincial protection zone of Songhua River	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
22		Tangjiagangz i tunnel	exit	CK84+650 left	farmland，woodland	15.2	1.03	14.71	Landform of valley, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
23		Chaoyanggou tunnel	entrance	CK85+300 left	farmland，woodland	9.7	1.22	7.95	Landform of gentle land, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
24			exit	CK86+000 left	farmland，woodland	9.7	1.22	7.95	Landform of gentle land, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
25		Houtaipinglin g tunnel	exit	CK87+100 left	farmland，woodland	3.7	0.47	7.93	Gultch, close to 005 village road, nearby Houtaipingling village. used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall	Suggested to upgrade protection standard to av the bad impact on the villa outgoing.
26		Ailin tunnel	entrance	CK90+300 right	farmland，woodland	12.5	1.57	7.98	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling
27			exit	CK92+800 right	farmland，woodland	12.5	1.57	7.98	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall. Suggested to upgrade the protection standards.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
28		Stone Gate tunnel	entrance	CK91+283 700m right	woodland	35	4.33	8.08	Gultch, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
29			inclined well	CK91+283 2400 m left	woodland	54	6.73	8.02	Gultch, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
30			exit	CK97+432 200 m left	woodland	23.6	5.73	4.12	Gultch, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
		Qian pear tree tunnel 1	entrance							

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
31			exit	CK99+030 200m right	woodland	8.6	1.27	6.79	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
32		Qian pear tree tunnel 2	entrance	CK99+597 400 m right	woodland	6	0.73	8.18	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
33		Qian pear tree tunnel 3	exit	CK100+542 700 m right	woodland	7	0.87	8.08	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
34		Sandaokou tunnel	exit	CK109+540 600 m left	woodland	40	5.93	6.74	Landform of vale, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
		Weihuling tunnel	entrance							
35	Dunhua City		exit	CK114+079 1000 m left	woodland	30	3.73	8.04	Landform of gentle slope, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
36		Dachuan tunnel	entrance	CK125+384 1300 m left	woodland	15	1.93	7.76	Landform of gentle slope, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
37		Sandaoquan tunnel 1	entrance	CK126+496 1700 m left	woodland	29	4.33	6.69	Landform of gentle slope, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
		Sandaoquan tunnel 2	entrance							
38			exit	CK130+138 300 m right	woodland	25	3.07	8.15	Landform of gentle slope, used farmland and woodland, better vegetation, no mudstone or slide found at pits. No sensitive points as villages, schools under the rataining wall, close to the river	Suggested to choose a n location
39		Shuangshan gquan tunnel 1	exit	300 m right	woodland	16	2.67	7.88	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits. Closer to the river and road	Suggested to choose a n location

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
		Shuangshangquan tunnel 2	entrance			5				
40		Mingchuan tunnel	entrance	CK133+112 600 m left	woodland	12	1.60	7.50	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
41			exit	CK134+519 500 m left	woodland	12	1.60	7.50	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
42		High Pine Tree tunnel	entrance	CK143+149 1000 m left	woodland	14	1.60	8.75	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
43			exit	CK144+795 400 m left	woodland	14	1.93	7.24	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
44	Dunhua City	Beiguan tunnel	exit	CK146+063 200 m left	woodland	10	1.20	8.33	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
45		Tiebei tunnel		CK150+300 300 m right	woodland	6	1.20	5.00	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	enhancing protection
46		West Mt. tunnel	entrance	CK170+644 600	耕地	12	1.93	6.21	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
47			exit	CK172+104 300 m right	woodland	13	1.93	6.72	Landform of hillock valley, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
48		Zhengyi tunnel 1	entrance	CK185+615 1900 m right	farmland	12	1.93	6.21	Landform of gentle slope, used farmland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
49			exit	CK187+103 2000 m right	woodland	13	1.93	6.72	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Suggested to upgrade protecton standards
50		Zhengyi tunnel 2	entrance	CK187+530 2000 m right	woodland	8.3	1.07	7.78	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
51		Haj'erbaling tunnel 1	exit	CK189+000 1300 m left	woodland	11.8	1.53	7.70	Landform of hilly valley, used woodland, better vegetation, no mudstone or slide found at pits, having villages and roads by the rataining wall, suggested to find a new place.	Suggested to choose a n location
52		Haj'erbaling tunnel 2	entrance	CK191+128 1400 m left	woodland	21	2.73	7.68	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
53	Antu county		exit	CK193+585 1200 m left	woodland	21	2.73	7.68	Landform of slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
54		Nangou tunnel 1	exit	CK195+320 600 m left	woodland	14	1.73	8.08	Landform of slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
55		Nangou tunnel 2	exit	CK196+783 700 m right	woodland	32	4.13	7.74	Landform of slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
		Beitun tunnel 1	entrance							

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
56			exit	CK198+822 1700 m left	woodland	16	2.00	8.00	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
57		Beitun tunnel 2	exit	CK200+081 1200 m left	woodland	32	4.33	7.38	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Beitun tunnel 3	entrance							
58			exit	CK202+192 1300 m left	woodland	21	2.93	7.16	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Liangbing tunnel 1								
59		Liangbing tunnel 2	entrance	CK204+002 1600 m left	woodland	14.8	1.93	7.66	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
60		Liangbing tunnel 3	exit	CK204+495 100 m left	woodland	5.4	0.67	8.10	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
61		Fengxi tunnel 1		CK206+610 600 m left	woodland	40.2	5.20	7.73	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Fengxi tunnel 2								
		Fengxi tunnel 3	exit							
62		Puguang tunnel	exit	CK208+330 700 m left	woodland	19.3	2.87	6.73	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Gaotai tunnel	entrance							
63			inclined well	CK210+400 3000 m right	woodland	27	4.00	6.75	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
64			exit	CK212+251	woodland	18.4	2.53	7.26	Old discarded quarry, used woodland, no mudstone or	Suggested to remove, us

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
		Dragon Mt. tunnel		600 m right					slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	the nearby borrow pit 40#
65		9-dragon tunnel	exit	CK221+203 1000 m right	woodland	54	7.07	7.64	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.。	Suggested to choose a n place, moved out of protect range
66	Antu county	Jingcheng tunnel	exit	CK228+345 300 m right	woodland	20.2	2.60	7.77	Landform of slope, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Dacheng tunnel	entrance							
67		5-family village tunnel	entrance	CK232+403 100 m right	耕地	16.4	2.13	7.69	Landform of slope, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.。	Suggested to choose a n place, moved out of protect range
68		5-peak Mt. tunnel	entrance	CK233+775 700 m left	woodland	16	2.33	6.86	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, but close to Bu'erhatong river and located within the natural protection zone of Mingmusongrong of Antu county, suggested to find a new location.	Suggested to choose a n place, moved out of protect range
69			inclined well	CK237+451 700 m left	woodland	64	8.87	7.22	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, but close to Yushuchuan and located within the natural protection zone of Mingmusongrong of Antu county, suggested to find a new location.	Suggested to choose a n place, moved out of protect range
			exit							
		Yushuchuan tunnel	entrance							
70			exit	CK239+976 900 m left	woodland	43	6.33	6.79	Landform of vale, used woodland, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, located within the natural protection zone of Mingmusongrong of Antu county.	Suggested to choose a n place, moved out of protect range
		Cock Crown Mt. tunnel	entrance							
71	Longjing city		inclined well	CK243+300 900 m right	woodland	32	5.07	6.32	Landform of gentle slope, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
72			exit	CK244+646 500 m right	woodland	23	3.07	7.50	Landform of hillock vally, used woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling.
73		Jiaohe tunnel		CK244+900 400 m right	farmland，woodland，wasteland，	9.7	1.21	8.04	Landform of hillock vally, used farmland and woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
74		Gold Buda tunnel		CK248+800 350 m right	farmland，woodland，wasteland，	6.1	0.73	8.32	Landform of slope, used woodland, close to Wangjiayao, suggested to find a new location.	Suggested to choose a n location
75		Yongchang tunnel	entrance	CK250+300 1100 m left	farmland，woodland，wasteland，	17	2.13	7.97	Landform of hillock vally, used farmland and woodland, better vegetation, no mudstone or slide found at pits, No sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
76			exit	CK255+800 200 m right	farmland，woodland，wasteland，	16	2.00	8.00	Landform of gentle slope, used farmland and woodland, close to Fumingdong village, suggested to find a new location.	Suggested to choose a n location
77		Fuming tunnel 1		CK257+700 800 m left	farmland，woodland，wasteland，	18.8	2.33	8.06	Landform of hillock valley, used farmland and woodland, close to Dongcheng team 10, suggested to find a new location.	Suggested to choose a n location
		Fuming tunnel 2	entrance							
78	Yanji city		exit	CK259+000 600 m left	farmland，woodland，wasteland，	12	1.47	8.18	Landform of gentle slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
79		Mingxing tunnel		CK271+700 200 m left	farmland，woodland，wasteland，	17	2.13	7.97	Landform of gentle slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
		Development tunnel								
80		Dongxing tunnel		CK278+600 450 m left	farmland，woodland，wasteland，	13	1.60	8.13	Landform of slope, used farmland and woodland, close to Guangji village, suggested to find a new location.	Suggested to choose a n location
81	Tumen	Fuxing tunnel		CK281+400	farmland，	21.4	2.67	8.00	Landform of slope, used farmland and woodland, close to	Suggested to choose a n

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
	city	Guangxing tunnel		400 m left	woodland，wasteland，				river and village, suggested to find a new location, suggested to choose a new location.	location
82		Shuinan tunnel	entrance	CK288+400 1300 m right	farmland，woodland，wasteland，	28	3.47	8.08	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
83			inclined well1	CK289+700 2700 m right	farmland，woodland，wasteland，	25	3.13	7.98	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
84			inclined well2	CK289+750 2700 m right	farmland，woodland，wasteland，	15	1.87	8.04	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
85			exit	CK291+900 1900 m right	farmland，woodland，wasteland，	56	6.93	8.08	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
		Shangdongjing tunnel	entrance							
86			inclined well	CK295+100 400 m right	farmland，woodland，wasteland，	34	4.27	7.97	Landform of vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
87			exit	CK296+000 900 m left	farmland，woodland，wasteland，	24	8.32	8.09	Landform of vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
88		Lifeng Mt. tunnel			farmland，woodland，wasteland，	15.3				
89	Tumen city	Riguang Mt. tunnel	entrance	CK296+000 900 m left	farmland，woodland，wasteland，	28	3.47	4.41	Landform of vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
90			inclined well	CK304+400 2100 m left	farmland，	58	7.20	8.06	Landform of vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as	Tunnel slag of ma rockworks, resum

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
			exit		woodland，wasteland，				villages, schools under the rataining wall, rational location.	vegetation by greening a levelling and refarming.
91		Hou'an Mt. tunnel	entrance	CK310+400 1500 m left	farmland，woodland，wasteland，	28	3.47	8.08	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
92			inclined well1	CK313+500 4300 m left	farmland，woodland，wasteland，	31	3.87	8.02	Landform of vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
93			inclined well2 exit	CK318+100 2500 m left	farmland，woodland，wasteland，	60	7.47	8.04	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
94		Qingrong tunnel Funing tunnel		CK324+000 400 m left	farmland，woodland，wasteland，	41	5.13	7.99	Landform of hillock gentle slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
95		Xixiakan tunnel	entrance inclined well1	CK328+700 1400 m left	farmland，woodland，wasteland，	52.6	6.60	7.97	Landform of hilly vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
96	Huichun city		inclined well2	CK332+000 1300 m right	farmland，woodland，wasteland，	38	4.73	8.03	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
97			exit	CK332+700 1000 m left	farmland，woodland，wasteland，	28	5.20	8.08	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
98		Mijiangxiang tunnel 1	entrance			14				
99			exit	CK334+500 800 m left	farmland，woodland，wasteland，	12.6	1.56	8.08	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, close to the salmon migration branck of Tumen river, suggested to find a new	Suggested to choose a n location。

No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
100		Mijiangxiang tunnel 2			farmland，woodland，wasteland，	26.4	3.31	7.98	location.	
101		Mijiangxiang tunnel 3		CK339+300 2400 m left	farmland，woodland，wasteland，	10	1.27	7.89	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, close to the salmon migration branck of Tumen river, suggested to find a new location.	Suggested to choose a n location。
102		Xiaopanling tunnel 1	entrance	CK340+500 300 m right	farmland，woodland，wasteland，	28	3.47	8.08	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
103			inclined well	CK343+200 350 m right	farmland，woodland，wasteland，	32	4.00	8.00	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
104			exit	CK346+000 左 1000 m left	farmland，woodland，wasteland，	27.8	3.48	11.78	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
105		Xiaopanling tunnel 2	entrance	CK346+000 1000 m left	farmland，woodland，wasteland，	13.2				
106			exit	CK347+900 300m left	farmland，woodland，wasteland，	13.2	7.27	7.98	Landform of hillock vale, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
107		Xiaopanling tunnel 3	entrance	CK347+900 300m left	farmland，woodland，wasteland，	44.8				
108			inclined well							
			exit	CK348+800 2200m lef	farmland，woodland，wasteland，	20	2.47	8.11	Landform of slope, used farmland and woodland, no mudstone or slide found at pits, no sensitive points as villages, schools under the rataining wall, rational location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.

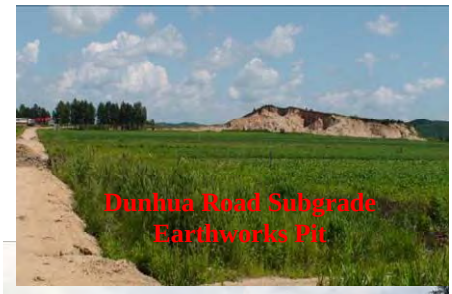
No.	Adminis-trative Division	Pit Name		Pit Location	Land Type	Dumping amount（10km3)	Land area（hm2）	height（m）	Pit Rationality Analysis	Suggestion
109		Sandaoling tunnel		CK357+900 350m left	farmland，woodland，wasteland，	10	1.27	7.89	Landform of hillock vale, used farmland and woodland, having Jingbian village under the retaining wall, suggested to find a new location.	Tunnel slag of ma rockworks, resum vegetation by greening a levelling and refarming.
Total						2518.4	324.21			

Table 5-5-3（2）Adjustment Summary of Borrow& Dumping Pits

No.	Divicion	Pit Name		Pit Location	Amount （10k m3)	Land Area（hm2）	Adjustment Conditions
1	Jiaohe city	Caomugou tunnel	exit	CK27+800 right	28.2	4.99	3.4km left to DK31, 1.1km away from protection zone and 1.35 west to Pingxitun, mainly woodland, 18km transporting distrance increased
2		Beicigou tunnel	entrance	CK27+800 right	11.4		
3		Lanjialing tunnel	entrance	CK29+600 right	4.2	0.53	
4		Huopenggou tunnel	exit	CK32+200 left	9.7	1.23	
5		Qingling tunnel	entrance	CK34+000 left	13.2	1.66	
6		Fala Mt. tunnel	entrance	CK38+200 right	21.7	2.70	
7			inclined well	CK39+000 right	153.7	19.21	1.2km left to DK52, west to Xinli village, mainly woodland, 8km transporting distrance increased
8			exit	CK47+000 right	16.7	5.57	4.5km left to DK54, northeast to Haiqing villag mainly woodland, 10km transporting distrance increased
9		Shangmiaozi tunnel	entrance	CK47+000 right	27.8		
10		Taiping tunnel	exit	CK60+800 right	10.2	1.28	Discarded to Perfume tunnel exit waste pit, 10km transporting distrance increased
d11		Jiaoxi tunnel	exit	CK65+500 left	8.2	1.03	500m right to DK71+600, east to south small Jiao River, mainly woodland, 15km transporting distrance increased
12		Fuqiang tunnel	entrance	CK80+500 right	18.6	2.33	

No.	Divicion	Pit Name		Pit Location	Amount （10k m3)	Land Area（hm2）	Adjustment Conditions
13		Beitun tunnel 2	exit	CK200+081 1200 to left	32	4.33	2.5km left to DK198, 1km away from protection zone and 2.4km northeast to Hebeitun, mainly woodland, 11km transporting distrance increased
		Beitun tunnel 3	entrance				
14			exit	CK202+192 1300 to left	21	2.93	2km left to DK97+140, 2.7km away from protection zone and 3km north to Beitun, mainly woodland, 13km transporting distrance increased
		Liangbing tunnel 1					
15		Liangbing tunnel 2	entrance	CK204+002 1600 to left	14.8	1.93	
16		Liangbing tunnel 3	exit	CK204+495 100 to left	5.4	0.67	
17		Fengxi tunnel 1		CK206+610 600 to left	40.2	5.20	2km left to DK195+600, 2.7km away from protection zone and 2.4km northeast to Nangou, mainly woodland, 18km transporting distrance increased
		Fengxi tunnel 2					
		Fengxi tunnel 3	exit				
18		Puguang tunnel	exit	CK208+330 700 to left	19.3	2.87	3km left to DK193+500, 4km away from protection zone and 3km north to Nangou, mainly woodland, 24km transporting distrance increased
		Gaotai tunnel	entrance				
19			inclined well	CK210+400 3000 to right	27	4.00	
20			exit	CK212+251 600	18.4	2.53	
		Dragon Mt. tunnel					

No.	Divicion	Pit Name		Pit Location	Amount （10k m3)	Land Area（hm2）	Adjustment Conditions
21		9-dragon tunnel	exit	CK221+203 1000 to right	54	7.07	4km left to DK194+140, 4.7km away from protection zone and 4km northeast to Nangou, mainly woodland, 38km transporting distrance increased
22	Antu county	Jingcheng tunnel	exit	CK228+345 300 to right	20.2	2.60	250m right to DK242+730, 1km away from protection zone and 1.5km northeast to Baoxing village, mainly woodland, 26km transporting distrance increased
		Dacheng tunnel	entrance				
23		5-family village tunnel	entrance	CK232+403 100 to right	16.4	2.13	
24		5-peak Mt. tunnel	entrance	CK233+775 700 to felf	16	2.33	250m right to DK241+240, 1km away from protection zone and 2km northeast to Baoxing village, mainly woodland, 26km transporting distrance increased
25			inclined well	CK237+451 700 to left	64	8.87	
			exit				
		Yushuchuan tunnel	entrance				
26			exit	CK239+976 900 to left	43	6.33	1km right to DK243+740, 1.9km away from protection zone and 1.2km northeast to Baoxing village, mainly woodland, 10km transporting distrance increased
		Cock Crown Mt. tunnel	entrance				



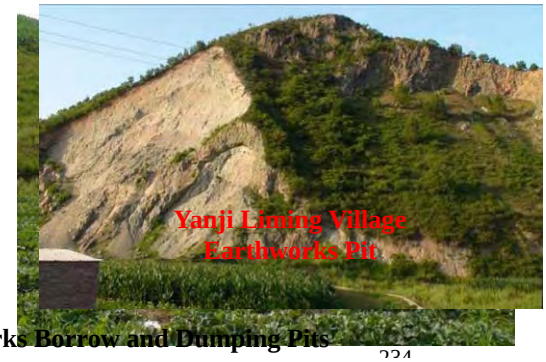


Figure 4-5-1 Some of Earthworks Borrow and Dumping Pits

Photo 4-5-2 Some of Earthworks Borrow and Dumping Pits

5.5.2 Other Temporary Works Distribution

The other temporary works included mainly assess road, girder precasting and storing plant, mixing station, rail placing base, tried to rent the old houses for the construction camps. The project built the new access road of 202.1km, repaired access road of 212.1km, estimated land occupation was 117.38hm2, mainly the wasteland.

The other temporary works was distributed as shown in the table 5-5-5.

Table 5-5-5 Other Temporary Projects Distribution

Items	Unit	Quantity	Location	Land Area
Construction access（newly built）	km	202.1	Along the line	82.68 hm2
Construction access（rebuilt）	km	212.1	Along the line	34.70 hm2
Rail placement base	place	2	Maxiangtun station, Qushui station	16 hm2
Material plant	place	7	Jilin station, Jiaohe Station, Dunhua station, Big Stone town station, Antu station, Yanji station and Tumenn station	7 hm2
Rail plank precasted plant	place	4	Jiaohe city, Big Stone town, Yanji city, Liangshi town	40 hm2
Beam making and storing plant	place	6	Xiaochuan, Jiaohe, Liushugou, Weihuling, Antu, Yanjixi	56 hm2
Concrete mixing station	place	58	Along the line	58 hm2
Improved soil and gradation broken stone mixing station	place	18	Along the line	18 hm2

5.5.3 Environment Impact Analysis and Protection Methods

I. Environment Impact Analysis

The temporary works like borrow pits, girder precasting and storing yard, rail placing base, construction assess and mixing station impacted the environment in the following aspects:

(1) The occupation of the farmland by the temporary works had certain impact on the agricultural production along the project. During the occupation period, the total foodstuff production amount would be reduced; the occupation of uncultivated land like the wasteland would damage the ground surface vegetaion, lead to the breakage of the water and soil maintaining facilities, bring about certain soil erosion and increase the total amount of the soil erosion.

(2) The disturbance to the ground surface during the constrution could change the soil internal physical structure within the occupied range of the temporary works, such as soil aperture reducing and density increasing, and affect the vertical intercourse of water and air in soil, influence the normal vegetation growth, lessen the vegetation coverage and biomass.

II. Prevention and Protection Measures

1. Optimize the construction organization and design, reduce the influence from the source

Due to the different working time of the borrow and dumping bits, mixing station and girder precasting and storing yard, the field for the borrow pit could be used for mixing station or girder precasting and storing plant after excavation. The project was parallel to Changtu line at some places, the open field of the Changtu stations could be employed for the rail placing base and girder precasting yard to reduce the land requisition for the temporary works and the vegetation damage of the temporary work.

2. Report for approval of the basic farmland by legal procedures, enhance the recultivation and vegetation restorage

The essential farmland along the project were mostly distributed in Jiaohe city, Dunhua city, Yanji city and Huichuan city, and more in Jiaohe and Dunhau city. In order to minimize the occupation and segmentation of the essential farmland, the project was basically parallel to the old lines or Changtu Expressway passage. According to the land occupation of the project, the construction units should entrust the qualified company to compile a project land pre-qualification report, submitted for approval to the State Land Resource Ministry after checked and approved by the experts. The land pre-qualification report should put forward the farmland occupation and compensation scheme and essential farmland planning adjustment scheme. The adjustment should be made within the cities and prefectures along the project in line with the relative regulations of the State Land Resource Ministry and also within Jilin province. Based on the land occupation characteristics, the active measures should be taken for the recultivation of the temporary land. The assessment required that the farmland-taken borrow pit excavation should be controlled to be as shallow as within 2m depth and trimmed to be bench land or terrace for farm resuming; as for the gentle hill or mountain slope, the earth borrow could go down to ground surface, recultivation or vegetation restorage should be done according to the soil quality and surrounding conditions after the earth borrow.

A timely levelling and restoring should be followed after the temporary works as the beam precasting yard and rail placing base on the old hardened field. The cultivation should be resumed completely in principle on the temporarily requisitioned land for the mixing station and beam precasting yard.

With the above illustrated preventive and protective measures, the impact of the temporary works on the ecological environment could be controlled within the acceptable range. The project preventive and protective measures for the temporary works were shown in the table 5-5-5.

Table 5-5-5 Summary of Protection Methods of Temporary Projects

No.	Items	Locations	Land Area	Resuming Methods
1	Construction access（newly built）	Along the line	82.68 hm2	Greening
2	Construction access（rebuilt）	Along the line	34.70 hm2	Greening
3	Rail placement base	Maxiangtun station, Qushui station	16 hm2	Site resuming
4	Material plant	Jilin station, Jiaohe Station, Dunhua station, Big Stone town station, Antu station, Yanji station and Tumenn station	7 hm2	Site resuming
5	Rail plank precasted plant	Jiaohe city, Big Stone town, Yanji city, Liangshi town	40 hm2	Site resuming, refarming, recultivating
6	Beam making and storing plant	Xiaochuan, Jiaohe, Liushugou, Weihuling, Antu, Yanjixi	56 hm2	Site resuming
7	Concrete mixing station	Along the line	58 hm2	Site resuming, greening
8	Improved soil and gradation broken stone mixing station	Along the line	18 hm2	Site resuming, refarming, recultivating
9	Earthworks borrow and Dumping Pits	Along the line	260.93 hm^2	refarming, recultivating, greening
10	Earthworks (slag) dumping area	Along the line	474.34 hm^2	refarming, recultivating, greening

5.6 Analysis on water and soil loss which may occur during construction

5.6.1 Causes of water and soil loss

As a result of different topography, geological structure, meteorology, hydrology and human activities influence etc. in the areas where the railway passes, the water and soil loss caused in different sections of these areas has different types. In the construction process, due to construction activities such as engineering borrow, spoil and construction of subgrade, bridges and tunnels etc., which not only form the remodeling landscape with artificial slope, but also cause serious damage within the scope of the original landscape and natural vegetation, reducing or lost its original soil and water conservation function, accelerated occurrence and development of the original landform water and soil loss, and created a new artificial water and soil loss.

Combining with the natural environmental conditions characteristics along the line of this project, main types of water and soil loss resulting from the construction is water erosion mainly distributed on temporary construction, production and living region such as occupied areas of both sides of the railway, subgrade slope, station, soil excavating and depositing site, and construction access.

Road embankment: If it is not timely protected in filling process, the road embankment itself shall be washed by rainfall during the rainy season, causing part of soil loss to both sides of the road embankment; when the flood comes, the road embankment may be destroyed by the flood or be washed.

Station: The filling and earth excavation of new station in this project are relatively large, the leveling, filling, or excavation of large area within the station will accelerate localized water and soil loss.

Bridge and culvert: mainly because the pier reduces flow cross-section, backwater upstream and increased speed of downstream flow velocities causing erosion or scouring of both banks of the river to collapse occur, or water and soil loss was caused by scouring the floor of trench. In case earth excavation mucking of abutment foundation has not been disposed properly, water and soil loss may also occur.

Tunnel: Mucking in this line of the tunnel, in case of inappropriate selection of stack yard site or protective measures, local water and soil loss easily occurs; earth excavation of the slope at the tunnel opening and open cut tunnel are consistent with road cut in nature, also leading to the destruction of vegetation, soil loosening to speed up water and soil loss.

Borrow area: borrow operation will destroy the existing vegetation, to make erosion resistance of soil worse, and weaken soil and water conservation. If no prompt protective or other measures to restore vegetation after borrow are taken, the bare ground can easily result in water and soil loss. After the soil is borrowed, it has a lower fertility and becomes harden. Borrow operation will push the topsoil aside to pile, in case of inappropriate selection of stack yard site or protective measures, local water and soil loss easily occurs.

spoil (waste slag) yard: in case of inappropriate selection of stack yard site or protective measures, a great quantity of loose deposits are highly susceptible to the influence of gravity and wash of rainfall causing water and soil loss.

Construction access and site: opening up construction access and site shall both cause damage and disturbance to the vegetation and soil structure on the surface of the earth, leading to harden soil and decreased fertility.

5.6.2 Prediction of water and soil loss

(1) Division of predicting phases

Construction activities during construction period and activities disturbing the original landscape are mainly concentrated on key sites such as subgrade slope, side upward slope of tunnels, cone slope of bridges, Borrow area, spoil (waste slag) yard, road construction and construction sites etc.. The construction period at which construction activities such as earth and stonework excavation, filling and waste slag are concentrated to cause damage vegetation and destroy soil structure, leading to a reduction or loss of soil and water conservation function owned by original soil and

water conservation facilities in the project area, and bringing about a great amount of loose deposits which may be easily washed for occurrence of water and soil loss, is the key period for occurrence of water and soil loss.

During the early operation, large-scale construction activities such as excavation, filling, and waste slag largely stop, but as part of water and soil conservation measure need to be gradually perform their functions, and taking into account that measures of some plants will be implemented at the later stage of the construction, some water and soil loss still occur at the early operation.

Therefore, the prediction phases of water and soil loss of this project can be divided into 4 years of construction phase (2011~2014), 2 years of natural recovery phase (2015~2016).

(2) Content and method of prediction

According to the main project design and site survey, investigation, on the basis of analysis on the disturbance of the original landscape in project areas, damage to the land and vegetation of the area, source, quantity, location and stacking types of spoil, the area of water and soil loss which may probably occur shall be determined, through analogy investigation, the amount of potential water and soil loss should be predicted with empirical formula; according to forecasts, the harm of water and soil loss which may probably occur shall be analyzed and predicted. Contents of water and soil loss prediction includes: disturbed earth surface area in the project, damaged area of soil and water conservation facility area, quantity of spoil (waste slag), area of water and soil loss and amount of water and soil loss and so on.

① Area of disturbed original landform and damaging vegetation of earth surface

The land use boundary of construction mainly covers permanent land acquisition and temporary land. The works implemented in the project construction area shall result in a complete change or a short-term loss in soil and water conservation function of original landform, thus leading to increased soil erosion and water and soil loss. The scope of works such as subgrade and station built in the project will cause permanent changes to the original function. The damage caused by the works to the original landform will be demonstrated on a permanently occupied area. Temporary sites such as soil excavating and depositing site and construction site through rehabilitation, restoration of vegetation and other measures may gradually resume its original function.

The disturbed earth surface area of the project is 2216.88hm^2, of which: arable land 963.74m^2, woodland 930.64hm^2, unused land 124.80hm^2, construction land 158.91hm^2, and other land 38.77 hm^2.

② Prediction of amount of soil (ballast) excavating and depositing of the project

Earth and stone work quantity of subgrade, station, tunnel and bridge works is 6990.29×10^{4}m^3 in total, of which fill earth 2384.50×10^{4}m^3, earth excavation 4605.79×10^{4}m^3, excavation shipped for fill 1406.66×10^{4}m^3, subgrade and station using the tunnel 208.98×10^{4}m^3, earth to be borrowed 768.86×10^{4}m^3, spoil 2990.15×10^{4}m^3.

③ Prediction of area of water and soil loss

The area of water and soil loss which may occur during construction period the occupied area of the works in the natural recovery period, the permanent area of the line, station and ground hardening permanently affected area, area of water and soil loss which may occur during

construction will reduce. Water and soil loss area which may occur during construction period and natural recovery time may be shown in table 5-6-1.

④ Prediction of amount of water and soil loss

a. Annual soil loss amount of original landform

Using background value of water and soil loss, estimation should be conducted on the amount of water and soil loss of the original landform within the project scope. Estimation scope covers soil loss of original landform within permanent area and temporary land. After calculation, soil loss amount of original landform is up to 0.64×10^4t / a. For specific calculations, see table 5-6-2.

b. Prediction of soil loss amount caused by disturbed earth surface of engineering construction and natural recovery phases.

Newly added soil loss amount of disturbed earth surface during project construction period and natural recovery phases, and prediction of soil loss amount which may be caused shall adopt analog method.

Newly added water and soil loss amount，that is, the difference between total amount of water and soil loss during construction period and natural recovery phase and the amount of water and soil loss of the original surface before the damage. The calculation formula is as follows:

$$W_1 = \sum_{i=1}^{n} \left[F \times (M_i - P_i) \times T_i \right]$$

Where:

W_1 - Newly added water and soil loss amount (t)

F - Disturbed earth surface area (km^2)

M_i - Soil erosion modulus of remodeling landform ($t/km^2 \cdot a$)

P_i - Soil erosion modulus of original landform ($t/km^2 \cdot a$)

T_i - Predicting phases (a)

Calculation of amount water and soil loss and prediction of their total amount caused by disturbed earth surface and natural recovery phase during construction period are shown in Table 5-6-3, 5-6-4, 5-6-5.

Table 5-6-1 Summary of Soil Erosion Area during the Construction and Natural Restoration Period (Unit: hm2)

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
CK0+000 ~ CK2+500	Jilin City	Changyi district	permanent land	Subgrade			14.40			14.40	7.20	4.32
				yard						0.00	0.00	0.00
				Tunnel						0.00	0.00	0.00
				Bridge			2.15			2.15	1.08	0.65
				Road diversion	0.60	0.40	0.33	0.13		1.46	0.49	0.29
				subtotal	0.60	0.40	16.88	0.13	0.00	18.01	8.76	5.26
			temporary land	Land borrow area						0.00	0.00	0.00
				Spoil ground						0.00	0.00	0.00
				Pioneer road	0.21				0.09	0.30	0.15	0.09
				Construction site and camp	6.30				2.70	9.00	4.50	2.70
				subtotal	6.51	0.00	0.00	0.00	2.79	9.30	4.65	2.79
			Total		7.11	0.40	16.88	0.13	2.79	27.31	13.41	8.05
CK2+500 ~ CK3+560		Fengman District	permanent area	Subgrade			5.47			5.47	2.74	1.64
				yard						0.00	0.00	0.00
				Tunnel						0.00	0.00	0.00
				Bridge			1.87			1.87	0.94	0.56
				Road diversion	0.67	1.33	1.00	0.33		3.33	1.11	0.67

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
				subtotal	0.67	1.33	8.34	0.33	0.00	10.67	4.78	2.87
			temporary land	Land borrow area						0.00	0.00	0.00
				Spoil ground						0.00	0.00	0.00
				Pioneer road	1.23				0.53	1.76	0.88	0.53
				Construction site and camp	0.70				0.30	1.00	0.50	0.30
				subtotal	1.93	0.00	0.00	0.00	0.83	2.76	1.38	0.83
			Total		2.60	1.33	8.34	0.33	0.83	13.43	6.16	3.70
CK3+560 ～ CK24+460		Longtan District	permanent area	Subgrade	18.89	30.70		8.85	0.31	58.75	29.38	17.63
				yard						0.00	0.00	0.00
				Tunnel		0.75				0.75	0.38	0.23
				Bridge	5.00	8.12		2.34	0.08	15.54	7.77	4.66
				Road diversion	5.27	5.73	2.47	0.73		14.20	4.73	2.84
				subtotal	29.16	45.30	2.47	11.92	0.39	89.24	42.25	25.35
			temporary land	Land borrow area						0.00	0.00	0.00
				Spoil ground	13.15	1.48				14.63	7.32	4.39
				Pioneer road	4.53				1.94	6.47	3.24	1.94
				Construction site and camp	10.03				4.30	14.33	7.17	4.30
				subtotal	27.71	1.48	0.00	0.00	6.24	35.43	17.72	10.63

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
			Total		56.87	46.78	2.47	11.92	6.63	124.67	59.97	35.98
CK24+460 ～ CK112+535		Jiaohe City	permanent area	Subgrade	73.54	106.63		2.76	0.11	183.04	91.52	54.91
				yard	12.60	3.33				15.93	7.97	4.78
				Tunnel	0.15	11.85				12.00	6.00	3.60
				Bridge	12.31	17.85		0.46	0.02	30.64	15.32	9.19
				Road diversion	1.54	4.40				5.94	1.98	1.19
				subtotal	100.14	144.06	0.00	3.22	0.13	247.55	122.79	73.671
			temporary land	Land borrow area	4.57	18.27				22.84	11.42	6.85
				Spoil ground	76.19	49.32				125.51	62.76	37.65
				Pioneer road	20.63				8.84	29.47	14.74	8.84
				Construction site and camp	33.71				14.45	48.16	24.08	14.45
				subtotal	135.10	67.59	0.00	0.00	23.29	225.98	112.99	67.79
			Total		235.24	211.65	0.00	3.22	23.42	473.53	235.78	141.47
CK112+535 ～ CK191+420	Yanbian Korean Autonomous Prefe	Dunhua City	permanent area	Subgrade	128.33	73.59		18.17	7.04	227.13	113.57	68.14
				yard	12.07	9.00		41.33		62.40	31.20	18.72
				Tunnel	0.80	5.20				6.00	3.00	1.80
				Bridge	22.68	13.01		3.21	1.25	40.15	20.08	12.05
				Road diversion	2.53	3.93	0.93			7.39	2.46	1.48
				subtotal	166.41	104.73	0.93	62.71	8.29	343.07	170.30	102.18

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
	cture		temporary land	Land borrow area	1.51	6.04				7.55	3.78	2.27
				Spoil ground	13.55	38.22				51.77	25.89	15.53
				Pioneer road	9.21				3.95	13.16	6.58	3.95
				Construction site and camp	23.73				10.17	33.90	16.95	10.17
				subtotal	48.00	44.26	0.00	0.00	14.12	106.38	53.19	31.914
			Total		214.41	148.99	0.93	62.71	22.41	449.45	223.49	134.10
CK191+420 ～ CK241+340		Antu City	permanent area	Subgrade	37.66	51.63		2.37	13.51	105.17	52.59	31.55
				yard	3.82	4.33		10.20		18.35	9.18	5.51
				Tunnel	1.65	9.35				11.00	5.50	3.30
				Bridge	4.73	5.53		0.30	1.69	12.25	6.13	3.68
				Road diversion	1.53	2.07	1.00			4.60	1.53	0.92
				subtotal	49.39	72.91	1.00	12.87	15.20	151.37	74.92	44.95
			temporary land	Land borrow area	6.80	27.20				34.00	17.00	10.20
				Spoil ground	18.28	69.19				87.47	43.74	26.24
				Pioneer road	14.17				6.07	20.24	10.12	6.07
				Construction site and camp	13.77				5.90	19.67	9.84	5.90
				subtotal	53.02	96.39	0.00	0.00	11.97	161.38	80.69	48.41
			Total		102.41	169.30	1.00	12.87	27.17	312.75	155.61	93.37

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
CK241+340 ～ CK253+440		Longjing City	permanent area	Subgrade	10.68	12.50		0.67	3.83	27.68	13.84	8.30
				yard						0.00	0.00	0.00
				Tunnel	0.23	1.27				1.50	0.75	0.45
				Bridge	1.29	1.51		0.08	0.47	3.35	1.68	1.01
				Road diversion	1.07	1.53				2.60	0.87	0.52
				subtotal	13.27	16.81	0.00	0.75	4.30	35.13	17.13	10.28
			temporary land	Land borrow area	0.97	3.86				4.83	2.42	1.45
				Spoil ground	2.85	13.21				16.06	8.03	4.82
				Pioneer road	0.00					0.00	0.00	0.00
				Construction site and camp	2.10				0.90	3.00	1.50	0.90
				subtotal	5.92	17.07	0.00	0.00	0.90	23.89	11.95	7.17
			Total		19.19	33.88	0.00	0.75	5.20	59.02	29.08	17.45
CK253+440 ～ CK278+120		Yanji City	permanent area	Subgrade	35.80	0.14		7.33	1.15	44.42	22.21	13.33
				yard	12.50	12.00		25.00		49.50	24.75	14.85
				Tunnel	0.37	2.13				2.50	1.25	0.75
				Bridge	14.77	0.06		3.02	0.47	18.32	9.16	5.50
				Road diversion	3.07	2.13	1.60	0.73		7.53	2.51	1.51
				subtotal	66.51	16.46	1.60	36.08	1.62	122.27	59.88	35.93
			temporary	Land borrow area	6.89	27.54				34.43	17.22	10.33

OD Miles	Administrative division		Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
					Arable land	Woodland	Urban land	Construction land	Unused land			
			land	Spoil ground	5.55	14.65				20.20	10.10	6.06
				Pioneer road	5.24				2.24	7.48	3.74	2.24
				Construction site and camp	16.89				7.24	24.13	12.07	7.24
				subtotal	34.57	42.19	0.00	0.00	9.48	86.24	43.12	25.87
			Total		101.08	58.65	1.60	36.08	11.10	208.51	103.00	61.80
CK278+120 ～ CK330+320		Tumen City	permanent area	Subgrade	24.05	10.73		5.15	0.83	40.76	20.38	12.23
				yard	8.42	19.53		18.67		46.62	23.31	13.99
				Tunnel	0.75	4.25				5.00	2.50	1.50
				Bridge	8.70	3.88		1.87	0.30	14.75	7.38	4.43
				Road diversion	1.20	1.53				2.73	0.91	0.55
				subtotal	43.12	39.92	0.00	25.69	1.13	109.86	54.48	32.69
			temporary land	Land borrow area	7.88	31.50				39.38	19.69	11.81
				Spoil ground	53.20	45.61				98.81	49.41	29.64
				Pioneer road	1.82				0.78	2.60	1.30	0.78
				Construction site and camp	19.74				8.46	28.20	14.10	8.46
				subtotal	82.64	77.11	0.00	0.00	9.24	168.99	84.50	50.70
			Total		125.76	117.03	0.00	25.69	10.37	278.85	138.97	83.38
CK330+320 ～ CK362+200		Hunchun City	permanent	Subgrade	7.63	3.88		0.64	0.75	12.90	6.45	3.87
				yard	0.00	10.03		4.00		14.03	7.02	4.21

OD Miles	Administrative division	Project type		Type of occupied lands and area					Soil erosion area dunring the construction period	Soil erosion area in the first year of natural restoration	Soil erosion area in the second year of natural restoration
				Arable land	Woodland	Urban land	Construction land	Unused land			
		area	Tunnel	0.00	4.25				4.25	2.13	1.28
			Bridge	6.58	3.35		0.55	0.65	11.13	5.57	3.34
			Road diversion	2.07	2.20				4.27	1.42	0.85
			subtotal	16.28	23.71	0.00	5.19	1.40	46.58	22.58	13.55
		temporary land	Land borrow area	23.58	94.33				117.91	58.96	35.37
			Spoil ground	27.77	32.12				59.89	29.95	17.97
			Pioneer road	25.10				10.76	35.86	17.93	10.76
			Construction site and camp	6.35				2.72	9.07	4.53	2.72
			subtotal	82.80	126.45	0.00	0.00	13.48	222.73	111.37	66.82
		Total		99.08	150.16	0.00	5.19	14.88	269.31	133.94	80.37
Total				963.75	938.17	31.22	158.89	124.80	2216.83	1099.41	659.64

Table 5-6-2 Calculation of Soil Erosion of the Original Landscaple

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
CK0+000 ～ CK2+500	Jilin City	Changyi district	permanent area	Subgrade		250	0.00		200	0.00	14.40	0	0.00		200	0.00		250	0.00
				yard		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Tunnel		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Bridge		250	0.00		200	0.00	2.15	0	0.00		200	0.00		250	0.00
				Road diversion	0.60	250	1.50	0.40	200	0.80	0.33	0	0.00	0.13	200	0.26		250	0.00
				subtotal	0.60		1.50	0.40		0.80	16.88			0.13		0.26	0.00		0.00
			temporary land	Land borrow area		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Spoil ground		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Pioneer road	0.21	250	0.53		200	0.00		0	0.00		200	0.00	0.09	250	0.23
				Construction site and camp	6.30	250	15.75		200	0.00		0	0.00		200	0.00	2.70	250	6.75
				subtotal	6.51		16.28	0.00		0.00	0.00			0.00		0.00	2.79		6.98
			Total		7.11		17.78	0.40		18.18	16.88			0.13		0.26	2.79		6.98
CK2+500 ～ CK3+560		Fengman district	permanent area	Subgrade		250	0.00		200	0.00	5.47	0	0.00		200	0.00		250	0.00
				yard		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Tunnel		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Bridge		250	0.00		200	0.00	1.87	0	0.00		200	0.00		250	0.00

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
				Road diversion	0.67	250	1.68	1.33	200	2.66	1.00	0	0.00	0.33	200	0.66		250	0.00
				subtotal	0.67		1.68	1.33		2.66	8.34			0.33		0.66	0.00		0.00
			temporary land	Land borrow area		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Spoil ground		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Pioneer road	1.23	250	3.08		200	0.00		0	0.00		200	0.00	0.53	250	1.33
				Construction site and camp	0.70	250	1.75		200	0.00		0	0.00		200	0.00	0.30	250	0.75
				subtotal	1.93		4.83	0.00		0.00	0.00			0.00		0.00	0.83		2.08
			Total		2.60		6.50	1.33		7.83	8.34			0.33		0.66	0.83		2.08
CK3+560 ～ CK24+460		Longtan district	permanent area	Subgrade	18.89	250	47.23	30.70	200	61.40		0	0.00	8.85	200	17.70	0.31	250	0.78
				yard		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Tunnel		250	0.00	0.75	200	1.50		0	0.00		200	0.00		250	0.00
				Bridge	5.00	250	12.50	8.12	200	16.24		0	0.00	2.34	200	4.68	0.08	250	0.20
				Road diversion	5.27	250	13.18	5.73	200	11.46	2.47	0	0.00	0.73	200	1.46		250	0.00
				subtotal	29.16		72.90	45.30		90.60	2.47			11.92		23.84	0.39		0.98
			temporary land	Land borrow area		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Spoil	13.15	250	32.88	1.48	200	2.96		0	0.00		200	0.00		250	0.00

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
				ground															
				Pioneer road	4.53	250	11.33		200	0.00		0	0.00		200	0.00	1.94	250	4.85
				Construction site and camp	10.03	250	25.08		200	0.00		0	0.00		200	0.00	4.30	250	10.75
				subtotal	27.71		69.28	1.48		2.96	0.00			0.00		0.00	6.24		15.60
			Total		56.87		142.18	46.78		188.96	2.47			11.92		23.84	6.63		16.58
CK24+460 ～ CK112+535		Jiaohe city	permanent area	Subgrade	73.54	250	183.85	106.63	200	213.26		0	0.00	2.76	200	5.52	0.11	250	0.28
				yard	12.60	250	31.50	3.33	200	6.66		0	0.00		200	0.00		250	0.00
				Tunnel	0.15	250	0.38	11.85	200	23.70		0	0.00		200	0.00		250	0.00
				Bridge	12.31	250	30.78	17.85	200	35.70		0	0.00	0.46	200	0.92	0.02	250	0.05
				Road diversion	1.54	250	3.85	4.40	200	8.80		0	0.00		200	0.00		250	0.00
				subtotal	100.14		250.35	144.06		288.12	0.00			3.22		6.44	0.13		0.33
			temporary land	Land borrow area	4.57	250	11.43	18.27	200	36.54		0	0.00		200	0.00		250	0.00
				Spoil ground	76.19	250	190.48	49.32	200	98.64		0	0.00		200	0.00		250	0.00
				Pioneer road	20.63	250	51.58		200	0.00		0	0.00		200	0.00	8.84	250	22.10
				Construction site and camp	33.71	250	84.28		200	0.00		0	0.00		200	0.00	14.45	250	36.13
				subtotal	135.10		337.75	67.59		135.18	0.00			0.00		0.00	23.29		58.23

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
			Total		235.24		588.10	211.65		799.75	0.00			3.22		6.44	23.42		58.55
CK112+535 ～ CK191+420	Yanbian Korean Autonomous Region	Dunhua city	permanent area	Subgrade	128.33	250	320.83	73.59	200	147.18		0	0.00	18.17	200	36.34	7.04	250	17.60
				yard	12.07	250	30.18	9.00	200	18.00		0	0.00	41.33	200	82.66		250	0.00
				Tunnel	0.80	250	2.00	5.20	200	10.40		0	0.00		200	0.00		250	0.00
				Bridge	22.68	250	56.70	13.01	200	26.02		0	0.00	3.21	200	6.42	1.25	250	3.13
				Road diversion	2.53	250	6.33	3.93	200	7.86	0.93	0	0.00		200	0.00		250	0.00
				subtotal	166.41		416.03	104.73		209.46	0.93			62.71		125.42	8.29		20.73
			temporary land	Land borrow area	1.51	250	3.78	6.04	200	12.08		0	0.00		200	0.00		250	0.00
				Spoil ground	13.55	250	33.88	38.22	200	76.44		0	0.00		200	0.00		250	0.00
				Pioneer road	9.21	250	23.03		200	0.00		0	0.00		200	0.00	3.95	250	9.88
				Construction site and camp	23.73	250	59.33		200	0.00		0	0.00		200	0.00	10.17	250	25.43
				subtotal	48.00		120.00	44.26		88.52	0.00			0.00		0.00	14.12		35.30
			Total		214.41		536.03	148.99		685.02	0.93			62.71		125.42	22.41		56.03
CK191+420 ～ CK241+340		Antu City	permanent area	Subgrade	37.66	250	94.15	51.63	200	103.26		0	0.00	2.37	200	4.74	13.51	250	33.78
				yard	3.82	250	9.55	4.33	200	8.66		0	0.00	10.20	200	20.40		250	0.00
				Tunnel	1.65	250	4.13	9.35	200	18.70		0	0.00		200	0.00		250	0.00
				Bridge	4.73	250	11.83	5.53	200	11.06		0	0.00	0.30	200	0.60	1.69	250	4.23
				Road	1.53	250	3.83	2.07	200	4.14	1.00	0	0.00		200	0.00		250	0.00

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
				diversion															
				subtotal	49.39		123.48	72.91		145.82	1.00			12.87		25.74	15.20		38.00
			temporary land	Land borrow area	6.80	250	17.00	27.20	200	54.40		0	0.00		200	0.00		250	0.00
				Spoil ground	18.28	250	45.70	69.19	200	138.38		0	0.00		200	0.00		250	0.00
				Pioneer road	14.17	250	35.43		200	0.00		0	0.00		200	0.00	6.07	250	15.18
				Construction site and camp	13.77	250	34.43		200	0.00		0	0.00		200	0.00	5.90	250	14.75
				subtotal	53.02		132.55	96.39		192.78	0.00			0.00		0.00	11.97		29.93
			Total		102.41		256.03	169.30		425.33	1.00			12.87		25.74	27.17		67.93
CK241+340～CK253+440		Longjing city	permanent area	Subgrade	10.68	250	26.70	12.50	200	25.00		0	0.00	0.67	200	1.34	3.83	250	9.58
				yard		250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Tunnel	0.23	250	0.58	1.27	200	2.54		0	0.00		200	0.00		250	0.00
				Bridge	1.29	250	3.23	1.51	200	3.02		0	0.00	0.08	200	0.16	0.47	250	1.18
				Road diversion	1.07	250	2.68	1.53	200	3.06		0	0.00		200	0.00		250	0.00
				subtotal	13.27		0.00	16.81		33.62	0.00			0.75		1.50	4.30		10.75
			temporary land	Land borrow area	0.97	250	2.43	3.86	200	7.72		0	0.00		200	0.00		250	0.00
				Spoil ground	2.85	250	7.13	13.21	200	26.42		0	0.00		200	0.00		250	0.00

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
				Pioneer road	0.00	250	0.00		200	0.00		0	0.00		200	0.00		250	0.00
				Construction site and camp	2.10	250	5.25		200	0.00		0	0.00		200	0.00	0.90	250	2.25
				subtotal	5.92		47.98	17.07		34.14	0.00			0.00		0.00	0.90		2.25
			Total		19.19		47.98	33.88		81.86	0.00			0.75		1.50	5.20		13.00
CK253+440 ～ CK278+120		Yanji city	permanent area	Subgrade	35.80	250	89.50	0.14	200	0.28		0	0.00	7.33	200	14.66	1.15	250	2.88
				yard	12.50	250	31.25	12.00	200	24.00		0	0.00	25.00	200	50.00		250	0.00
				Tunnel	0.37	250	0.93	2.13	200	4.26		0	0.00		200	0.00		250	0.00
				Bridge	14.77	250	36.93	0.06	200	0.12		0	0.00	3.02	200	6.04	0.47	250	1.18
				Road diversion	3.07	250	7.68	2.13	200	4.26	1.60	0	0.00	0.73	200	1.46		250	0.00
				subtotal	66.51		166.28	16.46		32.92	1.60			36.08		72.16	1.62		4.05
			temporary land	Land borrow area	6.89	250	17.23	27.54	200	55.08		0	0.00		200	0.00		250	0.00
				Spoil ground	5.55	250	13.88	14.65	200	29.30		0	0.00		200	0.00		250	0.00
				Pioneer road	5.24	250	13.10		200	0.00		0	0.00		200	0.00	2.24	250	5.60
				Construction site and camp	16.89	250	42.23		200	0.00		0	0.00		200	0.00	7.24	250	18.10
				subtotal	34.57		86.43	42.19		84.38	0.00			0.00		0.00	9.48		31.80
			Total		101.08		252.70	58.65		311.35	1.60			36.08		72.16	11.10		35.85

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
CK278+120～CK330+320		Tumen city	permanent area	Subgrade	24.05	250	60.13	10.73	200	21.46		0	0.00	5.15	200	10.30	0.83	250	2.08
				yard	8.42	250	21.05	19.53	200	39.06		0	0.00	18.67	200	37.34		250	0.00
				Tunnel	0.75	250	1.88	4.25	200	8.50		0	0.00		200	0.00		250	0.00
				Bridge	8.70	250	21.75	3.88	200	7.76		0	0.00	1.87	200	3.74	0.30	250	0.75
				Road diversion	1.20	250	3.00	1.53	200	3.06		0	0.00		200	0.00		250	0.00
				subtotal	43.12		107.80	39.92		79.84	0.00			25.69		51.38	1.13		2.83
			temporary land	Land borrow area	7.88	250	19.70	31.50	200	63.00		0	0.00		200	0.00		250	0.00
				Spoil ground	53.20	250	133.00	45.61	200	91.22		0	0.00		200	0.00		250	0.00
				Pioneer road	1.82	250	4.55		200	0.00		0	0.00		200	0.00	0.78	250	1.95
				Construction site and camp	19.74	250	49.35		200	0.00		0	0.00		200	0.00	8.46	250	21.15
				subtotal	82.64		206.60	77.11		154.22	0.00			0.00		0.00	9.24		23.10
			Total		125.76		314.40	117.03		431.43	0.00			25.69		51.38	10.37		25.93
CK330+320～CK362+200		Hunchun city	permanent area	Subgrade	7.63	250	19.08	3.88	200	7.76		0	0.00	0.64	200	1.28	0.75	250	1.88
				yard	0.00	250	0.00	10.03	200	20.06		0	0.00	4.00	200	8.00		250	0.00
				Tunnel	0.00	250	0.00	4.25	200	8.50		0	0.00		200	0.00		250	0.00
				Bridge	6.58	250	16.45	3.35	200	6.70		0	0.00	0.55	200	1.10	0.65	250	1.63
				Road diversion	2.07	250	5.18	2.20	200	4.40		0	0.00		200	0.00		250	0.00

OD Miles	Administrative division		Project type		Arable land			Woodland			Urban land			Construction land			Unused land		
					Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss	Area	Erosion modulus	Annual loss
				subtotal	16.28		40.70	23.71		47.42	0.00			5.19		10.38	1.40		3.50
			temporary land	Land borrow area	23.58	250	58.96	94.33	200	188.66		0	0.00		200	0.00		250	0.00
				Spoil ground	27.77	250	69.42	32.12	200	64.25		0	0.00		200	0.00		250	0.00
				Pioneer road	25.10	250	62.76		200	0.00		0	0.00		200	0.00	10.76	250	26.90
				Construction site and camp	6.35	250	15.87		200	0.00		0	0.00		200	0.00	2.72	250	6.80
				subtotal	82.80		207.00	126.45		252.91	0.00			0.00		0.00	13.48		33.70
			Total		99.08		247.70	150.16		397.86	0.00			5.19		10.38	14.88		37.20
Total					963.75		2409.37	938.17		3347.55	31.22		0.00	158.89		317.78	124.80		320.10

Table 5-6-3 Estimation of Soil Erosion in the Construction and Natural Restoration Period

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
CK0+000～CK2+500	Jilin city	Changyi district	permanent area	Subgrade	14.40	4500	3	1944.00	7.20	2250	1	162.00	4.32	900.00	1	38.88
				yard	0.00	4000	2	0.00	0.00	2000	1	0.00	0.00	800.00	1	0.00
				Tunnel	0.00	4500	3	0.00	0.00	2250	1	0.00	0.00	900.00	1	0.00
				Bridge	2.15	3000	3	193.50	1.08	1500	1	16.13	0.65	600.00	1	3.87
				Road diversion	1.46	4500	2	131.40	0.49	2250	1	10.95	0.29	900.00	1	2.63
				subtotal	18.01	/	/	2268.90	8.76	/	/	189.08	5.26	/	1	45.38
			temporary land	Land borrow area	0.00	5500	4	0.00	0.00	2750	1	0.00	0.00	1100.00	1	0.00
				Spoil ground	0.00	5000	4	0.00	0.00	2500	1	0.00	0.00	1000.00	1	0.00
				Pioneer road	0.30	2500	4	30.00	0.15	1250	1	1.88	0.09	500.00	1	0.45
				Construction site and camp	9.00	2000	4	720.00	4.50	1000	1	45.00	2.70	400.00	1	10.80
				subtotal	9.30	/	/	750.00	4.65	/	/	46.88	2.79	/	/	11.25
			Total		27.31	/	/	3018.90	13.41	/	/	235.95	8.05	/	/	56.63
CK2+500～CK3+560		Fengman district	permanent area	Subgrade	5.47	4500	3	738.45	2.74	2250	1	61.54	1.64	900.00	1	14.77
				yard	0.00	4000	2	0.00	0.00	2000	1	0.00	0.00	800.00	1	0.00
				Tunnel	0.00	4500	3	0.00	0.00	2250	1	0.00	0.00	900.00	1	0.00
				Bridge	1.87	3000	3	168.30	0.94	1500	1	14.03	0.56	600.00	1	3.37

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
				Road diversion	3.33	4500	2	299.70	1.11	2250	1	24.98	0.67	900.00	1	5.99
				subtotal	10.67	/	/	1206.45	4.78	/	/	100.54	2.87	/	1	24.13
			temporary land	Land borrow area	0.00	5500	4	0.00	0.00	2750	1	0.00	0.00	1100.00	1	0.00
				弃土（碴）场	0.00	5000	4	0.00	0.00	2500	1	0.00	0.00	1000.00	1	0.00
				Pioneer road	1.76	2500	4	176.00	0.88	1250	1	11.00	0.53	500.00	1	2.64
				Construction site and camp	1.00	2000	4	80.00	0.50	1000	1	5.00	0.30	400.00	1	1.20
				subtotal	2.76	/	/	256.00	1.38	/	/	16.00	0.83	/	/	3.84
			Total		13.43	/	/	1462.45	6.16	/	/	116.54	3.70	/	/	27.97
CK3+560～CK24+460		Longtan district	permanent area	Subgrade	58.75	4500	3	7931.25	29.38	2250	1	660.94	17.63	900.00	1	158.63
				yard	0.00	4000	2	0.00	0.00	2000	1	0.00	0.00	800.00	1	0.00
				Tunnel	0.75	4500	3	101.25	0.38	2250	1	8.44	0.23	900.00	1	2.03
				Bridge	15.54	3000	3	1398.60	7.77	1500	1	116.55	4.66	600.00	1	27.97
				Road diversion	14.20	4500	2	1278.00	4.73	2250	1	106.50	2.84	900.00	1	25.56
				subtotal	89.24	/	/	10709.10	42.25	/	/	892.43	25.35	/	1	214.18
			temporary land	Land borrow area	0.00	5500	4	0.00	0.00	2750	1	0.00	0.00	1100.00	1	0.00

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
				Spoil ground	14.63	5000	4	2926.00	7.32	2500	1	182.88	4.39	1000.00	1	43.89
				Pioneer road	6.47	2500	4	647.00	3.24	1250	1	40.44	1.94	500.00	1	9.71
				Construction site and camp	14.33	2000	4	1146.40	7.17	1000	1	71.65	4.30	400.00	1	17.20
				subtotal	35.43	/	/	4719.40	17.72	/	/	294.96	10.63	/	/	70.79
			Total		124.67	/	/	15428.50	59.97	/	/	1187.39	35.98	/	/	284.97
CK24+460 ～ CK112+535		Jiaohe city	permanent area	Subgrade	183.04	4500	3	24710.40	91.52	2250	1	2059.20	54.91	900.00	1	494.21
				yard	15.93	4000	2	1274.40	7.97	2000	1	159.30	4.78	800.00	1	38.23
				Tunnel	12.00	4500	3	1620.00	6.00	2250	1	135.00	3.60	900.00	1	32.40
				Bridge	30.64	3000	3	2757.60	15.32	1500	1	229.80	9.19	600.00	1	55.15
				Road diversion	5.94	4500	2	534.60	1.98	2250	1	44.55	1.19	900.00	1	10.69
				subtotal	247.55	/	/	30897.00	122.79	/	/	2627.85	73.671	/	1	630.68
			temporary land	Land borrow area	22.84	5500	4	5024.80	11.42	2750	1	314.05	6.85	1100.00	1	75.37
				Spoil ground	125.51	5000	4	25102.00	62.76	2500	1	1568.88	37.65	1000.00	1	376.53
				Pioneer road	29.47	2500	4	2947.00	14.74	1250	1	184.19	8.84	500.00	1	44.21
				Construction site and camp	48.16	2000	4	3852.80	24.08	1000	1	240.80	14.45	400.00	1	57.79

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
				subtotal	225.98	/	/	36926.60	112.99	/	/	2307.91	67.79	/	/	553.90
			Total		473.53	/	/	67823.60	235.78	/	/	4935.76	141.47	/	/	1184.58
CK112+535 ～ CK191+420	Yanbian Korean Autonomous Region	敦化市	permanent area	Subgrade	227.13	4500	3	30662.55	113.57	2250	1	2555.21	68.14	900.00	1	613.25
				yard	62.40	4000	2	4992.00	31.20	2000	1	624.00	18.72	800.00	1	149.76
				Tunnel	6.00	4500	3	810.00	3.00	2250	1	67.50	1.80	900.00	1	16.20
				Bridge	40.15	3000	3	3613.50	20.08	1500	1	301.13	12.05	600.00	1	72.27
				Road diversion	7.39	4500	2	665.10	2.46	2250	1	55.43	1.48	900.00	1	13.30
				subtotal	343.07	/	/	40743.15	170.30	/	/	3603.26	102.18	/	1	864.78
			temporary land	Land borrow area	7.55	5500	4	1661.00	3.78	2750	1	103.81	2.27	1100.00	1	24.92
				Spoil ground	51.77	5000	4	10354.00	25.89	2500	1	647.13	15.53	1000.00	1	155.31
				Pioneer road	13.16	2500	4	1316.00	6.58	1250	1	82.25	3.95	500.00	1	19.74
				Construction site and camp	33.90	2000	4	2712.00	16.95	1000	1	169.50	10.17	400.00	1	40.68
				subtotal	106.38	/	/	16043.00	53.19	/	/	1002.69	31.914	/	/	240.65
			Total		449.45	/	/	56786.15	223.49	/	/	4605.95	134.10	/	/	1105.43
CK191+420 ～ CK241+3		Antu city	permanent area	Subgrade	105.17	4500	3	14197.95	52.59	2250	1	1183.16	31.55	900.00	1	283.96
				yard	18.35	4000	2	1468.00	9.18	2000	1	183.50	5.51	800.00	1	44.04
				Tunnel	11.00	4500	3	1485.00	5.50	2250	1	123.75	3.30	900.00	1	29.70

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
40				Bridge	12.25	3000	3	1102.50	6.13	1500	1	91.88	3.68	600.00	1	22.05
				Road diversion	4.60	4500	2	414.00	1.53	2250	1	34.50	0.92	900.00	1	8.28
				subtotal	151.37	/	/	18667.45	74.92	/	/	1616.79	44.95	/	1	388.03
			temporary land	Land borrow area	34.00	5500	4	7480.00	17.00	2750	1	467.50	10.20	1100.00	1	112.20
				Spoil ground	87.47	5000	4	17494.00	43.74	2500	1	1093.38	26.24	1000.00	1	262.41
				Pioneer road	20.24	2500	4	2024.00	10.12	1250	1	126.50	6.07	500.00	1	30.36
				Construction site and camp	19.67	2000	4	1573.60	9.84	1000	1	98.35	5.90	400.00	1	23.60
				subtotal	161.38	/	/	28571.60	80.69	/	/	1785.73	48.41	/	/	428.57
			Total		312.75	/	/	47239.05	155.61	/	/	3402.51	93.37	/	/	816.60
CK241+340 ～ CK253+440		Longjing city	permanent area	Subgrade	27.68	4500	3	3736.80	13.84	2250	1	311.40	8.30	900.00	1	74.74
				yard	0.00	4000	2	0.00	0.00	2000	1	0.00	0.00	800.00	1	0.00
				Tunnel	1.50	4500	3	202.50	0.75	2250	1	16.88	0.45	900.00	1	4.05
				Bridge	3.35	3000	3	301.50	1.68	1500	1	25.13	1.01	600.00	1	6.03
				Road diversion	2.60	4500	2	234.00	0.87	2250	1	19.50	0.52	900.00	1	4.68
				subtotal	35.13	/	/	4474.80	17.13	/	/	372.90	10.28	/	1	89.50
			temporary land	Land borrow area	4.83	5500	4	1062.60	2.42	2750	1	66.41	1.45	1100.00	1	15.94

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
				Spoil ground	16.06	5000	4	3212.00	8.03	2500	1	200.75	4.82	1000.00	1	48.18
				Pioneer road	0.00	2500	4	0.00	0.00	1250	1	0.00	0.00	500.00	1	0.00
				Construction site and camp	3.00	2000	4	240.00	1.50	1000	1	15.00	0.90	400.00	1	3.60
				subtotal	23.89	/	/	4514.60	11.95	/	/	282.16	7.17	/	/	67.72
			Total		59.02	/	/	8989.40	29.08	/	/	655.06	17.45	/	/	157.22
CK253+440 ～ CK278+120		Yanji city	permanent area	Subgrade	44.42	4500	3	5996.70	22.21	2250	1	499.73	13.33	900.00	1	119.93
				yard	49.50	4000	2	3960.00	24.75	2000	1	495.00	14.85	800.00	1	118.80
				Tunnel	2.50	4500	3	337.50	1.25	2250	1	28.13	0.75	900.00	1	6.75
				Bridge	18.32	3000	3	1648.80	9.16	1500	1	137.40	5.50	600.00	1	32.98
				Road diversion	7.53	4500	2	677.70	2.51	2250	1	56.48	1.51	900.00	1	13.55
				subtotal	122.27	/	/	12620.70	59.88	/	/	1216.73	35.93	/	1	292.01
			temporary land	Land borrow area	34.43	5500	4	7574.60	17.22	2750	1	473.41	10.33	1100.00	1	113.62
				Spoil ground	20.20	5000	4	4040.00	10.10	2500	1	252.50	6.06	1000.00	1	60.60
				Pioneer road	7.48	2500	4	748.00	3.74	1250	1	46.75	2.24	500.00	1	11.22
				Construction site and camp	24.13	2000	4	1930.40	12.07	1000	1	120.65	7.24	400.00	1	28.96

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
				subtotal	86.24	/	/	14293.00	43.12	/	/	893.31	25.87	/	/	214.40
			Total		208.51	/	/	26913.70	103.00	/	/	2110.04	61.80	/	/	506.41
CK278+120 ～ CK330+320		Tumen city	permanent area	Subgrade	40.76	4500	3	5502.60	20.38	2250	1	458.55	12.23	900.00	1	110.05
				yard	46.62	4000	2	3729.60	23.31	2000	1	466.20	13.99	800.00	1	111.89
				Tunnel	5.00	4500	3	675.00	2.50	2250	1	56.25	1.50	900.00	1	13.50
				Bridge	14.75	3000	3	1327.50	7.38	1500	1	110.63	4.43	600.00	1	26.55
				Road diversion	2.73	4500	2	245.70	0.91	2250	1	20.48	0.55	900.00	1	4.91
				subtotal	109.86	/	/	11480.40	54.48	/	/	1112.10	32.69	/	1	266.90
			temporary land	Land borrow area	39.38	5500	4	8663.60	19.69	2750	1	541.48	11.81	1100.00	1	129.95
				Spoil ground	98.81	5000	4	19762.00	49.41	2500	1	1235.13	29.64	1000.00	1	296.43
				Pioneer road	2.60	2500	4	260.00	1.30	1250	1	16.25	0.78	500.00	1	3.90
				Construction site and camp	28.20	2000	4	2256.00	14.10	1000	1	141.00	8.46	400.00	1	33.84
				subtotal	168.99	/	/	30941.60	84.50	/	/	1933.85	50.70	/	/	464.12
			Total		278.85	/	/	42422.00	138.97	/	/	3045.95	83.38	/	/	731.03
CK330+320 ～ CK362+2		Hunchun city	permanent area	Subgrade	12.90	4500	3	1741.50	6.45	2250	1	145.13	3.87	900.00	1	34.83
				yard	14.03	4000	2	1122.40	7.02	2000	1	140.30	4.21	800.00	1	33.67
				Tunnel	4.25	4500	3	573.75	2.13	2250	1	47.81	1.28	900.00	1	11.48

OD Miles	Administrative division		Project type		Construction period				Soil erosion area in the first year of natural restoration				Soil erosion area in the second year of natural restoration			
					Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount	Area	Erosion Modulus	Construction year	Erosion amount
00				Bridge	11.13	3000	3	1001.70	5.57	1500	1	83.48	3.34	600.00	1	20.03
				Road diversion	4.27	4500	2	384.30	1.42	2250	1	32.03	0.85	900.00	1	7.69
				subtotal	46.58	/	/	4823.65	22.58	/	/	448.74	13.55	/	1	107.70
			temporary land	Land borrow area	117.91	5500	4	25940.86	58.96	2750	1	1621.30	35.37	1100.00	1	389.11
				Spoil ground	59.89	5000	4	11978.20	29.95	2500	1	748.64	17.97	1000.00	1	179.67
				Pioneer road	35.86	2500	4	3586.00	17.93	1250	1	224.13	10.76	500.00	1	53.79
				Construction site and camp	9.07	2000	4	725.36	4.53	1000	1	45.34	2.72	400.00	1	10.88
				subtotal	222.73	/	/	42230.42	111.37	/	/	2639.40	66.82	/	/	633.46
			Total		269.31	/	/	47054.07	133.94	/	/	3088.14	80.37	/	/	741.15
Total					2216.83			317137.82	1099.41			23383.29	659.64			5611.99

Table 5-6-4 Statistics of Poject Soil Erosion 1

Soil Erosion of the Original Landscape (t)	Soil erosion area dunring the construction period (t)	Soil erosion area in the first year of natural restoration (t)	Soil erosion area in the second year of natural restoration (t)	Project added soil erosion(t)
38368.74	317137.82	23383.29	5611.99	307764.36

According to the above calculation, the quantity of soil erosion of the original landscape is 3.84×104t，soil erosion in the construction period 1.71×104t，Soil erosion area in the first year of natural restoration (t) 2.34×104t，Soil erosion area in the second year of natural restoration (t) 0.56×104t，Project added soil erosion(t) 30.78×104t.

Table 5-6-5 Statistics of Poject Soil Erosion 2

Administrative division		Soil Erosion of the Original Landscape (t)	Soil erosion area dunring the construction period (t)	Soil erosion area in the first year of natural restoration (t)	Soil erosion area in the second year of natural restoration (t)	Project added soil erosion(t)
Jilin City of Jilin Province	Changyi district	259.14	3018.90	235.95	56.63	3052.34
	Fengman district	102.42	1462.45	116.54	27.97	1504.54
	Longtan district	2417.46	15428.50	1187.39	284.97	14483.40
	Jiaohe city	8717.04	67823.60	4935.76	1184.58	65226.91
	Subtotal	11496.06	87733.45	6475.64	1554.15	84267.19
Yanbian Korean Autonomous Region	Dunhua city	8414.94	56786.15	4605.95	1105.43	54082.59
	Antu city	4650.12	47239.05	3402.51	816.60	46808.05
	Longjing city	865.98	8989.40	655.06	157.22	8935.70
	Yanji city	4032.36	26913.70	2110.04	506.41	25497.79
	Tumen city	4938.84	42422.00	3045.95	731.03	41260.14
	Hunchun city	4158.78	47054.07	3088.14	741.15	46724.58
	subtotal	27061.02	229404.4	16907.65	4057.84	223308.9
Total		38368.74	317137.82	23383.29	5611.99	307764.36

5.6.3 Soil Erosion Prevention and Control Measures

1. Measure system of protection and control

According to characteristics, extent of harm, prevention and control objectives and prevention and control division results of water and soil loss under the railway construction project, based on the principle of combination of management and protection, plant measures and engineering measures, management of water and soil loss and reconstruct and improve land productivity, a variety of water and soil conservation measures such as engineering measures, plant measures and temporary measures are subject to overall layout (figure 5-6-1, figure 5-6-2), to form a complete water and soil loss prevention and control system.

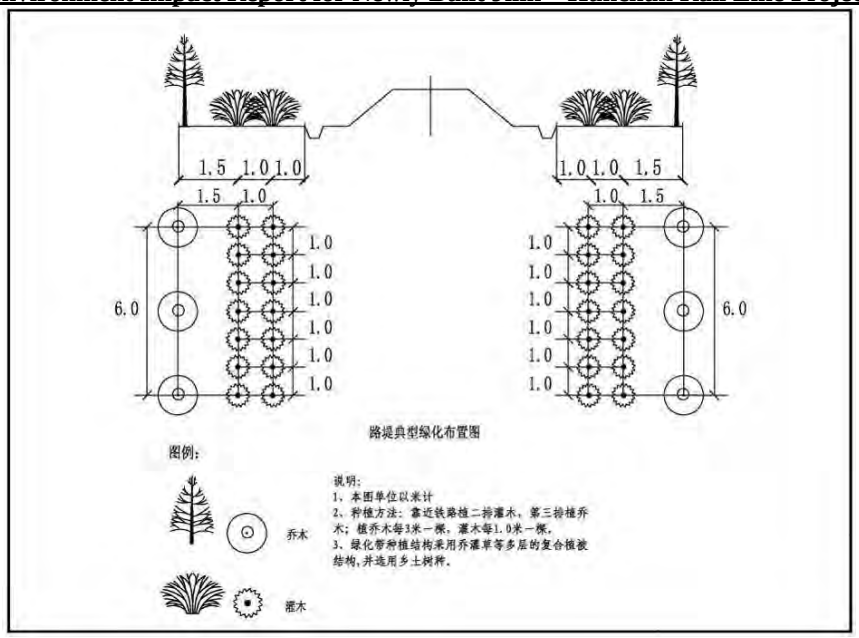


Chart 5-6-1 Plant Method Design Drawing

路堤典型绿化布置图	Typical green layout of road embankment
图例：	Legend:
说明： 1. 本图单位以米计 2. 种植方法：靠近铁路植二排灌木，第三排植乔木；植乔木每 3 米一棵，灌木每 1.0 米一棵。 3. 绿化带种植结构采用乔灌草等多层的复合植被结构，并选用乡土树种。	Explanation: 1. Meter is used as unit in this drawing. 2. Planting method: two rows of shrubs are planted near the railway, and arbor trees are planted in the third row; a arbor is planted every other 3 m, and a shrub every other 1.0 m. 3. Planting structure of green belt should adopt multi-layer composite vegetation structure consisting of arbor, shrub and grass, and native trees should also be selected.
乔木	Arbor
灌木	shrub

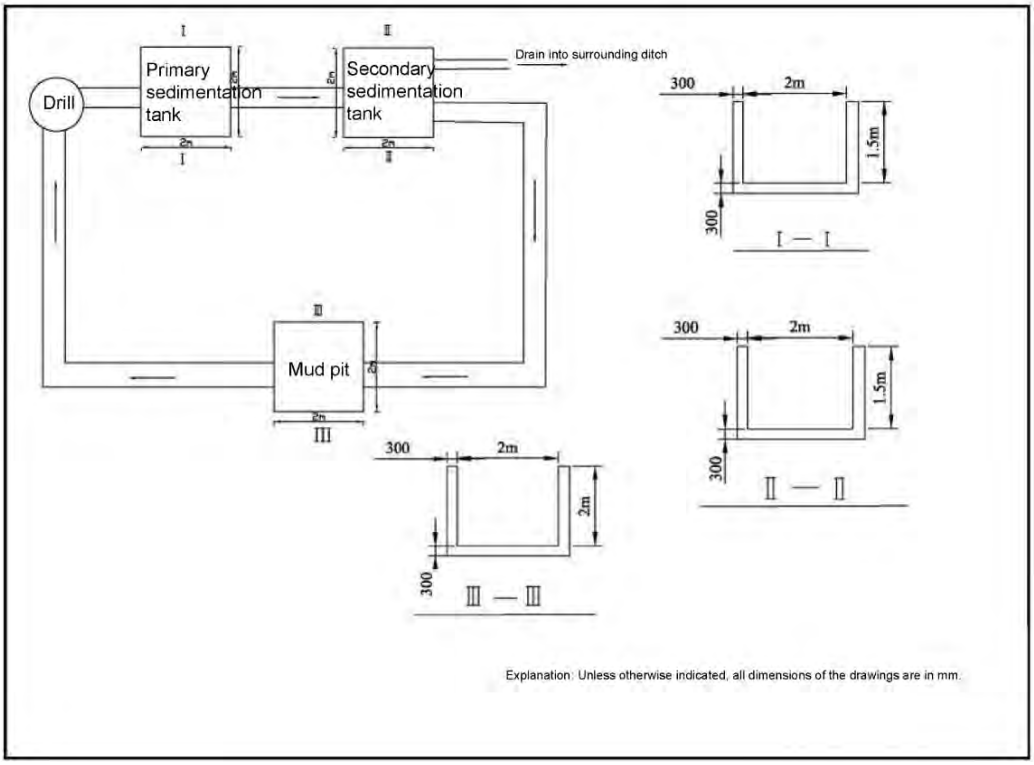


Chart 5-6-2 Temporary Method Design Drawing

2. Existing water and soil conservation measures of the main project

In the main project design, in line with local conditions, different forms of protective measures shall respectively be taken to protect the road embankment, slope of road cut, drainage of subgrade, bridge and culvert and tunnel, ensuring the safety of the main project as well as providing certain function of ecological protection at the same time.

(1) Protective measures of subgrade

1) Slope protection of road embankment

① When road embankment slope height H<3m, the slope shall use C20 precast concrete hollow bricks as protection in which grass and amorpha should be planted and earthed up.

② When road embankment slope height H≥3m, the slopes on both sides under the surface layer of subgrade bed of road embankment shall be horizontally paved with two-way stretch geogrid with width not less than 3m (tensile strength not less than 25KN/m, layer spacing of 0.6 m), and shall adopt M7.5 cement mortar rubble arch type intercepting framework as protection. Within the framework grass seeds are scattered and shrubs are planted. The framework sizes all adopt 3×3m, of which arch framework thickness is 0.4m and the thickness of frame 0.6m.

③ For flooded section, toe wall foundation mortar rubble slope protection shall be set, crest elevation of slope protection = design flood level + wave invasion height + hammed water height + 0.5 m.

④ For road embankment section with flat terrain, difficult vertical drainage conditions and foundation of soil layer in frozen heaving property, anti-frost berm shall be set on both sides of

slope, which width and height should be not less than the maximum seasonal frost depth of passing through areas.

2) High road embankment (when subgrade slope height is greater than 8m)

① Filling by both A and B groups should be adopted under surface layer of subgrade bed. Roller compaction which standard is consistent with the requirements of the bottom layer of subgrade bed should be strengthened.

② Slope of road embankment shall be protected at different levels below the elevation of road shoulder, and the level height of slope shall exceed 8.0m. The first-level slope ratio is 1:1.5, and the second-level 1:1.75, from the third-level the ratio maintains 1:2. Platform width of the slope is generally 2~3m, and the slope uses M7.5 mortar rubble arch-type intercepting framework within which grass seeds are sprayed and shrubs are planted as protection. Slope platform is closed by M7.5 mortar rubble, with rectangular intercepting ditch which bottom width is 0.4m, depth 0.4m and thickness 0.3m.

③ Geogrid re-enforcement shall be laid at 3.0m~4.0m width of slope, with 0.6m space between them; the 1~2 levels in the middle and lower part of the slope full-face continuous re-enforcement are set up at intervals of 1.5m. Two-way tensile strength of geogrid is not less than 50KN/m.

④ Set 3~5m gravity walls or 6~10m sheet pile wall at slope toe of road embankment to reduce the height of slope as needed.

3) Subgrade of steep slope (when cross slope of basal surface of road embankment is greater than 1:25)

Most unfavorable load is used in the check and calculation of sliding stability of weak layer along the base or at lower basement for subgrade of steep slope, with anti-slide stability coefficients of 1.25. When stability is not enough, strengthening stability measures may be adopted such as setting road embankment retaining wall. Gravity type road shoulder retaining wall should generally be not more than 8.0m, gravity type road embankment retaining wall not more than 6.0m, cantilever type retaining wall not more than 6.0m, and buttressed type retaining wall not more than 10.0m. Gravity retaining wall uses C25 concrete rubble masonry which embedded depth of foundation is not less than 1.25m, and its foundation soil within 0.25m depth range from the base to frost line should be replaced into a non-heaving soil for filling.

4) Slope protection of deep road cut and road cut

① Slope protection works should be set for road cut of weak rock, and of seriously weathered, fracture hard rock as well as of soil. The slope protection works should adopt sloping in combination with green slope protection as possible on the basis of insuring the stability of the slop in principle.

② Soil road cut

When the slope height is not more than 3m, its surface should be protected by grass seed and shrubs planting by jetting; when the slope height is more than 3m, its surface should be protected by a 3×3m M7.5 stone arch-type framework which is bonded with cement mortar with a cut-off trench. Within the framework, the grass seed and shrubs should be planted by jetting. When the cut slope height is more than 6m, at the bottom short retaining wall of 3m shall be established. When the slope is relatively high, the central platform shall be set up with drainage

ditches in the middle.

When the retaining wall is taller than 6m, protective measures such as anchor bolt spray should be adopted temporarily during the construction. The anchor bolt shall be staggered up and down or left and right by every 2.0m interval, made from φ16HRB335 level reinforcing bar. The anchor hole is 1.6m in depth into which M30 cement mortar is pouring. The slope surface shall be sprayed with M10 cement mortar with thickness of 0.04m, where galvanized wire mesh should be laid if necessary.

③ Rock road cut

a. When the slope is relatively high, it may use retaining wall to close; as for road cut slope of soil or soft rock, protective or reinforcement measures such as M7.5 mortar rubble intercepting framework slope protection, mortar rubble slope protection, revetment, dimensional ecological protective bags, spray protection by hanging net, frame anchor bolt, anchor rope shall be used according to the specific conditions; complete hard rock road cut slope should adopt smooth blasting (or pre-splitting blasting) in principle, and the slope surface shall not be protected.

Retaining wall uses C25 rubble concrete masonry, which maximum height does not exceed 8m, and embedded depth of foundation is not less than 1.25m.

When using full slope surface masonry protection, set planted tank where climbers are planted for greening at the slope toe. Within the framework slope protection, grass and shrub slope protection are used. If necessary, geocells are set to be earthed within framework.

b. For the working spot of road cut with larger earth excavation and worse engineering geological conditions, according to the specific work site conditions, reinforcement measures such as prestressed anchor rope and sheet pile wall should be used.

c. When the retaining wall set on the soft rock is taller than 8m, and on the section with more rock fragmentation, protective measures such as anchor bolt spray should be adopted temporarily during the construction. The anchor bolt shall be staggered up and down or left and right by every 2.0m interval, made from φ16HRB335 level reinforcing bar. The anchor hole is 1.6m in depth into which M30 cement mortar is pouring. The slope surface shall be sprayed with M10 cement mortar with thickness of 0.04m, where galvanized wire mesh should be laid if necessary.

5) Flooded subgrade

① Pond road embankment

If water retains after the construction, road embankment crossing the pond shall usually be filled following pumping, dewatering and dredging by setting the cofferdam, and filled with permeable soil below the elevation of pond ridge where mortar rubble slope protection is also used. The slope is slowed down by one level, and stucco stone foundation is set at the slope toe and 2.0m wide platform is located at the pond ridge elevation spot. Soft soil section of pond subgrade after the pumping, dredging and dewatering of the cofferdam, shall be strengthened as per soft soil subgrade, and then be filled with permeable soil up to pond ridge height. Considering that the whole pond is abandoned, fist pumping, dewatering and dredging, then filling as per ordinary road embankment, and road embankment drainage system should be kept smooth.

② Road embankment of riverside and Binhe

a. Fortification elevation = fortification water level + height of waves invasion + height of hammed water + 0.5 m. A 2.0m wide platform shall be left on the protection elevation spot. Permeable soil may be filled below protection elevation. Slope ration has slowed down by one level comparing to that of ordinary road embankment.

b. Protective measures: beach velocity Vp<1.8m/s, using 0.30m thick dry-laid rubble slope protection; beach velocity Vp＝1.8~3.0m/s, using 0.30m thick M7.5 mortar rubble slope protection; beach velocity Vp>3.0m/s, using C20 rubble concrete retaining wall protection.

c. Subgrade on both sides of the bridge crossing the river uses M7.5 mortar rubble with 0.30m thick slope protection; consider 20m as the protection length.

6) Expansive soil (rock) road cut

① Slope of road cut is graded by every 6m. At bottom 6m, slope may be made in accordance with 1:1.5, and at upward 6~10m, with 1:1.75. 2m wide platform on which drainage ditch is set is located between the levels. The road cut which slope height is more than 10m should check and calculate the stability through arc method of which a safety factor value is 1.25. Slope type and ration should be designed according to the checking results.

② When the slope height is less than 3m, high hollow brick plant should be used as slope protection; when it is more than 3m, 3×3m M7.5 mortar rubble arch type intercepting framework plus hollow brick plants as protection of slope surface. When the slope height is taller than 6m, at the slope toe are set C25 rubble concrete toe wall with height of 3m and 2m wide platform on its top. The above slopes should be graded and protected again according to the aforementioned principles, if necessary, anti-slide retaining wall or anti-slide pile shall be set.

③ Enhance the design of drawing and discharging water. For side ditch, gutter and intercepting ditch, reinforcement measures such as .scour prevention and anti-seepage should be taken.

7) Subgrade drainage

Subgrade should be with a good and improve drainage system. The drainage equipment should be reasonably arranged, connecting and matching with drainage devices of bridges and culverts, tunnels and stations etc., with sufficient flow capacity to ensure the water flow. Drainage works should appropriately enhance the lateral drainage facilities of subgrade in combination with specific conditions, and timely implemented to prevent soft subgrade and collapse of slope surface resulting from the invasion of surface water and underground water during the construction period.

① Drainage ditch, intercepting ditch and gutters: on obvious section of lateral slope of ground, and drainage ditch and gutter are set on one side of subgrade. If there is no obvious lateral slope of ground, they should be set on both sides of the subgrade. Rectangular platform intercepting ditch should be set on slope of road cut. Drainage ditch and gutter generally take the trapezoidal form of which bottom width is 0.4m, depth 0.6m, slope ratio of 1:1, using puzzle M7.5 mortar rubble masonry block or precast concrete C15; drainage ditch usually takes the form of rectangle which bottom width is 0.4m, depth 0.4m.

② Side ditch: takes the form of rectangle which bottom width is 0.6m, depth 0.8m, using C25 reinforced concrete member as masonry, with thickness of 0.2m, with additional reinforced concrete cover on the top. When drainage discharge is large on local sites, side ditch should be

expanded based on discharge data.

③ Blind ditch: on the earth excavation section with relatively developed groundwater, blind ditch are set to influx the groundwater within bottom layer of subgrade bed, and to lead them to outside the subgrade.

(2) Protection of bridges and culverts works

The amount of bridges and culverts along this line is very large, construction of bridges and culverts will arouse a certain impact on the ecological environment and water and soil conservation, so active measures has been taken in its design to reduce the impact of project construction.

When crossing the river, the bridge arrangement should try not to reduce river channel, damage of the river bank caused by the construction should be restored and soiling of embankment should be carried out;

When crossing the gully, long and big change of channel should be avoided. Natural runoff status should be maintained to ensure the smooth flow of flood discharge. Whenever possible, the pier should be streamlined to reduce the water blocking area of its body, to prevent from increased erosion, and reduce the impact on slope of upstream and downstream at bridge site so as not to result in water and soil loss;

Full consideration should be given to flood discharging capacity of culvert diameter in the design so as to avoid contracting flow which may lead to water and soil loss by increased downstream since the culvert is a little smaller.

For every trench for farmland irrigation and drainage, bridge and culvert should be set up to ensure a smooth irrigation and drainage system.

The spoil generated by pit excavation shall be transported to dump on the special spoil yard site or low-cavity areas, and to make proper greening.

Construction cofferdam shall be removed timely to ensure a smooth flow of water and waterways.

(3) Tunnel works protection

The principle “come in early and go out late” should be strictly observed in tunnel design and construction process. In the suitable conditions, oblique style portal should be adopted to minimize height of moving away rocks of tunnel entrance edge and heading slope, also to reduce the destruction of surface vegetation. In construction process, settings of construction access, camp and work site should try to maintain the natural landscape, even while occupying wasteland, less excavation and moving away rocks should also be followed to protect the vegetation. After the construction is completed, the destroyed areas of tunnel entrance edge, heading slope and vegetation should be restored.

(4) Station protection

Station protection project mainly includes drainage and green protection of station.

Within the rail station, concrete retaining walls uses protective method of slope surface covering with climbing plants planted on the top; the gentler slope may use planting shrubs, with arbor trees planted at slope toe of road embankment; platform barrier may be covered with climbing plants or with high hedges; in the middle of platform barrier, arbor, shrub and greenways may be adopted.

Flower border, arbor and shrubs may be arranged at the side of the station house; Wall is greened by planting climbing plants, and green fence is used to separate and guide the flow.

The greening of area around office and production district should give priority to the requirements of health protection. It is suitable to plant deciduous trees in the southern slope, and to plant tall shade trees to the east-west and to plant mixedly evergreen and deciduous tree and shrubs to the north, and open space should be widely planted with lawn. At 1~2m in front of window, shrub and green pole are planted, where lawn are paved and dotted with flowers. At windows in the west, if conditions allow, green shade shall be set to prevent western exposure, with climbing plants such as leguminous plants and beer flower. The wall is fully greened, if conditions allow, turf plants as well as vegetables are planting on the roof. The whole wall is vertically greened. Under normal conditions, green belt accounts for more than 20% of the road, with turf and shrubs planted under the trees of sidewalk.

Working quantity of water and soil conservation measures of main projects is shown in table 5-6-6.

Table 5-6-6 Grass Seeds Speeding & Protecting Methods Working Quantity Summary of Original Water and Soil of Main Projects

Investiment Items			Expenditure (10k RMB Yuan)	
Water and soil maintaining methods	Slurry maison slate		32659	(included in the main project items)
	Subgrade side slope greening protect		3982.7	
	Side slope geotexile grill		3746.8	
	Arbor planting beyond subgrade side slope	81133 ps	321	
	Subgrade earth dumping pit arbor within protection zone	11117 ps	42.4	
	Subgrade earth dumping pit shrub within protection zone	100000 ps	12.3	
	Shrub planting beyond subgrade side slope	679067 ps	83.2	
	Grass seeds speeding at subgrade earth dumping pit	2285741m^2	418.1	
	Grass seeds speeding at tunnel openning			
	Station greening	9 ps	101.7	

3. Additional measures of environmental assessment

In the main project design, there are not only protection design plan and adequate works quantities for slope of subgrade and bridge abutment cone, but also line and station with complete drainage facilities. After the implementation of protection works, water and soil loss within the

scope of works can be effectively controlled, and protection of subgrade slope and bridge abutment cone requirements can achieve the standard of soil and water conservation ecological protection.

(1) Improve the protective measures design of the main project, and add soil and water conservation requirements during the construction period.

In the main project design, prevention and management zone of subgrade, bridge and culvert, and tunnel works should take engineering measures to meet the requirements of water and soil conservation, without the need of taking new protective engineering measures during operation period. For construction period, temporary protective measures should be taken to prevent water and soil loss.

(2) Solve the problem concerning temporary stacking of topsoil removed by the main project

Since the farmland is highly concentrated along the project line, and permanent and temporary occupation are likely to take up a lot of farmland during the construction, it is necessary to strip, stack and store the topsoil from farmland within the occupying area and to make use of the topsoil as covering soil for temporary land reclamation and greening. In addition, as earth and stonework in the project is in great quantity, cut-fill transition is frequent in order to reduce borrow occupying area. It is necessary to consider temporary staking of dispensed earth. Combined with the construction sequence and construction site use, further implementation of the temporary stacking space and related temporary protective measures shall be conducted.

(3) Complement and improvement of protection design of borrow (slag) area

Location of borrow area should be unified planned according to borrow nature and quantity of different sections, integrated with elements such as subgrade drainage, topography, soil, construction methods, land conservation and environmental protection. Soil excavating and depositing site should be centralized to set. Under the prerequisite of meeting the requirements of filling, wasteland, poor land should be use as more as possible, with little or no occupation of farmland. When filling earth of road embankment is in large quantity and concentrate, far transportation and centralized borrow should be use.

Centralized soil excavating and depositing site should take the necessary bracing, protection, greening measures to ensure slope stability and reduce water and soil loss. When occupying farmland for earth borrowing, practical rehabilitation measures should be taken. Before borrow, surface arable soil on the surface should be stripped, which should be leveled and restored after borrow.

Waste slag of tunnel should be maximally used as concrete aggregate, filling of subgrade or station, etc.. For those which can not be used, select low-lying wasteland which is not easily washed by surface runoff such as rivers, canals, or low productive site for disposal. At the bottom of the waste slag yard, penetrated pipes are set, with waste slag retaining wall around the facilities. At the top of the waste slag and around the waste slag yard drainage ditch are set to prevent the loss of waste slag. If conditions allow, the top of waste slag deposited should be earthed to return into farmland or to restore vegetation by spreading grass seed.

(4) Supplement and improvement of protection design of other temporary works

Construction access, construction camps and site of the project is large in scale, according to requirements of water and soil loss control, do a good job of temporary drainage during the

construction, and take the appropriate recovery measures in terms of vegetation restoration and land reclamation.

Environment assessment added maintaining method working quantity is shown in table 5-6-7.

Table 5-6-7 Environment Assessment Added Maintaining Method Working Quantity Summary

Type Zone	Items	Unit	Quantity	Expenditure (10k RMB Yuan）
Main work prevention zone	1. project methods			242.86
	Surface soil peeling	$\times10^4m^3$	289.13	242.86
	3. temporary methods			615.84
	Temporary sandbag protection for surface soil peeling	m^3	1935.26	14.86
	Temporary grass planting protection for surface soil peeling	hm^2	138.83	13.38
	soil drainage ditch	m^3	4127.97	3.60
	Temporary sandbag and earth, rock works retaining allocation	m^3	23600	184.00
	Temporary earth, rock works mesh covering allocation	hm^2	229.73	400.00
Earth(slag) borrowing and dumping prevention zone	1. project methods			40.53
	Slurry masoning stone ditches	m^3	1642.92	40.53
	4. land treatment methods			152.92
	Cultivation resuming	hm^2	160	152.92
Constrution access prevention zone	2. plantation methods			7.8
	Greening by grass planting	hm^2	77.68	7.8
	3. temporary methods			29.82
	soil drainage ditch	m^3	48556.42	29.82
Other temporary work prevention zone	3. temporary methods			3.93
	soil drainage ditch	m^3	6268.57	3.93
	4. land treatment methods			122.00
	Resuming the ground by hardening	hm^2	62.85	/

Type Zone	Items	Unit	Quantity	Expenditure (10k RMB Yuan）
	Cultivation resuming	hm^2	127.61	122.00

5.7 Main ecological sensitive area along the line

5.7.1 General

Ecological sensitive area along the project line (see figure 5-7-1) are:

(1) Relic type: Mao’er Mt. Graveyard and Longtanshancheng;

(2) ~~Forest park type: Riguang Mt. Forest Garden;~~ According to feasibility study stage, the alignment will traverse Riguang Mt. Forest Garden. During later design stage, the alignment was shifted to avoid passing it.

(3) Natural preservation zone type: Songhuajiang 3-lake Natural Protection Zone and Mingmusongrong Protection Zone;

(4) Aquatic germ plasm resources conservation area: Mijiang Salmon Aquatic Germ Plasm Resource Protection ZONE

Longtanshancheng

Mao'er Mt. Graveyard

Songhuajiang 3-lake Natural Protection Zone

Mingmusongrong Protection Zone

Sunlight Mt. Forest Garden

Mijiang Salmon Protection Zone

Fig. 5-7-1 Ecological sensitive area along the project line

For general overview of above-mentioned ecological sensitive area, see table 5-7-1.

Table 5-7-1 Sensitive Zone along the Project

Ecological sensitive zone name	Geographic location and scope	Protection grade	Main protected objects
Mao'er Mt. Graveyard	Located at Songhuajiang bank of east suburban of Jilin city, Yong'an village of	State level	Han Dynasty cultural relic

	Jiangnan of Fengman district, Yuming village and Tiantai village of Longtan, with total area of 15km^2. Including Nanshan graveyard zone, Mao'er Mt. graveyard group zone, West Mt. graveyard group zone, Pianbian Mt. graveyard group zone and Guandi relic, Nanchengzi relic zone. Centred with Mao'er Mt., to Longtan Mt. foot to the east, Mao'er Mt.and Nan Mt. and south slope of Pianlian Mt. to the south, boundried with Jiyao highway, and to Songhuajiang in the north.		
Longtanshancheng	Locate on the Longtan Mt. of Jilin in the northeast, 7km to the downtown, 388.1m elevation, about 100m higher than ground surface.. having rolly hillock in the east and south, Songhuajiang of south to north current in the west, neighbored with Geyaya river and Mao'er graveyard in the southwest; facing Songhuajiang and Sandaolingzi Mt. city in the northwest	State level	Gaojuli period building relic
~~Riguang Mt. Forest Garden~~	~~Located in the southeast of Tumen city, 4.3km to the downtown, with elevation of 400m and protection area of 647 hectare.~~	~~Provincial~~	~~Forest ecological resource, ecology diversity and scenery resource~~
Songhuajiang 3-lake Natural Protection Zone	Starting from A'shehadamo Cliff in the north to the Wusong couny of Baishan city in the south, 1.1447 hectare in total area, including 16 villages (towns) of Fengman district, Jiaohe city and Huadian city, and 12 villages (towns) of Wusong county of Bai Mt. city and Jingyu county.	Provincial	Forest ecology and water resource
Mingmusongrong Protection Zone	In the north of Antu county, the Mingmu basin of Changbaishan north footing, geograhic location: 128°37′30″-129°9′45″ at east longitude, 42°56′10″-43°26′ at the north latitude, total area of 120k hectare, including Mingyue county, Stone Gate Village and south of Changxing village	Provincial	Pine antler resource, red pine forest and wild animal for the pine antler existance
Mijiang Salmon Aquatic Germ	Tumenjiang branch-Mijiang area, including Mijiang truck section of 56km and other	State level	Migration fish: salmon(Masu

Plasm Resource Protection Zone	relative branches. Protection area of 6610 hectarr, core zone of 2080 hectare and experimental area of 4530 hectare.		salmon, hunch back salmon, salmo), cold water fine scale fish, beach head fish, Japanes lamprey, red spot salmon), migration passage, egg laying place and natural habit.

5.7.2 Relationship between ecological sensitive area and line position

The project is passing through construction control areas of two cultural relics, Longtanshancheng and Mao'er Mt. Graveyard, on the length of 2.29km; it is passing through the peripheral zone (experimental zone) of Songhuajiang 3-lake Natural Protection Zone in three parts which are respectively 23.32km, 9.36km and 8.8km in length, a total of 38.5km; it is passing through Natural Protective Zone of Antu Mingyuesongrong on the length of 41.3km; ~~it is passing through Riguang Mt. Forest Garden on the length of 2.25km;~~ it is passing through Mijiang Salmon State Level Aquatic Germ Plasm Resource Protection Zone in length for the 770m, of which the core area of 570m, experimental area 200m.

Project overview and lines type in the above mentioned ecologic sensitive area and their relationship with the ecological sensitive area are shown in table 5-7-2.

Table 5-7-2 Line Type and Length Summary in Ecologic Sensitive Zone
length unit: km

Name of Ecologic Sensitive Zone	Chainage	Length	Subgrade length and percentage (%)	Bridge length and percentage	Tunnel length and percentage
Longtanshan City and Mao'er Cemetery relic controlling belt	DK2+680~DK3+350 DK4+580~DK6+200	2.29	/	0.67 (29.3%)	1.62 (70.7%)
Surrounding area of Songhuajiang	DK24+800~DK48+120 DK59+640~DK69+00	40.5	12.57 (31.0%)	8.61 (21.3%)	19.32 (47.7)

3-lake natural protective zone	0 DK73+000~DK81+800				
Natural protective zone of Mingyuesongrong	DK200+000~DK241+300	41.3	12.903 (31.2%)	6.1 (14.8%)	22.287 (54.0%)
~~Riguang Mt. forest garden~~	~~DK301+600~CK303+850~~	~~2.25~~	~~/~~	~~/~~	~~2.25 (100%)~~
Mijiang salmon state level aquatic germ plasm resource protection zone	DK337+280~DK338+050	0.77	/	0.77 (100%)	/

This section focuses on the environmental impact of the engineering construction on Songhuajiang 3-lake Natural Protective Zone, Natural Protective Zone of Songrong and Mijiang Salmon State Level Aquatic Germ Plasm Resource Protection Zone. For the effect of engineering construction on Mao'er Graveyard and Longtanshancheng relic, see section concerning the social and economic impact.

~~5.7.3 Impact analysis of project on Riguang Mountain Forest Garden~~

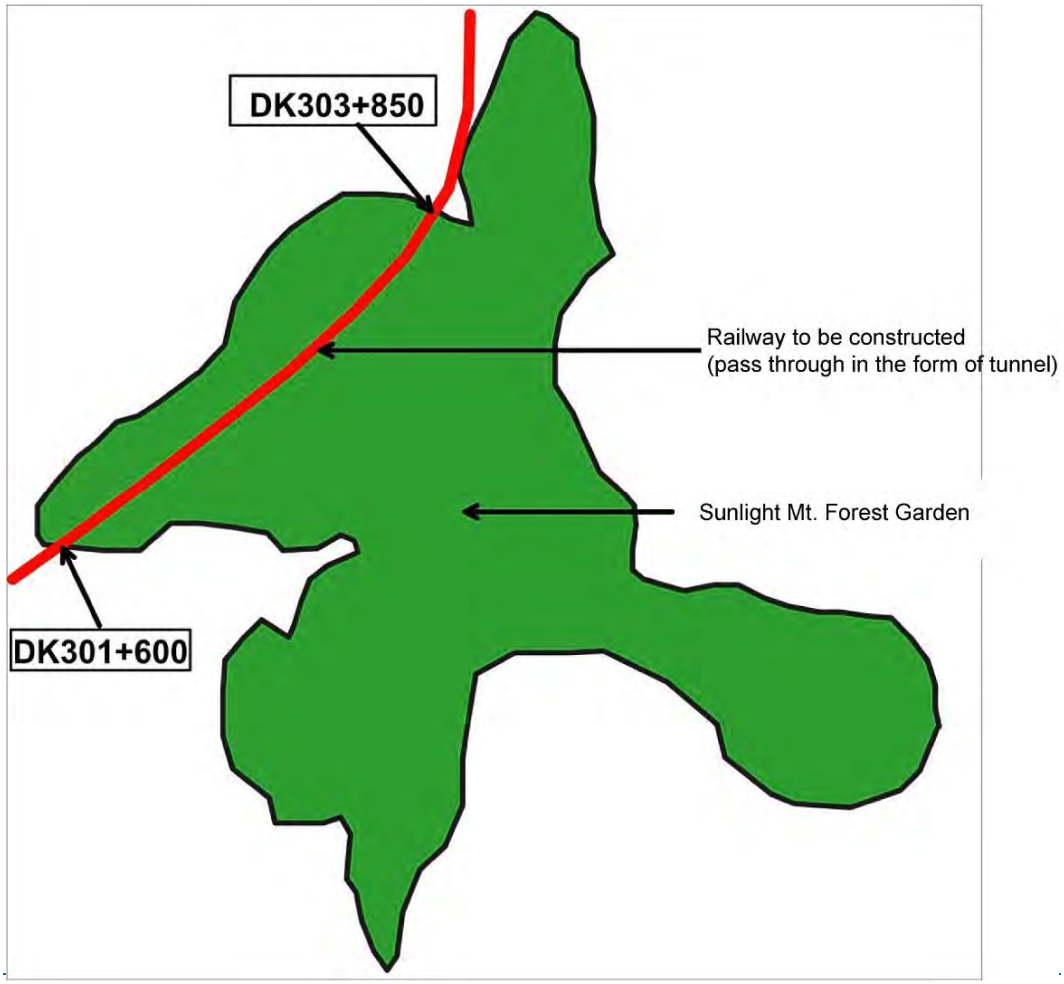
~~5.7.3.1 Overview of Riguang Mt. Forest garden~~

~~Located in the southeast of Tumen city, 4.3km away from the downtown, Riguang Mt. Forest garden boasts steep mountains on its eastern side and flat on north western, which main peak rises to a height of 390.7m. The mountain is covered with grotesque peaks and jagged rocks and luxuriant forests, which topsoil is yellow sand suitable for planting pine and cypress trees. The mountain was named Riguang Mt. in 1937 as it has a relatively longer sunshine. Huayan Temple as a residence for the monk "Suigetsu Master" who is famous both at home and abroad has been reserved on the mountain. Facing North Korea across the river, its scenery between the two countries is clearly visible when climbing Riguang Mt.. The park covering a protective area of 647hm^2, with 70% forest cover has lush forest, peaceful valley and rich wildlife resources; its ecological environment is very beautiful. Every early spring, clusters of azalea flowers are fully blooming at the foot of hills and slopes, which are extremely bright to form a red sea across the mountains, at this time visitors may enjoy the scenery endowed by nature by car or hiking. At the top of Riguang Mt., there is panoramic view with beautiful scenery between China and North Korea at a single glance. The forest garden is ratified as a provincial level forest park by Jilin Provincial Forestry Department in 1993. Located in the west side of the mountain, "Huayan Temple" on Riguang Mt. was created by Suigetsu Monk in 1913, a master from North Korean, which is the biggest one—with maximum number of followers among 15 temples in Tumen city. On the former site of "Huayan Temple", there is still cornerstone of the temple, the housing~~

~~tiles ant other materials at that time, as well as the spring water used by Suigetsu Master then.~~

~~5.7.3.2 Location relation between the project and Riguang Mt. Forest Garden~~

~~The line passes through Riguang Mt. forest garden by Riguang Mt. tunnel in DK301+600~DK303+850, which length is 2.25km. The buried depth of the tunnel within the park is 22m~151m. There are no auxiliary construction tunnels such as inclined shaft, shafts and cross-hole set in the garden. The specific locations of line and Riguang Mt. forest garden are shown in figure 5-7-3:~~



~~Figure 5-7-2 Location Relation between the Project and Riguang Mt. Forest Garden~~

~~5.7.3.3 Analysis on impact of project on Riguang Mt. Forest Garden~~

~~The design plan is that 2.25km tunnel passes through Riguang Mt. Forest Garden, which entrance and exit are all located within the Forest Park. Environmental impact which may possibly be caused under tunnel construction is mainly shown in following aspects: damage resulting from building of construction access and construction sites, and spoil operation to ground vegetation of local area; excavation inside the tunnel may cause a certain amount of gushing water resulting in partial loss of groundwater. Meanwhile, engineering construction will cause a reduction in trees~~

~~quantities to some extent within the Forest Park, mainly consisting of a small portion of shrubs and arbors at the tunnel entrances. But the loss only accounts for a small portion of original large amount of forest, furthermore, methodical forest rehabilitation measures are adopted after construction, therefore, forest vegetation in Forest Park will not be affected significantly.~~

~~In order to reduce the impact on the Forest Park, the following measures are recommended:~~

~~Soil excavating and depositing operation in the park is strictly prohibited. Waste slag of tunnel should be considered as filling earth for construction of surrounding villages and towns. Valley and low-lying area without affecting the surrounding landscape should be selected for waste slag yard which top should be beautified by planting trees. Entrance and exit of tunnel portal should use environment-friendly portal, and select tree and grass species which are consistent with surrounding vegetation around portal so as to contribute to maintain regional vegetation coordination.~~

~~To avoid influence on the view of the park, tunnel construction should not set inclined tunnel and cross hole, but should adopt single port tunneling at entrance and exit. During the construction process, the required boundary and scope of construction should be strictly observed, and shielding measures should be set. Construction personnel and vehicles moving carelessly outside the boundary are prohibited. After completion of construction, the site should be thoroughly cleaned up and leveled, with vegetation restoration.~~

~~It is suggested that design units should carefully investigate hydrogeological structure of the location where the tunnel passes through in the next stage of design, to avoid the occurrence of surface-water and groundwater loss, as well as of destruction of mountain vegetation due to the tunnel running through. Monitoring gushing water and surface water inside the tunnel should be strengthened under the construction. For tunnel gushing water, effective measures for water plugging should be taken to reduce the influence of leakage on the upper surface vegetation of tunnel in the excavation process.~~

~~According to the above analysis, the route that tunnel passes through the Riguang Mt. Forest Garden will not arouse a significant impact on the environment of Forest Park after taking effective mitigation measures.~~

5.7.4 Analysis on impact of engineering construction on Mijiang Salmon Protection Zone

To have in-depth understanding of the engineering construction's impact on the major ecological sensitive areas along the line, and provide the scientific decision-making basis to the competent authorities, and in consideration of this project's certain impact on the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve, the owner commissioned Fishery Science Academy of Jilin Province to prepare “Environmental Impact Report for Construction of the Super Large Bridge over Mi Jiang River for Jilin-Hunchun High Speed Railway on the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve” and report to Department of Agriculture for approval. The following section is written on basis of the above special evaluation report.

1. Overview

Mi Jiang River chum salmon state-level aquatic product Germplasm resources reserve is established by approval of the General Office of Ministry of Agriculture with reference to "*Notice on Promulgation of Ranges and Functional Zoning of Forty State-Level Aquatic Product Germplasm Resources Reserves for Yellow River Sheatfish at Yellow River's Erdos Sections, etc.（Nong Ting Ban 【2008】No. 47）*". This germplasm resources reserve's total area is 6,610 Hectares with core area of 2，080 hectares and experimental area of 4，530 hectares. The main protected fishes are migration fishes like chum salmon （cherry salmon, humpbacked salmon, chum salmon ）, as well as the state key protected cold-water fishes like brachymytax lenok pallas，lecus brandti(dybowski),lamprey-eel，salvelinus malma，etc. The fish migration corridors, spawning places and nature habitats are also reserved.

The reserve is located in the Mi Jiang River reach, the primary branch of Tu Men River, on the northeastern side of Mt. Changbai, with the geographical coordinates as N.L. 42 ˚59′to 43 ˚16′20″, E.L. 130 ˚07′40″to 130 ˚28′40″, including Mi Jiang River's main stream , total 56 kilometres long, as well as Mi Jiang River's relevant branches. See Table 5-7-3 for details. The reserve's southernmost end starts from Mi Jiang River's mouth, running through Mi Jiang Village, Jia Fang Village, Xia Wa Zi Village, Zhong Gang Zi Village, San An Village, Qing Shui Dong Bridge, Da Huang Gou Village, with the river branches coming in one after another. See "*Geographic Location of Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve"* for detailed information about location of the reserve.

Table 5-7-3 Statistics of reserve range of Mi Jiang River chum salmon

No.	Name	Length（km）	Geographical coordinates
1	Mi Jiang River's main stream	56	
2	Mi Jiang River's branch		
2.1	Yang Mu Qiao Zi Gou	4	N.L.43 ˚15′37 ″， E.L.130 ˚21′30″；N.L.43 ˚14′7 ″，E.L. 130 ˚22′21″
2.2	Zhou Pi Gou	8.2	N.L.43 ˚14′48 ″，E.L. 130 ˚19′49″；N.L.43 ˚12′19 ″，E.L. 130 ˚21′58″
2.3	Bei Gou River	13.9	N.L.42 ˚13′20 ″，E.L. 130 ˚27′39″；N.L.43 ˚8′，E.L. 130 ˚23′38″
2.4	Bei Dong Gou River	14.5	N.L.43 ˚12′48 ″，E.L. 130 ˚27′58″；N.L.43 ˚6′30″，E.L. 130 ˚25′21″
2.5	Dong Gou River	22	N.L.43 ˚12′13 ″，E.L. 130 ˚29′47″；N.L.43 ˚

			8′，E.L. 130 ˚23′38″
2.6	Da Bin Lang Gou	18	N.L.43 ˚12′18 ″，E.L. 130 ˚13′46″；N.L.43 ˚ 10′27″，E.L. 130 ˚22′18″

This reserve is divided into two core areas and one experimental area. The first core area is located downstream of Mi Jiang River, on the river reach between Mi Jiang River's Mouth and Da Huang Gou Village, with the river course's historical maximum flood level as border, the river reach thereof 35 kilometre long, the area of 1620 hectares, taking 24.5% of the reserve's total area, where the typical reserved aquatic wildlife are chum salmon, Lampetra japonica and Lecus Brandti(Dybowski). Here the main reserved items are the spawning sites and migration pathways of the above migration fishes. The second core area is located upstream of Mi Jiang River, on the river reach from Da Huang Gou to Xi Bei Gou's valley mouth as well as the river branches-- Xi Bei River and Yang Mu Qiao Zi Gou River, with the rivers' historical maximum flood level as border for all the above rivers, the river reach's total length 39.5 kilometers, the area of 460 hectares, taking 7% of the reserve's total area, where the typical reserved aquatic wildlife are brachymytax lenok pallas and Salvelinus malma, and the main reserved items here are the spawning sites, nursery areas and wintering areas for the above fishes. The experimental area is built on the outskirts of the core area, downstream of Mi Jiang River and from Mi Jiang River's opening to Da Huang Gou Village, with village highway and mountain foot as border; 100 meters extended from the core area as border for upstream of Mi Jiang River, total area of 4530 hectares, taking 68.5% of the reserve's total area.

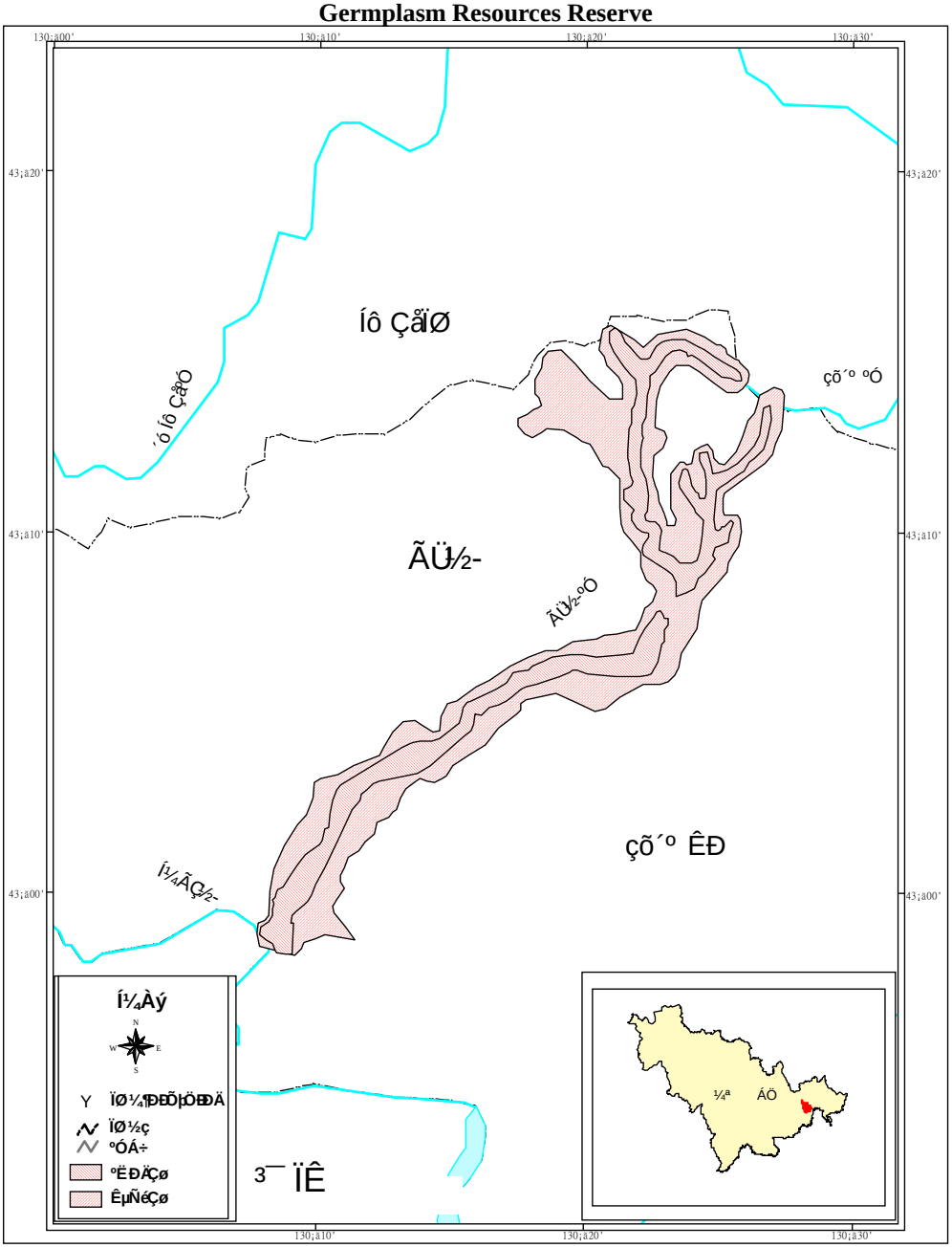
Directory of Fish Stocks of National Germplasm Conservation Zone of Mijianghe River Salmon
RETROMYZONIFORME
A. Retromyzonidae

Lampetra japonica (Martens)
SALMONIFORMES
B. Saimonidae
2 Oncorhynchus masou (Brevoort)
3 Massu-type cannabis landlocked Kazakhstan
4 Oncorhynchus Keta(Walbaum)
5 Oncorhynchus gorbuscha(Walbaum)
6 Salvelinus malma(Walbaum)
7 Brachymystax lenok(Pallas)
C. Osmeredae
8 Osmerus dentes(Steindachner)
9 Hypomesus olrdus (Pallas)

CYPRINIFORMES
D. Cyprinidae
10 Cyprinus carpio Linnaeus
11 Carassius carpio (Linnaeus)
12 Hemiculter leucisculus (Basilewsky)
13 Rhodeus sericeus(Pallas)
14 Abbottina rivularis (Basilewsky)
15 Mesogobio tumenensis Chang,sp.nov
16 Gobio Macrocephalus (Mori)

17 Pseudorasbora parva (Temminck et Schiegei)
18 Phoxinus phoxinus (Linnaeus)
19 Phoxinus percnurus (Pallas)
20 Phoxinus percnurus (pallas)
21 Phoxinus oxycephalus (Sauvage et Dabry)
22 Leuciscus Waleckii (Dybowski)
23 Leuciscus brandti (Dybowski)
24 Leuciscus hakonensis (Gunther)
E. Cobitidae
25 cobitis taenia (Linnaeus)
26 Oreonectes costata (Kessler)
27 Misgurnus anguillicaudatus (Cantor)
28 Nemacheilus toni (Dybowski)
GADIFOMES
F. Gadidse
29 Eleginus gracilis (Tilesius)
GASTEROSTEIFORMES
G. Gasterosteidae
30 Gasterosteus aculeatus (Linnaeus)
31 Pungitus sinensis (Guichenot)
MUGILIFORMES
H. Mugil cepalus Linnseus
32 Mugil cephalus (Linnaeus)
33 Liza haematocheila (Temminch et schlegel)
PERCIFORMES
I. Eleotridae
34 Perccottus glehni (Dybowsk)
J. Gobiidae
35 tenogobivs brunneus (temmick et Schlegel)
36 Chaenogobius annulars (Gill)
37 Chaenogobius iaevis (Steindachner)
SCORPAENIFORMES
K. Cottidae
38 Cottus poecilopus Heckel

Geographic location of Mi Jiang River Chum Salmon State-Level Aquatic Germplasm Resources Reserve



Scale 1: 250000

Figure 5-7-3 Geographic location of Mi Jiang River Chum Salmon State-Level Aquatic Germplasm Resources Reserve(FS phrase)

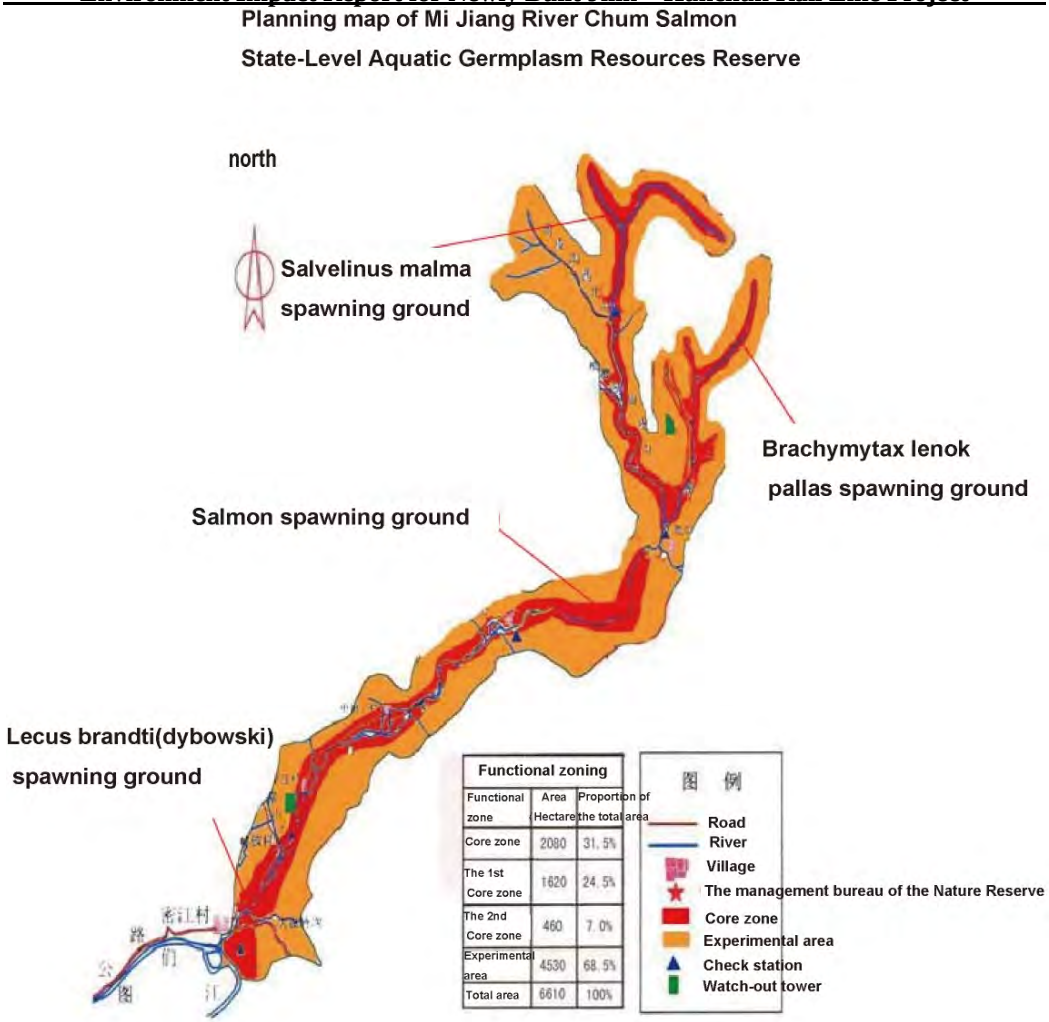


Figure 5-7-4 Planning map of Mi Jiang River Chum Salmon State-Level Aquatic Germplasm Resources Reserve

2. Analysis of reasons for impossibility of the engineering to move around the reserve

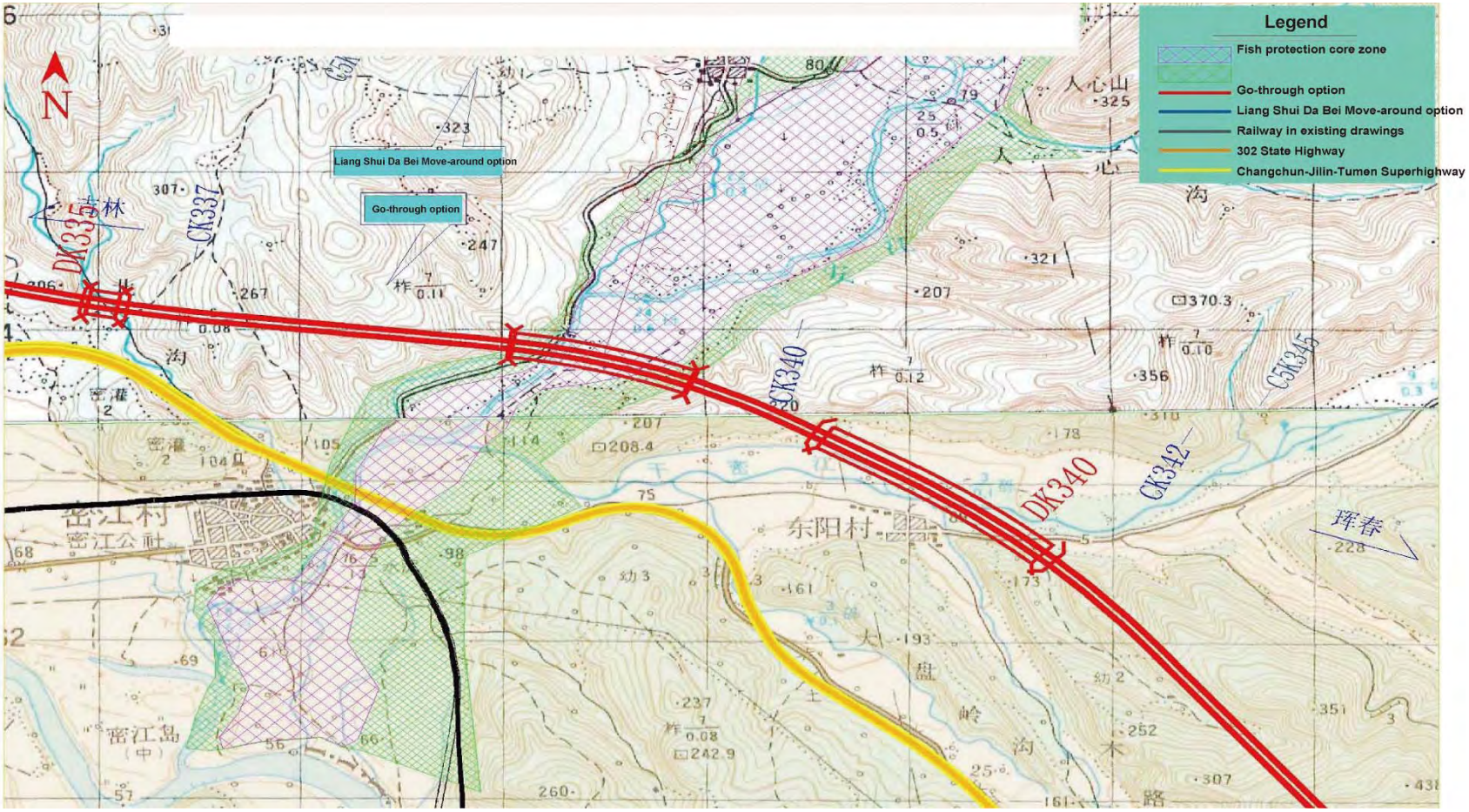
This project is located at the junction of China, Russia and North Korea, the core area of northeastern Asia. To better make use of the advantages in this region, the State Council indorsed the *"China Tu Men River Regional Cooperation & Development Planning Outlines -- Listing Chang Chun, Ji Lin and Tu Men as Leading Areas for Development and Opening"*. This project is significant to improving the investment environment in the above Chang Chun-Ji Lin-Tu Men leading opening region to Russia and North Korea. It can also improve the corridor's transportation system's efficiency and transportation service level and complete the port functions to Russia and North Korea. The main administrative regions where the project will serve are the cities in the Chang Chu-Ji Lin-Tu Men Jiang Leading Region like Jin Lin, Jiao He, Dun Hua, An Tu, Yan Ji, Tu Men and Hun Chun, and the major economic cities which can affect the line's orientation are Ji Lin, Yan Ji, Tu Men and Hun Chun. The economic cities affecting the line's

orientation in the neighborhood of Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve are Tu Men and Hun Chun, therefore the line's orientation generally runs from west to east along the Tu Men River. According to *"Geographic Location of Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve"*, the reserve is distributed along the Mi Jiang River's reach, and the Mi Jiang River's main stretch is totally 56 kilometers long, running in south-north direction. If the Ji-Tu-Hun special passenger line runs around the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve, the line will turn back to the northwest into Wang Qing County after leaving Tu Men Station to move around the above reserve, and then turn back to the southeast, cross over Hun Chun River to the terminal of this project -- Hun Chun North Station. In this way, it will form a large folding angle with the length of line about 110km, two times the recommended option (56km long), meanwhile the elevation is higher in Wang Qing County, in which the mean sea level of Mt. Mo Pan up to more than 800 meters, and the line plain profile's conditions can't meet the specifications for the passenger line, therefore the project line can't move around the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve.

3. Relationship between engineering and reserve's location

According to the FS design documentation, the run-through scheme for the line section in the neighborhood of Mi Jiang River is located on the northern side of the express highway, running basically in parallel with Chang-Ji-Tu express highway. Based on the scheme, it will cross over Mi Jiang River in DK337+280～DK338+050 section, going through special fish protection zone by 770m, where the super large bridge is built (central mileage DK337+662). Limited by river course and engineering economic conditions, this super large bridge adopts 27-span simply-supported beam with hole size 32 meters crossing over river course and low-lying places. The bridge need to set 1-2 in-water posts. See Figure 5-7-5 for the relative location of the line and the reserve.

Figure 5-7-5 Relative location between the project line and Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Rreserve



4. Brief introduction of engineering in the reserve

This project line crosses over the core areas and experimental areas of Mi Jiang River chum salmon state-level aquatic product Germplasm resources reserve via Ming Jiang Super Large Bridge in section of DK337+280～DK338+050, 570m long; crossing over the experimental area in DK337 +280～DK337+400 and DK337+970～DK338+050，with the length of line 200m in the experimental area. According to Figure 5-1-4, all the line's forms in the above section are bridge, and all the bridges have the standard beam with span of 32m. According to spot survey, the spread of flow is 28m at the bridge location in low-water season of Mi Jiang River, where the line nearly directly crosses the Mi Jiang River's river course. The lines' width on the water surface is about 30m in low-water season'（spread of flow in high water period up to more than 100 meters, 3-4 posts in water）. Limited by positions of the highways' bridge piers on the west bank where the Min Jiang Super Large Bridge crosses over the river course, and with reference to the beam span of the downstream under-construction motorway bridge and existing railroad bridge's span, one in-water post is to be set up in Min Jiang's main channel in the main body design at this FS research phrase, and the in-water post is located in the middle by east in the river course(see Figure 5-1-5).From the Figure 5-1-4, on the east and west banks of Mi Jiang River's river course are hills and mountainous region, with two tunnels connecting with the Mi Jiang Super Large Bridge, and on the east bank is No. 3 Tunnel at Mi Jiang Xiang, 681m long. On the west bank is Ming Jiang Xiang's No.2 Tunnel, 1889m long, and entrance to Ming Jiang Xiang No. 3 Tunnel and exit to Ming Jiang Xiang No.2 Tunnel near to Mi Jiang River's river course（horizontal projection distance 400m, elevation difference above 15m）.Neither station engineering nor borrow pit, excavation waste dump, etc. are set up for this project in this reserve.

The project's bridge is located near to the frontier with a number of military footholds distributed on the way. Location of the bridge crossing over Mi Jiang River is limited both upstream and downstream by military targets. The project's line location is required to set outside the safe range of the military targets, therefore there is very few options for the bridge's location. Now the bridge's location is chosen at the most narrow part of Mi Jiang River, i.e. ： the project crosses over the range of the reserve by the minimum distance.

The assessor and the designer communicated and coordinated for the future works in preparing the report: with the relevant requirements by the reserve, on one hand, adjust positions of the bridge piers on side banks for the bridge crossing over Mi Jiang River's main channel and set the bridge piers on the bank not on the main channel；on the other hand, add bridge span crossing over the main channel as appropriate, not setting piers in water to ensure construction in the low-water season doesn't go in water. Meanwhile, on both sides of the bridge are tunnels mainly on the medium and low mountains where the engineering is confirmed in limited space, and the minimum construction range between tunnel mountain body and main channel is only over 100 meters in width while the long span bridge's beam needs to be cast on site with the

supporting modes occupying a large area in construction, which needs a open and spacious area to meet the construction requirements. 32m standard beam can be pre-cast on site, which is initially located in CK335+705, near to San An River's Super Large Bridge. The pracast beam will be transported by truck to job site for installation. If 32m standard beam is used, the construction's impact on the reserve would be reduced to the minimum level but the bridge span is samll, occupying water surface area in high water period and giving more negative impact on spawning site than the long span bridge, but bridge pier takes very little proportion of the spawning site's area, and such a negative impact can be equally compensated by choosing new appropriate area in neighborhood for the occupied or damaged spawning site' area. Under the existing site conditions, the designer's recommended max. span is 48m, and compared with 32m standard beam, span is increased less and on site cast is needed, and the working area in construction period is big, and the working time long. Except occupying or destroying a certain area of spawning site(this impact substantially the same as 32m standard beam), it may impact the migration of the relevant fishes, affecting the reserve much more. Table 5-7-4 （1）shows the comparative analysis of construction forms, range of impact, working specifications, etc. of 32m standard beam, 48m span and above 64m large-span beam.

As shown in Table 5-7-4（1）, although above 64m large-span beam hasn't in-water pier, its temporary facilities occupy the biggest area in the reserve, giving relatively big impact on the reserve; and the 32m standard beam would occupy less area of the reserve if its bridge piers are re-arranged (no in-water pier set for low-water season), and its in-water pier number same as 48m beam in normal season, occupying the same area of the spawning site. Based on the comprehensive consideration, at the final survey phrase, the designer will adjust the positions of the bridge piers crossing over the river course at the FS phrase, and adjust the bridge piers in river course to the main channel's side banks, and not bridge piers are to be set in water in the main channel, and no in water jobs in construction period. Under this pre-condition, the engineering construction's impact on Mi Jiang River Chum Salmon State-Level Germplasm Resources Reserve can be reduced to the minimum level.

Table 5-7-4 （1）:Summary on comparative analysis of various spans across Mi Jiang River's main channel

No.	Category	Beam body's construction method and means of transportation	Type of temporary facilities	Requirements on range of construction operation	Number of in-water pier in low-water season /normal season	Occupying area of bridge pier in river course in normal season （m^2）	Floor area of temporary facilities （m^2）	Total occupied area in river course （m^2）
1	32m standard beam	Pracast in casting yard at DK335+700 San An Jiang Super Large Bridge and transport and lift by truck	Pier base's excavation site, construction camp , concrete mixture station , temporary stock yard, etc.	Usually open within range of 100m in line's direction	0/2	280	400	680
2	48m beam	On site cast	Beam body on site casting ground and relevant brackets besides pier base's excavation site, construction camp , concrete mixture station , and temporary stock yard.	Usually open within range of 100m in line's direction	0/2	280	450	730
3	Above 64m large-span beam	On site cast	Beam body on site casting ground and relevant brackets besides pier base's excavation site, construction camp , concrete mixture station , and temporary stock yard.	Usually open and spacious within range of 200m in line's direction	0/0	0	840	840

Distribution of Engineering in the neighborhood of Mi Jiang River Chum Salmon State-Level Germplasm Resources Reserve

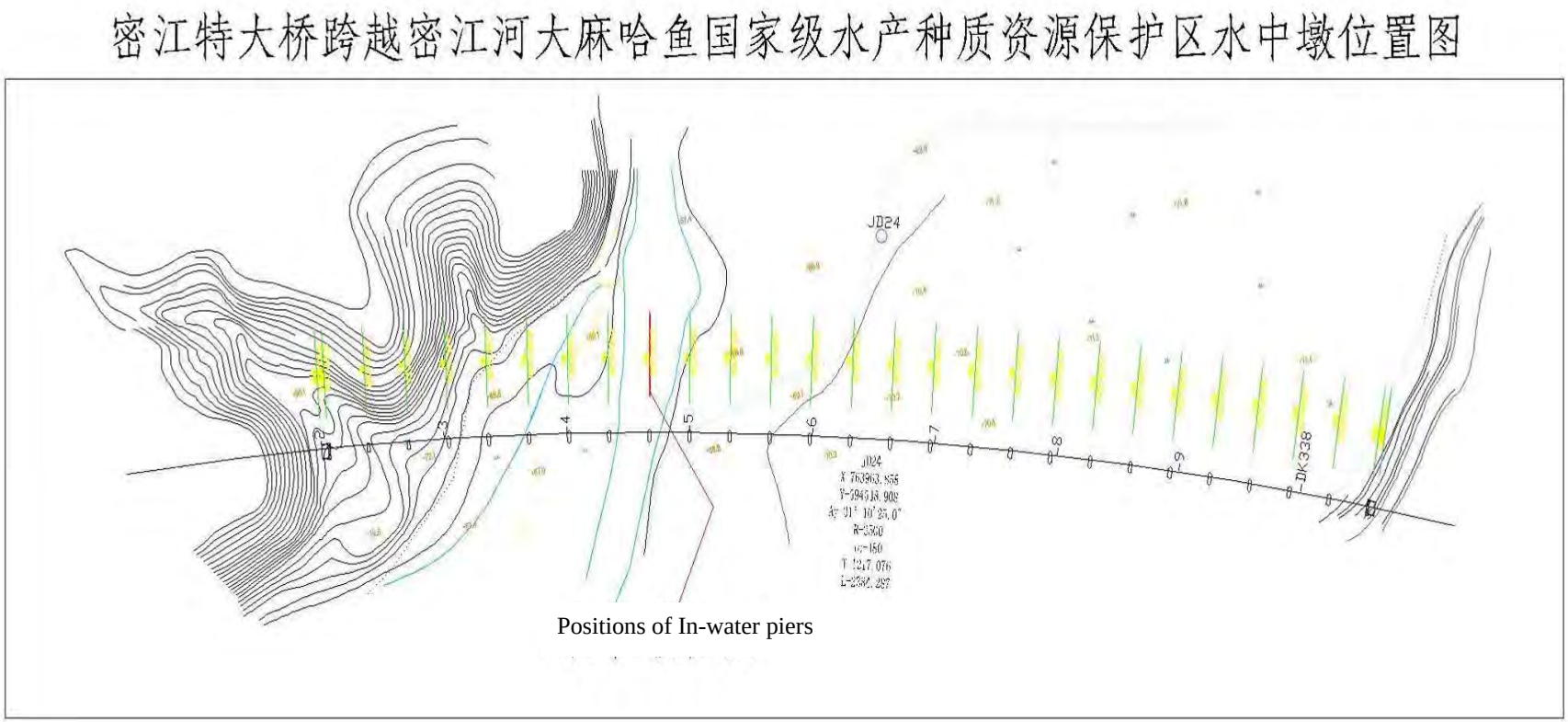


Figure 5-7-6 Location of bridge piers in water in the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve(FS phrase)

5. Environmental impact analysis of engineering construction

(1) Ecological status in the reserve

1) Natural ecological environment in the reserve

Mi Jiang River is the primary river branch to Tu Men River，total 56km long, collecting more than 20 rivers and brooks with plenty of water flow. The annual normal flow is 9.05 cubic meters per second and the river's water quality is lucid. This region is forest at an elevation of 58～1435 meters in ecological environment. The river-bed is the rubble stone shoal formed over the years. It is the only river where the pristine river-bed natural form is maintained downstream of Tu Men River, both the migration pathway and natural spawning place for migration fishes. Owing to big elevation spanning for Mi Jiang River's reach, at the upstream part at high elevation, the water temperature is low and here is the important habitat and spawning site for the cold-water fishes. To learn about the environmental quality status in the reserve, the Fishery science academy of Jilin Province monitored the reserve twice in May and August in 2008-2009, mainly in the seasons of fish reproduction and growth with the annual monitoring frequency of two times. A monitoring point is set up about 8 kilometers upstream of the river mouth in the first core area, E.L.130°07´40´´，N.L.43°16´20´´.Monitoring items include: water quality category (PH，DO，CODMn，total phosphorus, non-ionic ammonia, oils, volatile phenol, heavy metals) and biologic category（chlorophyll a, phytoplankton, qualitative and quantity test of zooplankton, etc. ）.Main monitoring results as follows：

- Water Quality

  COD_{Mn}：Mean annual monitoring value 2.82mg/L；Total phosphorus：Mean annual monitoring value 0.03mg/L.See Table for details.

- Biology

  Phytoplankton：Six kinds of phytoplankton was tested out by microscope, belonging to chrysophytax. Annual biological mass is 630,000 pieces/1.11mg/L on average. In which，the average biological mass is 770,000 pieces/1.36mg/L in May, and the dominant species is Nitzschia sp.；and the average biological mass is 480,000 pieces/0.864mg/L in August, and the dominant specie is Navicula sp.

  Chlorophyll a：Chlorophyll a's annual average is 0.8746mg/m3. In which，the average value is 0.1752mg/m3 in May; and 1.574mg/m3 in August.

  Zooplankton：In 2008, the zooplankton biological mass 20/0.4-80/0.92(pieces/mg/L)，dominant specie--Bosmina sp.，average 50/0.66(pieces/mg/L)，and not tested out in 2009.

  Biological mass and list of the biological mass for phytoplankton and zooplankton

are shown below.

Table 5-7-5 Genet and list of the phytoplankton in the Mi Jiang River's Reserve

Name	May	August
Nitzschia sp.	+	+
Synedra sp.	+	+
Cymbella sp.	+	+
Gomphonema sp.		+
Navicula sp.		+
CycLoteLLa sp.	+	
Melosira		+

Table 5-7-6 Genet and list of the zooplankton in the Mi Jiang River's Reserve

Name	May	August
Bosmina sp.	Bosmina sp.	Bosmina sp.

Table 5-7-7 Monitoring results of the plonkton in Mi Jiang River's Reserve for 2008-2009

Monitoring point	**Monitoring time**	**Monitoring items**				
		Phytoplankton(100,000 pieces/mg/L)		**Zooplankton(pieces/mg/L)**		**Chlorophyll a (mg/m3)**
		Biological mass	**Dominant species**	**Biological mass**	**Dominant species**	
Mi jiang River	2008.05	77/1.25	Melosira	20/0.4	*Bosmina sp.*	0.8776
	2008.08	24/0.384	Nitzschia sp.	80/0.92	*Bosmina sp.*	1.2832
	Average	51/0.817		50/0.66		1.0804
Mi Jiang River	2009.05	77/1.36	*Nitzschia sp.*	——	——	0.1752
	2009.08	48/0.864	*Navicula sp.*	——	——	1.574
	Average	63/1.11				0.8746

Table 5-7-8 Water quality monitoring results in Mi Jiang River's reserve for 2008-2009

No.	Monitoring item	2008			2009		
		May	August	Average	May	August	Average
	PH	7.21	7.14	7.18	7.39	7.01	7.20
2	DO	8	8.8	8.4	9.72	8.32	9.025
3	COD	4	4	4	2.48	3.15	2.82
4	Non-ionic	0	0.001	0.005	0.001	0.0001	0.0005

No.	Monitoring item	2008			2009		
		May	August	Average	May	August	Average
	ammonia						
5	Total phosphorus	0.01	0.05	0.03	0.05	0.01	0.03
6	Oils	0.006	0.005	0.006	0.01	0.01	0.01
7	Volatile phenol	0.001	0.001	0.001	0.001	0.001	0.001
8	Cu	0.03	0.03	0.03	0.03	0.03	0.03
9	Pb	0.04	0.04	0.04	0.04	0.04	0.04
10	Zn	0.002	0.002	0.002	0.002	0.002	0.002
11	Cr	0.004	0.004	0.004	0.019	0.006	0.0125
12	Cd	0.003	0.003	0.003	0.003	0.003	0.003
13	As	0.00002	0.00002	0.00002	0.0006	0.0023	0.0015
14	Hg	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001

Note: according to fill-out requirements of Fishery environment Center, Department of Agriculture, not tested items, as per half of the minimum testing limit when filling out.

2) Status of anadromous fishes in reserve

The main protected fishes in this reserve include migration fishes like oriental salmon（cherry salmon, humpbacked salmon , chum salmon）and cold-water fishes like brachymytax lenok pallas, Lecus Brandti(Dybowski), lamprey-eel, Salvelinus malma, etc., in which, brachymytax lenok pallas is the state Category protected animal, and cherry salmon, humpbacked salmon , Salvelinus malma and Lampetra japonica are listed as the first group in the Jilin Province's government's “List of Aquatic Wildlife Under Jilin Provincial Key Protection”（Ji Zheng Fa 【2006】No. 5）.Distribution and life habits of fish resources in the reserve are shown in Table 5-7-5.

Since its establishment, Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve has been continuously carrying out the Multiplication and Discharge of living aquatic resources like oriental salmon, Lecus Brandti(Dybowski), brachymytax lenok pallas, etc. , totally discharging 185,710,000 tails of various young fishes from 2007 to 2009, in which multiplication and protection of the oriental salmon has already gotten good results initially. According to fishery statistics, by the end of the 1990s, the oriental salmon has nearly been extinct in Mi Jiang River, with the statistical record of annual harvesting only 20-30 tails. Through multiplication and discharge in recent years, the oriental salmon parent fish caught in 2007 was 60-odd tails, and 100-odd parent fish caught in 2008, and up to more than 800 tails of parent fishes caught in 2009；Number of anadromous oriental salmon goes up sharply each year. In the Jilin Province's conservation action plan for living aquatic

resources for 2010, more than 400,000 tails of oriental salmon young fishes will be discharged, which plays an active role in restoration and improving of the fishing stock size in the Tu Men River's reach.

- Distribution of spawning grounds

According to *"Environmental Impact Report for Construction of the Super Large Bridge over Mi Jiang River for Jilin-Hunchun High Speed Railway on the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve"* prepared by Fishery Science Academy of Jilin Province, the position where Ming Jiang Super Large Bridge crosses over the reserve is in the first core area of the reserve which is the migration pathway for oriental salmon, Lecus Brandti(Dybowski), etc., meanwhile is also an important spawning ground for Lecus Brandti(Dybowski) but away from the spawning sites for oriental salmon, brachymytax lenok pallas, Salvelinus malma, and the spawning sites for oriental salmon, brachymytax lenok pallas and Salvelinus malma is located outside 20km upstream of this project. See Table 5-7-9 for distribution of relevant spawning grounds in the reserve.

Table 5-7-9 Distribution of spawning grounds for fishes in Mi Jiang River's Reserve

Name	Spawning ground
Lecus brandti(dybowski)	Mi Jiang River'mouth-8 kilometre's river stretch, in which, river ,mouth-5 kilometre as crowd area
Lamprey-eel	Mi Jiang River'mouth-8 kilometre's river stretch, in which, river ,mouth-5 kilometre as crowd area
Three kinds of oriental salmon	Mi Jiang River'mouth upstream 7-35 kilometre's river stretch, in which, river ,15-35 kilometre as crowd area
Brachymytax lenok pallas Salvelinus malma	Mi Jiang River's upper reaches，river stretch from Da Huang Gou to canal mouth of Xi Bei Gou Canal , Bei Gou River of river branch of Mi Jiang River, Yang Mu Qiao Zi Gou River, Tian Shan Gou River, the river stretch's total length 39.5 kilometres.

- Regular pattern of the protected fish migration

Three kinds of oriental salmon

Cherry salmon 3-4 years mature，body weight 2.5-4.0 kilograms. In March and April each year, the pre-mature Cherry salmons gather in groups at Tu Men River's mouth, and in April and June, they flood into Tu Men River and continue feeding in Tu Men River's trunk stream, and when the flooding discharge downwards in August and September, the mature individual goes against the stream into Mi Jiang River, and in the early September, it begin spawning and reaches the peak time in the middle of September.

The age composition of **humpbacked salmon** going against the stream is 3-5 years, in which, 3-year humpbacked salmon takes 80% with mature body weight 1.4-2.9

kilograms. They turn up in the lower reach of Hun Chun River, Tu Men River's river branch in June and July each year, and the laying-season from the last ten-day of August to the middle of September.

Oriental salmon matures in four years, and has the biggest size among all the oriental salmons. The mature individual weighs 3.5-6.0 kilograms. In the last ten days of September, a large number of oriental salmons begin going against the stream into Mi Jiang River for spawning, which reaches the peak time in the beginning of October. The laying-season for three kinds of laying-season begins in last ten days of August and continues to the middle of October. After spawning, all the oriental salmon parent fishes die. The juvenile fishes float along stream down to the sea after hatching fresh water. According to history, the oriental salmon's spawning grounds are distributed at 8-35 kilometers upstream of the Mi Jiang River's mouth, and the river stretch here has lucid water and rubble stone and sand bottom with the average water depth about 0.5 meter, the average flow rate about 0.7 m/sec., PH value 6.8-7.5, and dissolved oxygen 8-10 milligrams per liter.

Lamprey-eel

Lamprey-eel is only distributed in Tu Men River's water system in China. It belong to migration fish. its adult lives in the sea. From the last ten days of April to June each year, it goes back to Tu Men River's trunk stream and branches from the Sea of Japan for spawning, and all the parent fishes die after spawning. Its major spawning grounds are at Mi Jiang River's mouth and 8 kilometers upstream of the mouth. The young fishes go to the sea after staying in river for 3-4 years and live in the sea for 2-3 years.

③Lecus brandti(dybowski)

Lecus Brandti(Dybowski) is distributed in a very narrow area in China, only being observed in Tu Men River and Sui Fen River. It belongs to the migration fishes at river mouth. Generally, the adult fish weighs 0.5-0.85 kilograms. In May and June each year, The parent fishes go back to Mi Jiang River from Sea of Japan for spawning, and the major spawning grounds are Mi Jiang River's mouth and 7 kilometers upstream of the mouth. The young fishes temporarily stay in Tu Men River after being hatched and go into the sea with stream, and become mature at Tu Men River's mouth and in the sea.

Table 5-7-10 Summary on regular patterns of fish migration and reproduction time in Mi Jiang River's Reserve

Species	Migration time(month)							
	3	4	5	6	7	8	9	10
O.masou			……		———		△	
O.gorbuscha				……	———		△	
Chum salmon						……		△
Lecus brandti(dybowski)			△					
Lamprey-eel			△					

…… Intermitent ——— Conspicuous △ Spawning time

Table 5-7-11 Summary on distribution and life habits of the fish resources in the reserve

No.	Name	Distribution	Life cycle	Picture
1	Oriental salmon	The first core area of reserve（Mi Jiang River's lower reaches）	Belong to migration fishes. Each srping,young fish just hatched out in fresh water go downstream into the sea from Mi Jiang River and become mature in the sea for 3-5 years, and in spawning seasons of August and September, the mature oriental salmon upstream migrates to Mi Jiang River from Sea of Japan for spawning. All the parent fishes die after spawning and young fishes go down to the sea after being hatched in fresh water. According to its habit, September and Octomber are generally the oriental salmon's harvesting season each year.	
2	Lecus brandti(dybowski)	The first core area of reserve（Mi Jiang River's lower reaches）	In each June, the mature Lecus Brandti(Dybowski) goes up to Mi Jiang River from Sea of Japan for spawning, and young fish being hatched in river and goes with stream into the sea and become mature in the sea.	

No.	Name	Distribution	Life cycle	Picture
3	Lamprey-eel	The first core area of reserve（Mi Jiang River's lower reaches）	Each May, the mature Lampetra japonica goes upstream to Tu Men River's trunk stream and branches from Sea of Japan for spawning. All the parent fishes die after spawning. The young fishes go down to the sea after staying in river for 3-4 years and become mature after living in the sea for two years.	
4	Brachymytax lenok pallas	The second core area of reserve（Mi Jiang River's upper reaches）	Live through the winter deep in the river or big river. In the spring, upstream migrate for spawning. Its foods include tiny fish, frog, tadpole , aquatic insects, and aquatic invertebrate. Sexual maturation period is usually five years. The laying-season is in the middle of April or May with the water temperature above 5 . The spawn is laid on the grit bottom with clear water quality and slow water flowing. When the water temperature is 5～10 , it hatches in 15～20 days. It likes laying low, staying in darkness, and inactive. After 15 days, it swims to shore for preying. Brachymytax lenok pallas is the natural enemy to other fished, especially causing extreme hazard to oriental salmon's reproduction（like to eat oriental salmon's cytula）.	

No.	Name	Distribution	Life cycle	Picture
5	Salvelinus malma	The second core area of reserve（Mi Jiang River's upper reaches）	In China, it is landlocked form Salvelinus malma and lives in clear and cold river's trunk stream and branches for life. Each September to October, when the water temperature is about 8 ，it spawns on the gravel bottom at water depth of 30-60 centimetres in tranquil flow. Sexual maturation needs 3-4 years. Egg is round, orange yellow with egg diameter of 4.2-5.0 millimeters. Brood amount are 194-310 eggs. Its food habit is wide, mainly on benthic animals and insects falling on the water surface, sometimes even jump out of water surface to prey.	

3) Assessment on the reserve's ecosystem status

- General assessment on biological resources

The survey on the environment of aquatic lives is based on the technical documentation（“Master Plan for The Tu Men River's Oriental Salmon & Brachymytax Lenok Pallas State-Level Aquatic Germplasm Resources Reserve”，“Scientific Survey Report on the Tu Men River's Oriental Salmon & Brachymytax Lenok Pallas State-Level Aquatic Germplasm Resources Reserve”，“Submission Report for State-Level Aquatic Germplasm Resources Reserve --- Tu Men River's Oriental Salmon & Brachymytax Lenok Pallas State-Level Aquatic Germplasm Resources Reserve”）prepared at the preliminary phase of application for the reserve and the monitoring data in the reserve. The planned Mi Jiang River Super Large Bridge on Jilin- Hun Chun high speed railway is located downstream of the first core area of the Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve, about 4.5 kilometers to the Ming jiang River's mouth. The bridge is 898.96 meters long. The only migration pathway for the migratory fishes is inside the project area, where the river-bed bottom is not damaged by the people and under the pristine ecosystem status. This area is the natural breeding ground for protection of fishes due to its plentiful water flow, lucid water quality, pollution-free；rapid flow rate and rich dissolved oxygen. Few species of phytoplankton and zooplankton and low biological mass in this area, which is greatly relevant to low water temperature and big flow rate of make-up water source to Mi Jiang River.

Aquatic fibrovascular cord plants

According to incomplete statistics, there are 16 species of aquatic（humidogene）plants in the first core area of Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve

Euryale, coontail, trapa pseudoincisa, t.litwin, trapa manshurica， watermilfoil, willowleaf wormwood , arrowhead , causewaygrass, kentucky bluegrass , reed, flagleaf, lemna perpusilla torrey, greaterduckweed, common cattail , Marshy sedge , etc.

Phytoplankton

Because the water flows quicklyand the water temperature is low in Mi Jiang River, there are few species of phytoplankton and the biological mass is low. Based on monitoring, there are seven species of phytoplankton in the first core area down stream Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve.

Nitzschia sp．, synedra, cymbella, gomphonema，navicula, cyclotella meneghiniana, and melosira. The average biological mass is 51/0.817-63/1.11(10,000 pieces/mg/L).

Zooplankton

According to scientific survey, there are two kinds of microzoons, one kind of rotalina, and one kind of crustacean in Mi Jiang River. In 2008-2009, when we monitored in Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve,

only downstream the first core area （7.5 kilometers to river's mouth）we picked up one kind （Bosmina sp.）with the biological mass of 50/0.66(pieces/mg/L).

Benthic animals

According to scientific survey, there is only one kind of benthic animal-- 黑龙江短沟锩's conch in Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve.

From the above data, there are few species of higher aquatic（humidogene）plants in the first core area downstream Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve; aquatic animal species relatively simple and in small number, and few natural enemies to the protected fishes too. Such a aquatic animal composition is favorable to fish eggs' hatching of oriental salmon in natural spawning place. As the oriental salmon's fish egg hatching time is long, usually 30-60 days, the number of biotic component and biological mass in water determine on hatchability, young fish's survival rate and ultimately number of fishes swimming down to the sea. Therefore，the Mi Jiang River's biological resources is favorable to protection of fish's reproduction, which is also the result of natural selection.

- Assessment on water environment quality status

According to two years' monitoring for 2008-2009，the water quality of the first core area in Mi Jiang River Chum Salmon State-Level Aquatic Product Germplasm Resources Reserve fully conform to the state fishery water quality standard, which will not affect the fishes' living and growth. Therefore all the water quality specifications meet the environmental requirement on inhabitation and breeding of fishes.

Table 5-7-12 Analysis of water quality monitoring results in Mi Jiang River's Reserve for 2008-2009

No.	Monitoring item	Time		Standard value	Conformance
		2008	2009		
1	PH	7.18	7.20	6.5-8.5	√
2	DO	8.4	9.025	≤5	√
3	COD	4	2.82	4	√
4	Non-ionic ammonia	0.005	0.0005	≤0.02	√
5	Total phosphorus	0.03	0.03	0.1	√
6	Oils	0.006	0.01	≤0.05	√
7	Volatile phenol	0.001	0.001	≤0.005	√
8	Cu	0.03	0.03	≤0.01	√
9	Pb	0.04	0.04	≤0.05	√

10	Zn	0.002	0.002	≤0.01	√
11	Cr	0.004	0.0125	≤0.1	√
12	Cd	0.003	0.003	0.005	√
13	As	0.00002	0.0015	≤0.05	√
14	Hg	0.000001	0.000001	≤0.005	√

Note：COD and total nitrogen assessed as per surface water .

(2) Environmental Impact Assessment of Construction

The project line lies downstream of Mijiang, crossing the first core area. Its length crossing core area is 570m, and crossing the experimental area 200m, both of which are the bridges. It is necessary to set one water pier in the main river of Mijiang in core area. Water operation exists during construction period.

- Bridge construction technology

Bridge of extra large bridge of Mijiang will generally be round end pier. Its bridge pile foundation is generally bored pile. The construction process are: level field, lay the work platform, install drilling, press casing, drill into the hole, locate steel cage and anti-duct, pour concrete, pull the casing.

Main pier foundation construction: firstly plug the positioning steel pipe pile, then plug the pile foundation steel casing into the stable ground, and then carry out bored pile construction on the water.

Installation of steel box girder: generally use bridge girder erection machine for installation of construction.

- Environmental impact factors of engineering construction

According to analysis of the project characteristics and current status of protective zones, major environmental impact factors of engineering construction include the following:

First, setting the piers in the water of protective zones will permanently occupy main channel area of the first core area in protective zone to affect flow form.

Second, wading river pier foundation construction will disturb the river bed, thus resulting in a certain amount of waste water and waste slag which increase suspensions in water;

Third, during the pier foundation excavation, construction such machinery excavation, machinery transportation and construction of tunnel machinery on both banks of protective zone will arouse some noise and vibration;

Fourth, during operation period, the train operation will arouse some noise and vibration.

- Environmental impact analysis of engineering construction

According to engineering construction environmental impact factors and current ecological status of protective zones, the impact of engineering construction on Mijiang salmon state level aquatic germ plasm resource protection zone is shown in the

following areas:

① Occupy channel, narrow migration channels and destroy spawning grounds

The engineering construction requires one water pier located in core area of protective zone, permanently occupying cross section of main channel. The diameters of bridge pile foundation are generally φ1.0m or φ1.25m, and for special bridges which need to increase capacity, bored piles with larger diameters of φ1.5m, φ2.0m or φ2.5m should be used. Each underground pile foundation of round end pier occupies about 10*14m^2 (140m^2) area. Considering the factors such as expansion of construction operating area, the construction of bridge pile foundation will occupy 140~160m^2 river area, narrowing 11m width of river channel, accounting for below 10% of occupation of total cross section width in wet season (migration period). Round end pier above ground has a permanent occupation of an about 8.7*3.0m^2 (26.0m^2) area, permanently occupying 3.0m river pier width, accounting for below 3% of occupation of total cross section width in wet season. Water pier construction will narrow water fish migration channel to destroy spawning grounds during construction period, thus causing that salmon and beachhead fish may not do an anadromous migration into spawning ground of Mijiang for breeding, as a result, quantities of anadromous migration decrease and river fish fry resources decline This effect usually lasts for 2 years and then will gradually recover.

② Water quality affected by subaqueous work

After living in freshwater river for a few months, juvenile salmon follows downstream along the river, then after a few years in the ocean, they will migrate to the river channel where they were born for breeding. What is the mechanism to guide salmon migration accurately? After a long-term study from 50s to 70s, U.S. ichthyologist Hasler (A.D.Hasler) suggested that salmon which is matured in the ocean could return birthplace for breeding mainly dependent on the smell of water quality of birthplace during the migratory breeding process. With its keen sense of smell, salmon is able to distinguish extremely slight difference between the river channel where it is born and other channels. Once water quality of the birth place changes, it will affect mature salmon in migratory breeding process.

According to the construction technology, the basic operation of underwater pier includes the links such as steel protective pipe positioning, sinking, drilling, depositing steel cage, pouring concrete. Steel barrel sunk requires clearing retaining topsoil in the barrel; in drilling process, wall protection by drilling mud should be used to maintain the stability of hole wall. The construction process is carried out within the cofferdam which separates inside from outside water of Mijiang, that is, localized water within the cofferdam is separated from external water outside cofferdam, without waste efflux, causing less impact on river water. Mud generated in the pier construction of should be processed in the cyclic sedimentation tank on the construction platform, not allowing to be discharged into the river, which should be disposed at the designated place after drying on the shore. The waste water generated after precipitation shall not be discharged into river, which can be used for road water spray. Wash waste water for sand, stone material containing great amount of silt, is easy for precipitation, so they are recommended to be recycle after being processed in a set sedimentation tank. Therefore,

the foundation construction will not arouse significant adverse impact on water quality. In mud loading and transporting process, a small amount of mud falling into the water may occur, resulting in increased water suspension. According to analog data analysis, using cofferdam construction technology, at 100m of construction downstream, the SS increment does not exceed 50mg / L, resulting in little effect on the Mijiang water quality.

Waste water during construction mainly includes production waste water and domestic sewage. Main production waste water of bridge construction consists of washing waste water from concrete mixing systems, construction machinery and transport vehicle, mainly containing ingredients such as sand, with high concentration of solids (SS) and pH of weak acid, as well as a small amount of oil. (2) Domestic sewage: during bridge construction, there is many engineering staff on the site, so they will generate a great amount of biological sewage which is similar to ordinary domestic sewage, mainly containing ingredients such as organic compounds, oxygen, ammonia and suspended solids. If the waste water generated during the construction process is directly discharged into the water, water clarity and dissolved oxygen concentration will be lowered, moreover fish and other aquatic organisms will be directly hazarded by some special ingredients. However, as there are fewer construction workers, they produce less quantity of sewage resulting in limit impact on water environment of river.

③ Affect migration and spawning of salmon and beachhead fish etc.

According to their living habits, beachhead fish in June and salmon in August every year begin anadromous migration from the sea to Mijiang for spawning. Their young fish will be hatched in the Mijiang, then flowing into the sea where they will be fattening and mature. Meanwhile, the engineering section across the Mijiang is close to the beachhead fish spawning grounds, so pier set in the water in the engineering construction will occupy the main channel and crowd migrating channel so as to destroy spawning grounds; pier construction in the water will make breeding parent fish escape the spawning ground. The floating material generated during construction has a certain impact on existing spawn and fish fry, as a result, anadromous migration and spawning of salmon and beachhead fish will be affected and their propagation could suffer. But this effect is mainly manifested during the construction period, after the completion of construction, the percentage of pier in the water occupying total flow cross section is very small during operation period, and its unfavorable impact will be greatly relieved.

④ Noise impact during construction and operation

Throughout the process of construction of the bridge, all kinds of construction machinery operation will generate noise. During the links of cofferdam of bridge foundation, operations such as pile and steel casing sticking and sinking, drilled piles etc. will arouse an impact noise, bringing about shock to some species of fish and arousing the fish avoidance response so as to interfere with their normal migratory and lay eggs. Compared with the construction, the level of train noise is much smaller during operation period; Compared with the downstream existing Ji Hui line, the noise level generated by passenger rail train is much lower. Existing Ji Hui line has been running for many years, which running noise basically does not affect fish migration and spawning in Mijiang. Therefore, the impact the noise on fish migration and spawning

mainly concentrates in the construction period, which will basically eliminated after construction period is completed.

⑤ Analysis of impact on river bed structure

Water flow (including flow velocity and direction) is an important factor that affects migration and spawning of salmon and beachhead fish. In case engineering construction results in damage of structure of watercourse and river bed, dramatic changes of in-stream flow will occur, thus affecting migration and spawning of salmon and beachhead fish. The pier of this project uses pile foundation which contributes to the bridge lines and river bed stability and will not arouse impact on the river bed. Pier setting in the water will not lead to hammed water at pier location or dramatic changes of water flow. However, if pier construction is chosen for migration period, operation plane will occupy and narrow flow cross section of the main channel, which cause changes of flow near the operation plane, thus affecting the migratory and spawning of fish to some extent.

(3) Mitigation measures for environmental impact

- Adjustment of construction schedule and construction period

  In June every year beachhead fish following upstream starts migration and breeding, and in August salon starts. This period usually lasts till the end of September and early October, which is also the season to protect releasing and proliferating of the salmon and beachhead fish. Therefore, combined with living habits of salmon and beached fish, the construction schedule and construction period should be rationally arranged to avoid setting operation plane in the river water within the protective zone during the migratory breeding season of fish. Construction activities in protective zones should try to be arranged at non-migratory breeding season from the end of October to April of the following year.

- Optimization of construction technology

  The bridge construction technology shall be optimized as possible in the construction process, especially wading operation link. ① reduces impact of noise on the reproduction of migration of fish by selecting low-noise construction machinery. ② underwater construction blasting should be avoided as possible. Millisecond blasting method should be used for blasting of the tunnel on both sides of rivers. ③ carefully organize the drilling and cofferdam sinking operations, control operation time, and shorten operating time in the water.

- Water pollution and control

  Salmon migration requires a relatively strict water quality. This project is dedicated line without impact on river water quality during the operation period. Its impact on water quality is mainly manifested during construction period. The main preventive measures of protection are:

  ① Under bridge foundation construction, waste slag such as sludge which is bored out will be the biggest potential pollutants to affect the water. The relevant

specification shall be observed strictly, that is, waste slag should be shipped out of river and a certain protective measures should be taken. The storage sites must be selected by consulting with local governments, fisheries authorities, and protection management department. Transportation and storage process should be monitored by supervisors. Free disposal is prohibited so as to minimize the impact of waste slag on water quality and to prevent adverse effects of waste slag piling on flood control.

② Cofferdam of the main river channel should take the structure form of a smaller cross section to ensure that occupation of area of waterway is as small as possible, and to minimize interference with the river flow. Construction of the bridge pier in water requires cofferdam built to be the island, which will narrow the river cross section, so the evaluation recommends reasonable arrangement of construction period and selection of the dry season, non-migratory breeding period for the bridge pier construction of the main channel; pier construction uses steel cofferdam construction in order to reduce sediment pollution on water. After construction is completed, all temporary works will be removed to ensure the smooth flow of water. Construction machinery should be kept clean, and contamination of the water body should be avoided.

③ Construction camps and sites can not be set within the scope of protection zones, and sewage and garbage discharged into the river is strictly prohibited. Location of construction materials stacked should be away from the water. All kinds of material should be provided with facilities sheltering from rain, at the same time, digging of open ditches, de-sanding well and protective walls, etc. around the material field should be conducted to avoid the material washed into the river by storm. Waste generated during construction period should be timely cleaned up every day and be intensively collected, of which food-related refuse should be piled for waterlogged compost, and the remaining waste should be transported to dump for disposal.

④ Direct discharge of production waste water and domestic sewage into the river is prohibited. Production waste water containing ordinary suspended solids should be discharged after being settling. Other waste water and domestic sewage should be treated with sewage treatment facilities to be built.

⑤ When construction is completed, construction site should be cleaned timely, without construction waste or facility left within the scope of river channel, to ensure that the impact of works on the river bed will be minimized, and to timely dredge and restore the migration routes of migratory fish. The ecological environment along the coast should be timely restored to avoid the impact of water and soil loss on the water environment.

(4) Monitoring measures

In construction and operation phases, project owners and management unit shall set up the environmental protection department to develop and implement all environmental protection measures. Project owners and management units should also strengthen ties with the local fishery sector, acquire guidance from the relevant departments, and actively accept the supervision of the

implementation of relevant environmental protection measures by relevant authorities in the process of construction and operation, while enhancing the management of construction workers and improving protecting awareness of fishery resources of construction staff.

(5) Preparation of temporary rescue plan for rare animals

At initial phase of anadromous migration of fish, the event concerning direct injury of protected species such as salmon and beachhead fish should be avoided. Construction unit should prepare relevant treatment preplans, if injury of protected fish occurs, should contact with the local fishery as soon as possible, and provide temporary aid for injured fish timely, such as: disinfection, treatment, and transport them to other places collectively. Holding culture, rescue, transport, discharge of fish are highly professional, involving multi-disciplinary, so the construction units should strengthen technological exchanges with the fisheries sector for rescue technology, and gradually establish a management and technical supportive agency as required, to ensure smooth development of temporary aid.

(6) Relevant monitoring

Works crossing the sections of Mijiang is close to spawning intensive-area of beachhead fish, and engineering construction will occupy a certain area of the beachhead fish spawning area. In order to understand the influence of the bridge on anadromous migration and reproduction of the migratory fish, it is necessary to carry out monitoring on a restricted range during bridge-building construction period (calculated by 2 years) and the initial operating phase (calculated by 2 years). Scope of monitoring should be set in the upstream and downstream of extra large bridge of Mijiang.

① Fish resources

Monitoring indicators: species and resource of fish.

Monitoring location: 500m upstream and downstream at the bridge site;

② Fishing spawning area

Monitoring indicators: species and proportion of initial resources, spatial and temporal distribution, hydrological factors, and distribution and size of spawning ground;

Monitoring location: beachhead fish spawning ground;

(7) Estimated loss of fisheries resources

In conclusion, the impact caused by engineering construction is: first, the construction of pier occupies fish spawning grounds, second, the construction noise will arouse avoidance response of fish, third, and the construction will result in local influence to the migration of migratory fish. Its economic loss consists of the following components: annual loss of underwater construction, annual loss of water construction and loss of permanent occupation of spawning grounds. The second core area of protection zones is located above 35km upstream of Mijiang where protected fish has not migratory habits and will not cause damage, so the amount of economic loss of fisheries should calculate 5 migratory fish of the first core area, taking into account other commercial fishes such as crucian and carp at river mouth. The influence of operation period needs to be further confirmed.

First, the selected parameters for annual economic loss estimation of underwater construction (construction of bridge piers)

1) Determination of fish populations entering into the spawning grounds

- According to annual increment trend of salmon resources, it output is expected to reach 20 tons in 2010, calculated as per 60% entering into Mijiang river.
- According to incomplete statistics of protection zones, every year lampetra japonica into spawning area of Mijiang River through anadromous migration approximately stands at above 1 ton. Calculated as per 1 ton.
- According to annual increment trend of beachhead fish resources, it output is expected to reach 80 tons in 2010, calculated as per 40% entering into Mijiang river.
- Commercial fishes such as crucian and carp shall be calculated according to 25% the total output of the Tumen River entering into the Mijiang River.

2) Other calculation parameters

Male female ratio of salmon 1:1; evasion90%, price of spawn 0.2 Yuan/ grain;

Male female ratio of beachhead fish 1:1; evasion20%, price of spawn 0.01 Yuan/ grain;

Male female ratio of lampetra japonica 1:1; evasion20%, price of spawn 0.02 Yuan/ grain;

Male female ratio of crucian and carp etc. 1:1; evasion 20%, price of spawn 0.01 Yuan/ grain.

3) Loss estimation

Calculation formula:

F (Ten thousand Yuan) = $\sum_{i=1}^{n}$ (Resources × Reproductive Capacity × Proportion of Mature × Evasion × Spawn Price)

Table 5-7-13 Loss Estimation of Bridge Pier Construction on Fish in Protection Zone

No.	Species	Resource amount (t)	Productivity (10k grains/kg)	Individual mature percentage (%)	Avoiding ration (%)	Spawn loss (10k grains)	Economic loss (10k RMB Yuan)
1	Salmon	4.8	0.10	80	90	345.6	69.12
2	Masu salmon	0.9	0.11	80	90	71.28	14.256
3	Hunchback salmon	0.3	0.12	80	90	25.92	5.184
4	Beachhead fish	16	2.3	50	20	3680	36.8
5	Japanese lamprey	0.5	11.3	50	20	565	11.3
6	Carp,	6.25	12	10	20	125	1.25

	crucian,etc						
Total							137.91

The resource amount listed in the table was for female, counted by half total amount.

It has been calculated underwater (pier) construction period results in a direct annual loss of CNY 1.3791 million to fish resources of protection zone. See table 5-7-13.

Second, selected parameters for estimation of annual economic loss of water (bridge construction) construction

Considering corresponding decreases of annual suspension of the bridges construction and cofferdam removed will cause a lower effect on migratory fish spawning, but many factors such as the noise of the construction site, the destruction of migration routes and destroyed spawning grounds still exist, based on other parameters unchanged, evasion correspondingly decreases, of which salmon calculated by 45%; beachhead fish and lampetra japonica calculated by 10%; the loss of economical fishes like carp, crucian shall not be calculated any more.

Loss estimation

Calculation formula:

F (Ten thousand Yuan) = $\sum_{i=1}^{n}$ (Resources × Reproductive Capacity × Proportion of Mature × Evasion × Spawn Price)

Table 5-7-14: Loss Estimation of Bridge Pier Construction on Fish in Protection Zone

No.	Species	Resource amount (t)	Productivity (10k grains/kg)	Individual mature percentage (%)	Avoiding ration (%)	Spawn loss (10k grains)	Economic loss (10k RMB Yuan)
1	Salmon	4.8	0.10	80	45	172.8	34.56
2	Masu salmon	0.9	0.11	80	45	35.64	7.128
3	Hunchback salmon	0.3	0.12	80	45	12.96	2.592
4	Beach head fish	16	2.3	50	10	1840	18.4
5	Japanese lamprey	0.5	11.3	50	10	282.5	5.65
Total							68.33

The resource amount listed in the table was for female, counted by half total amount.

It has been calculated water (bridge) construction period results in a direct annual loss of CNY 683,300 to fish resources of protection zone.

Third, economic loss caused by reduction of spawning ground resulting from permanent building of bridges

Location of bridges not only changes the hydrological conditions of spawning grounds, but also directly occupies spawning ground; as a result, spawning grounds at or near the pier permanently disappears. According to spawning habits of avoiding noise of fish, the loss amount is calculated in accordance with 10 meters near the bridge.

The total length of spawning grounds for beachhead fish and lampetra japonica of the first core area is about 8,000 meters, and the reduced amount accounting for 0.125% of total spawning ground.

Years of occupation of permanent facilities, combined with operation period, the design life and other factors of rail and road, should be calculated by 20 years, and charging method uses one-time charge.

Calculation Formula:

F (Ten thousand Yuan) = $\sum_{i=1}^{n}$ (Resources × Reproductive Capacity × Proportion of Mature × Loss Ratio of Spawn Area × Spawn Price × Years)

Table 5-7-15 Loss Estimation of Bridge Pier Construction on Fish in Protection Zone

No.	Species	Resource amount (t)	Productivity (10k grains/kg)	Individual mature percentage (%)	Avoiding ration (%)	Spawn loss (10k grains)	Economic loss (10k RMB Yuan)
4	Beach head fish	16	2.3	50	0.125	2.3	0.023
5	Japanese lamprey	0.5	11.3	50	0.125	3.5	0.07
Total							0.093

The resource amount listed in the table was for female, counted by half total amount.

Loss caused by permanent occupation of spawning grounds is 930 Yuan/year. Total loss = 0.093 × 20 = 18,600 Yuan.

Fourth, the direct economic loss of fisheries

According to accumulation of Table 5-7-13, 5-7-14, 5-1-15, construction period of extra large bridge of Mijiang River is 2 years, causing direct loss of 2.061 million Yuan to of fishes in protection zones. Calculation method is as follows:

Fishery Losses: 137.91+66.33+1.86=2 061 000 Yuan

Fifth, restoration compensation of fisheries resources

According to relevant provisions of article 5.3 *Calculation of Economic Loss of Fishery Pollution Accidents* (GB/T21678-2008), “any damage to the natural fishery resources caused by the fishery water pollution or destruction, in terms of calculation of economic loss, restoration compensation of natural fisheries resources should be considered, which shall be not less than 3 times of direct economic losses in principle”. The construction period is 2 years, direct loss year is 2 years, and restoration compensation of fisheries resources is:

(1) 1 379 100 Yuan × 1 × 3 = 4 137 300 Yuan

(2) 683 300 Yuan × 1 × 3 = 2 043 900 Yuan

(3) Loss of permanent occupation of spawning grounds: 18 600 Yuan.

(1) + (2) + (3) = 413.73+204.99+1.86=6 205 800 Yuan

According to the above analysis, construction of extra large bridge of Mijiang River results in a direct annual loss of CNY 2.081 million to protection zone. According to the relevant provisions of national standards, the construction party should provide CNY 6.2058 million as compensation for restoration of fishery resources to protection zone.

Protection zone should use this restoration compensation of fisheries resources to restore the natural spawning grounds and migration routes, maintaining its original ecological condition; to increase the amount of releasing and proliferating of protected of fish, and compensate for loss

of natural resources by artificial means, for the purpose that quantities of protected areas are not affected by construction projects. For special restoration measures and investment, see table 5-1-13.

(8) Ecological restoration measures

Ecological restoration measures include the following:

First, dredge and restore migration routes of migratory fish.

Dredge, restore (or be opened separately) 200 meters migration routes of migratory fish. The measures such as removing construction waste, dredging, and laying gravel should be taken to restore the landform of the river bed, if it is necessary to separately open a migration routes, river dredging and laying of pebbles should be carried out.

Second, opening up a new natural fish spawning ground

Opening up a new 400 meters spawning ground for beachhead fish and lampetra japonica upstream the railway bridge. Its total area and length shall meet the requirements of natural reproduction of beachhead fish and lampetra japonica.

Third, newly-built collection yard of salmon parent fish at the mouth of Mijiang river

Newly-built management room covers 100 square meters, and holding and excavation pond 150 square meters, with power engineering, movable type ovum collection, hatchery equipment, arrested facilities etc.

Fourth, newly-built flow pond for fish fries cultivation

In order to offset the loss of salmon, beachhead fish resources during construction year and ensure continued growth in the quantity of fishes, a newly-built 500 square meters cement flow pond is needed.

Fifth, hatching equipment

Newly-built hatchery workshop covers 200m^2, with 10 sets of hatching equipment.

Sixth, fry rearing

Newly-added fish fries of salmon up to 600,000, and beachhead fish (lampetra japonica) fries 5,000,000.

Seventh, ecological environment monitoring

Monitoring shall be conducted for 10 years. In breeding season monitoring should be carried out for 3-5 times, at 35km section from the river mouth to Dahuanggou 3-5 monitoring points are set. Monitoring contents are: population size, maturity ratio, fisheries environment, and food organisms.

The above ecological restoration measures investment estimation was shown in the **table 5-7-16**.

Table 5-7-16 Ecological Restoration Measures Investment Estimation.

Name	Quantity	Unit price	Amount (10k RMB Yuan)
Rusuming(dredging)	200m	0.1*10k CNY/m	20

Name	Quantity	Unit price	Amount (10k RMB Yuan)
migration passage			
Opening egg laying plant	400m	0.05*10k CNY /m	20
Fishing plant:			
1 management house	100 ㎡	0.15*10k CNY /㎡	15
2 power distribution project		5	5
3 temporary feeding pond	150 ㎡	0.1*10k CNY /㎡	15
4 mobile hatching equipment	1 set	5	5
5 holding up facilities	1 set	10	10
releasing base expanding:			
6 hatch workshop	200 ㎡	0.15*10k CNY /㎡	30
7 cement pond	500 ㎡	0.1*10k CNY /㎡	50
8 hatching equipment	10 set	0.5*10k CNY /set	5
New accrue releasing:			
1 salmon	60k ps	5*10k CNY /10k ps	300
2 beach head fish	500 k ps	0.2*10k CNY /10k ps	100
Ecologic environment survey	10 years	2.5	25
Salmon mark releasing study	4 years	5	20
Total			620

To sum up, extra large bridge construction of Mijiang River results in economic loss of CNY 8,286,800 to fish resources in protection zone, of which direct economic loss accounting for CNY 2,081,000. According to the relevant provisions of national standards, about CNY 6,205,800 should be provide as compensation for restoration of fishery resources; in order to restore types and quantity of fishery resources in the protection zone, ecological restoration measures investment in this engineering construction stands at CNY 6,200,000.

4) Opinion of the competent authority

In August 2010, the ministry of agriculture has organized relevant experts to review *Thematic Assessments Report Concerning Environmental Impact of Construction of Extra Large Bridge for Passenger Rail Line from JILIN to Hunchun on Mijiang Salmon State Level Aquatic Germ Plasm Resource Protection Zone*, and in August 17, 2010 approved the project crossing protection zone according to *Agriculture and Fisheries Resources Memo [2010] No. 82 'A Letter Concerning Acceptance in Principle of Compensation Proposal for Fisheries Resources and Measures in Thematic Assessments Report Concerning Environmental Impact of Construction of Extra Large Bridge for Passenger Rail Line from Jilin to Hunchun on Mijiang Salmon State Level Aquatic*

Germ Plasm Resource Protection Zone', and required the owners units shall implement all proposal and measures of the report in accordance with "3-Simultaneous" principle, in the project implementation process.

5.7.5 Analysis on impact of engineering construction on Songhua Jiang Three-Lake Nature Reserve

To have in-depth understanding of the engineering construction's impact on the major ecological sensitive areas along the line, and provide the scientific decision-making basis to the competent authorities, and in consideration of this project's certain impact on the Songhua Jiang Three-Lake Nature Reserve, the owner commissioned Forestry Survey & Design Academy of Jilin Province to prepare "Evaluation Report for New Jilin-Hunchun Special Passenger Railway Line's Impact on Biologic Diversity of An Tu Ming Yue Pine Mushroom Nature Reserve When Crossing Over It"？？？ report to forestry department of Jilin Province for approval. The following section is written on basis of the above special evaluation report.

1. Overview

In 1990， Jilin Province's Government approved the establishment of Three-Lake Provincial-Level Reserve on Songhua Jiang on the basis of the original Song Hua Hu Nature Reserve（354,098 hectares）built up in 1982 upon the document of "Notice on Establishment of Three-Lake Provincial-Level Reserve on Songhua Jiang"（Ji Zheng Han [1990]no. 9）, with the area extended to 1,144,710 hectares. In September of 2009, the state council approved upgrading of 115,253.2-hectare area inside the original Three-Lake provincial-level reserve to the state-level nature reserve. Songhua Jiang Three-lake Provincial-Level Reserve refers to Song Hua Lake, Hong Yan Lake and Bai Shan Lake at the second Songhua Jiang upper reaches, as well as the Songhua Jiang's water area connecting these three lakes, and the land area demarcated along the lake and river. It's located in the southeast of Jilin Province with the geographic coordinates as E.L.126°35′-128°02′，N.L.42°06′-43°51′. In terms of administrative region, it covers the Feng Man District of Jinlin and Baishan Cities, Jiao He City, Hua Dian City, and 33 towns and one sub-district of JIng Yu County and Fu Song County. It is 196 kilometers long in south-north direction, 119 kilometres in west-east direction, the total area of 1144710 hectares, slightly in a rectangular shape（See Figure 5-7-7）.

The reserve is divided into the lake surface area, the area adjacent to the lake and the area far from the lake. The lake surface area refers to the area inside the normal storage water level line designed for Songhua Jiang's three lakes, and the highest wash-marking line at the Songhua Jiang section connecting the three lakes, with an area of 57305 hectares. Its main functions are power generation and flood protection together with water conservation, irrigation, aquaculture and shipping，etc. The area adjacent to the lake refers to the area extended outwards by 500m from the

normal storage water level line designed for Songhua Jiang's three lakes, and the highest wash-marking line at the Songhua Jiang section connecting the three lakes(within this range, if ridge exists, take the first ridge as border), with an area of 71,268 hectares. Its main functions are protection of lands along the river and lake to prevent a large amount of sands and earth from flowing into rivers and lakes. The area far from the lake refers to area from the area adjacent to the lake to the boundary line of the reserve, with an area of 1016137 hectares. Its main functions are to reserve the water source and solids, prevent pollution and protect the ecological environment by virtue of a large amount of forests and vegetation cover.

The vegetation cover in this area belongs to the Changbai Shan florae with a diverse vegetation types, well known as Natural Treasury with plant ecological community based on the forest vegetation. Due to human activities, the original forest is scare. Most are natural secondary forests mainly with Mongolian oak, Populus davidiana, or Betula platyphlla. The forestry community mainly includes mixed broadleaf-conifer forest, broad-leave mixed forest, Oak tree forest, POPLAR-BIRCH forest and a variety of man-made forests mainly based on larch, red pine, and cob pine. The grassland vegetation mainly includes dry herbosa and emersiprata. The agricultural vegetation cover includes maize , soybean , paddy , rice , etc.

Songhua Jiang Three-Lake Provincial-Level Reserve is the area with the greatest biologic diversity in Changbai Shan's ecosystem and is the important protected area for precious, rare and endangered animals and plants resources and their habitats. It is also the important protected area for domestic water, industrial and agricultural water sources for dozens of cities and counties along the Song Hua River downstream of three lakes like Jilin, Changchun , Song Yuan, Harbin, Jiamusi, etc. The provincial-level reserve plays an important buffer role to the Jilin Songhua Jiang Three-Lake State-Level Nature Reserve established in September of 2009.

Songhua Jiang Three-Lake Nature Reserve is a multifunctional nature reserve for protection of the forest ecosystem and its biologic diversity in the headwater reserve upstream of Songhua Jiang with the functions of conservation management, scientific research and monitoring, education, etc. The protected items include：

Relative location between Jilin Songhua Jiang Three-Lake Nature Reserve provincial-level reserve

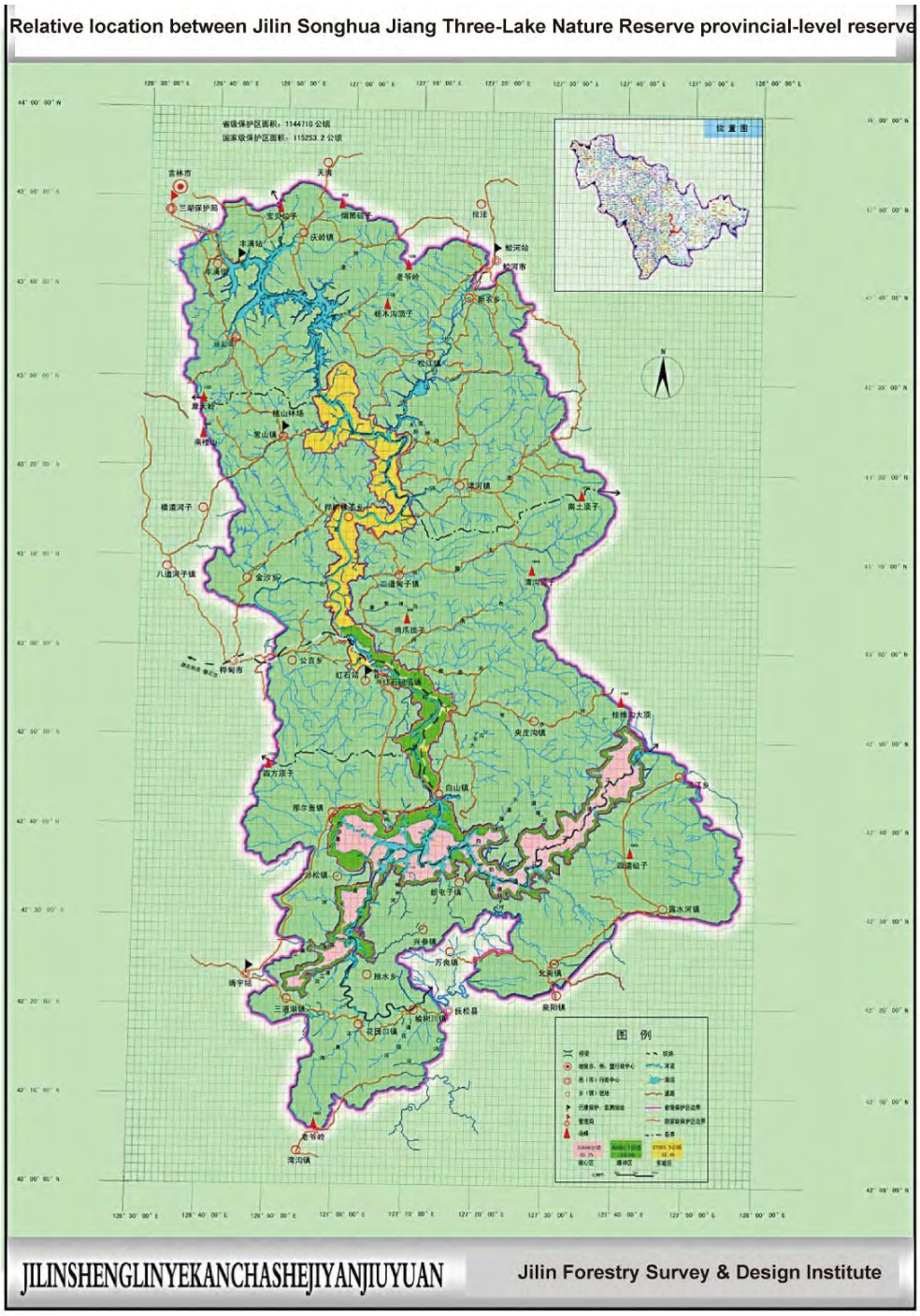


Figure 5-7-7 Songhua Jiang Three-Lake Nature Reserve

（1）Resources of precious, rare and endangered animals and plants and their habitats：There are 12 kinds of wild plants under state key protection, in which, two kinds of state Category I key protected wild plants, i.e. , taxus cuspidata and ginseng；there are ten kinds of state category ii key protected wild plants: red pine, largescale chosenia, wild groundnut, lotus root, Manchurian ash, cork-tree, tilia amurensis rupr, Juglans mandshurica，etc. There are nine kinds of state Category I key protected wildlife in the reserve like Ciconia boyciana, Aquila chrysaetos，erne, Mergus squamatus，red-crowned crane, white crane, hooded crane , sable and Moschus moschiferus；there are 44 kinds of state Category II key protected wildlife like Anthropoides virgo, Grus vipio, common crane , mandarin duck, red deer , etc.

（2）Rich biologic species resources：A great variety of wildlife live in the reserve with a very rich germplasm gene resources. According to the preliminary survey, there are 7 types of vegetation, 25 Population lines, and 40 associations. Wild plants has 63 orders, 160 families, 526 genuses, and 1489 Species(including 57 Species of lichcn and 1.432 Species of higher plant). There are 403 Species of land wildlife, accounting for 90.6% of the whole province's 445 Species(and wildlife resources investigation report 2006 for Jilin Province's ten-year game-hunting prohibition). There are 171 species of known wildlife in the area, in which 13 species are state key protected ones. There are 553 species of known wild plants, in which 6 species are state key protected ones. protection of these wildlife's good genes is of great significance to the social subsistence and development.

（3）Important water source：Three-Lake provincial-level nature reserve is the important ecological safety barrier to the water resources in Northeast China. it is also the water source of the domestic water, industrial and agricultural water to over 10 cities and counties along the Songhua River downstream Three Lakes liek Jilin, Changchun, Songyuan, Harbin, Jiamusi, etc.

2. Relationship bewteen engineering and reserve

（1）Analysis of reasons for impossibility of the engineering to move around the reserve

Because Jiao He City/s urban area is enclosed by the reserve on east, south and west sides. Jiao He City is an important economic foothold along this project's line. With the consideration of requirements on the passenger traffic, local economic development and engineering standards, etc. , new Jiao He Station （CK64+350）will be set up on the west side of the urban area (in neighborhood of the development zone).Meanwhile，as the project's route is affected by many environment-sensitive areas like Mt. La Fa State Forest Park, distribution of mineral resources concerned, Jiao He City's drinking-water source reserve, etc., the line can only go through junction area of the above sensitive areas and Three-Lake Nature Reserves, therefore the project line can't move around the Three-Lake nature reserve. The project line will pass the reserve by about 40.5 kilometres. See Figure 5-7-8 for relative location between the project line and Three-Lake Provincial-Level Reserve On Songhua Jiang.

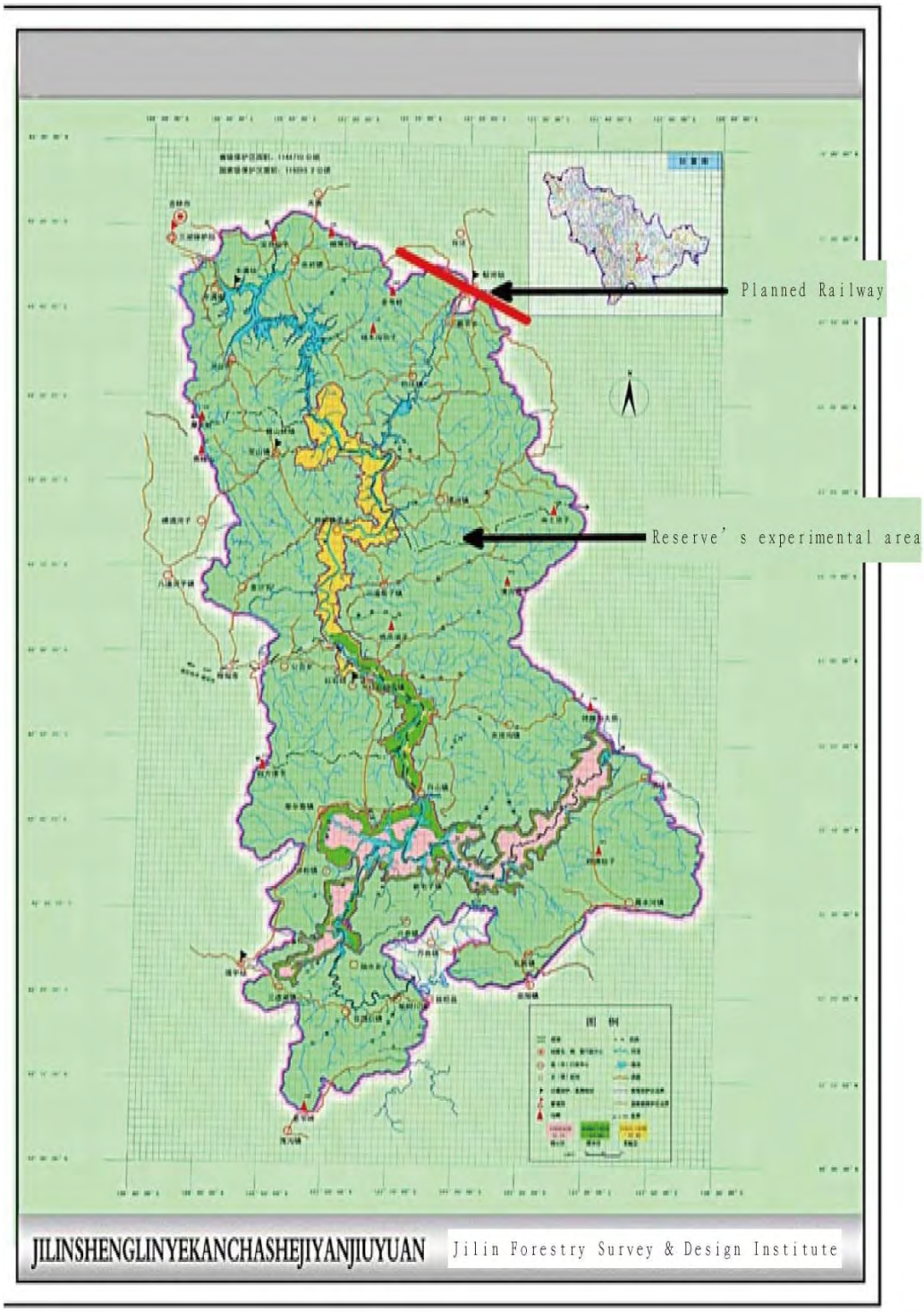


Figure 5-7-8 Relative location between Songhua Jiang Three-Lake nature reserve and the project line

（2）Relationship between engineering and reserve's location

Three-Lake Provincial-Level Reserve on Songhua Jiang covers a large area, including both

Changchun-Tumen Railway, 302 national highway, provincial-level road and county-level road. Due to early establishment of the reserve, its control scopes have not been divided. According to "Administrative Directions for Three-Lake Provincial-Level Reserve On Songhua Jiang of Jilin Province"： the reserve is divided into lake surface area, the area adjacent to the lake and the area far from the lake. The line runs in the area far from the lake． The line goes through the reserve by about 40.5 kilometres, away from the reserve's lake surface. The pass-through stretch is located on the edge of the area far from the lake in the reserve (0~3km to the border of the reserve， meanwhile in parallel with existing 302 national highway). In this way, this project moves around the Songhua Jiang Three-Lake State-Level Nature Reserve, above 15km away from Songhua Jiang Three-Lake State-Level Nature Reserve.

3. Profile of engineering in the reserve

Limited by the topographical condition and Jiao He Station's location, the planned railway line will pass through the experimental area of Songhua Jiang Three-Lake Provincial-Level Reserve in three sections, see Table 5-7-17 for details.

Table 5-7-17 Statistics of engineering for proposed railway line passing through Three-Lake nature reserve

Pass-through mileage	Pass-through length（m）	Bridge （%）	Tunnel （%）	Railroad bed（%）
CK24+800～CK48+120	23320	3296m（14.1%）	16884m（72.4%）	3140m（13.5%）
CK59+640～CK69+000	9360	3333m（35.6%）	887m（9.5%）	5140m（54.9%）
CK73+000～CK81+800	8800	1984m（22.5%）	1548m（17.6%）	5268m（59.9%）
Total pass-through mileage 40.5 km，in which，total length of bridge and tunnel 27.93km, taking 69% of total pass-through length.				

There are totally 10 tunnels，13 bridges, 6 dumping grounds and a few work yards in the reserve.

The line passes through the area far from the lake in the north of three-lake provincial-level reserve on Songhua Jiang, respectively at Tian Nan Forest Farm，Chi Shui Forest Farm and Xin Nong Forest Farm. The line plans to occupy the nature reserve's forest land of 81hm2 permanently, in which, main works occupies 15hm2, two of four slope collars occupies 0.6hm2, railroad bed's dumping ground occupies 6.4hm2 of forest land, and the tunnel dumping ground occupies 59hm2 of the forest land, as shown in Table 5-7-18, Table 5-7-19, and Table 5-7-20.

Table 5-7-18 Statistics of occupied forest land for line's passing through Three-Lake

Provincial-Level Reserve Unit:hm^2

Item	Man-made forest	Natural forest	Total
Line	4.1	10.9	15.0
Slope collar	0.3	0.3	0.6
Borrow pit/dumping ground for railroad bed	4.5	1.9	6.4
Tunnel's dumping ground	55.0	4.0	59.0
Total	63.9	17.1	81.0

Table 5-7-19 Statistics of occupied forest land areas for passenger line's main line passing through the reserve Unit:hm^2

Name of forest farm	Start point	End point	Length（m）	Wooded area	Man-made forest	Natural forest
Tiannan forest farm	DK26+040	DK27+430	1390	4.1		4.1
	DK27+710	DK27+947	237	1.0		1
	DK28+635	DK29+160	525	2.2		2.2
	DK29+492	DK30+330	838	2.5	1	1.5
	DK30+450	DK30+920	350	0.8	0.3	0.5
	DK31+280	DK31+335	55	0.5		0.5
	DK31+917	DK32+150	233	1.0	0.7	0.3
	DK32+450	DK32+550	100	0.3	0.3	
	DK45+968	DK46+209	241	1.3	0.5	0.8
Chishui forest farm	DK62+750	DK62+980	230	0.7	0.7	
	DK63+060	DK63+140	80	0.3	0.3	
Xinnong forest farm	DK80+220	DK80+260	40	0.3	0.3	
Total			4319	15.0	4.1	10.9

Table 5-7-20 Statistics of the occupied forest land areas for slope collars（Unit: hm2）

Location	Total area of occupied land	Occupied wooded area	Man-made forest	Natural forest
DK38+500Slope collar	0.3	0.3	0	0.3
DK41+000Slope collar	0.3	0	0	0
DK43+000Slope collar	0.3	0	0	0
DK44+000Slope collar	0.3	0.3	0.3	0
Total	1.2	0.6	0.3	0.3

4. Construction Impact assessment on the reserve

（1） Ecological status of the reserve

1) Species diversity

There are rich plant species in the reserve. At present, 63 orders, 160 families, 526 genuses and 1489 species of wild plants are known, including 1 order, 17 families, 27 genuses and 57 species of lower plant--lichcn；in higher plants, 11 orders, 24 families, 35 genuses and 50 species of bryopsida；8 orders, 20 families, 35 genuses and 81 species of filicales；l order, 3families, 7 genuses and 11 species of gymnosperms；and 42 orders, 96 families, 422 genuses and 1290 species of anthophyta. Totally, 35 orders, 93 Families and 403 species of invertebrates are found in the Three-Lake Reserve. In which：1 order 1 family 3 species for cyclostomes；6 orders 14 families 71 species for fishes；2 orders 6 families 13 species for amphibia；3 orders 4 families 11 species for reptiles；17 orders 51 families 255 species for birds；6 orders 17 families 50 species for beasts. In addition, 16 orders 156 families 896 species for insecta are known in the reserve.

There are many precious, rare and endangered animal and plant species in the reserve. There are 12 kinds of wild plants under state key protection, in which, 2 kinds of state Category I key protected wild plants, i.e. , Taxus cuspidata and ginseng；there are 9 kinds of state Category II key protected wild plants: red pine , Largescale chosenia , Wild groundnut , lotus root , Manchurian ash , cork-tree , Tilia amurensis Rupr, Juglans mandshurica，etc. There are 9 kinds of state Category I key protected wildlife in the reserve like Ciconia boyciana, Aquila chrysaetos，erne, Mergus squamatus，red-crowned crane , white crane , hooded crane , sable and Moschus moschiferus. There are 44 kinds of state Category II key protected wildlife like Anthropoides virgo, Grus vipio, common crane , mandarin duck, red deer , etc.

According to the spot survey，the area where engineering passes through the reserve is not the wildlife’s concentrated distribution area, and most state key protected wild animals and other important species are distributed in the area adjacent to the lake in the reserve, and most key protected wild animals are migratory birds with a very large range of activities. Distribution of the state key protected wild plants in the area where the engineering passes through in the reserve based on Spot survey is shown in Table 5-7-21. There are 18 kinds of state Category key protected wild animals in the area where the engineering passes through the reserve，i.e.，mandarin duck, goshawk, Accipiter nisus，Accipiter virgatus, Buteo buteo，Buteo hemilasius, Buteo lagopus，Circus melanoleucos, Circus cyaneus, Falco subbuteo, Falco vespertinus , kestrel, Strix uralensis, Asio flammeus, lynx , wild boar, roe deer, and black bear.

Table 5-7-21 List of state key protected and endangered wild plants in the reserve

Chinese name	Latin name	Class and category	Habitat and distributional characteristics	Protection reasons
Red pine	*Pinus koraiensis*		Scattered or aggregated in the mixed broadleaf-conifer forest	Ever as the major timber-tree in Northeast China，the tertiary plant relic species
Amur linden	*Tilia amurensis*		Mixed broadleaf-conifer forest	Major nectariferous plant
Manchurian ash	*Fraxinus mandshurica*		Scattered in mixed broadleaf-conifer forest	Major timber-tree
Cork-tree	*Phellodendron amurense*		Scattered in mixed broadleaf-conifer forest	Major timber-tree , tertiary plant relic species
Wild groundnut	*Glycine soja*		Aggregated on forest roadside and hillside prairie	Important plant of germplasm resources

2) Social economic status

Songhua Jiang Three-Lake Provincial-Level Reserve is 196 kilometres long in south-north direction, and 119 kilometres wide in east-west direction, in which the forest land as major part takes nearly 80% of the total area, farmland nearly 12%. In terms of administrative division, it covers Feng Man District of Jilin and Baishan Cities, Jiao He City, Hua Dian City, Jing Yu County and Fu Song County, including the above cities and counties' 33 towns and 1 sub-district, 293 villages, and 1230 natural villages.

（2） Construction environmental impact assessment

- Impact on forest eco-system

The railway is planned to occupy 81hm^2 forest land in the nature reserve, including 15hm^2 for the project main part and 66hm^2 for temporary construction (tunnel inclined shafts, spoil ground, etc.). Main tree species on the occupied forest land include Pinus koraiensis, Fraxinus mandshurica, Juglans mandshurica, Phellodendron amurense, Tilia amurnesis, Tilia mandshurica, Quercus mongolica, Pobulus davidiana, silver birch, Betula costata trautv, Acer mono Maxim, Acer mandshuricum, Acer triflorum, elm, willow, deciduous pine tree, Picea asperata, Mongolian Scotch pine, etc. Under the woods there are honeysuckle, Spiffy Bushclover, Corylus heterophylla, Hazel, Winged Euonymus, elderbush, Acanthopanacis Senticosi, Aralia elata(Miq.) seem, Syringa amurensis, sheepberry, Sorbaria kirilowii, Lilium distichum Nakai, Adenophora tetraphylla, Platycodon grandiforus, Rosa darica Pall, Glycine soja, Fillipendula palmata, Dictamnus dasycarpus, Artemisia annua L, Artemisia princeps, Agrimonia pilosa Ledeb, Evening Primrose, Convallaria majalis, Fructus Schisandrae Chinensis, Actinidia arguta, Actinidia kollmikta, Spuriopimpinnellabrachycarpa（Kom.）kitagawa, agaricus, mellea armillaria sporophore, Hericium erinaceus, Pleurotus, Hohenbuehelia serotina, etc.

The occupied forest land includes 78.9% man-made forest and 21.1% natural forest (mainly natural Quercus mongolica broadleaved mixed stands). There are state key protected wild plants Pinus koraiensis, Fraxinus mandshurica, Juglans mandshurica, Phellodendron amurense, Tilia amurnesis and Glycine soja. These plants in the occupied forest show a small total quantity and belong to common species in the east part of Jilin Province. Glycine soja grows mainly at the edge of forests and farm lands (see Table 5-7-22).

Table 5-7-22 Quantity of Key Protected Wild Plants

Species	Level of protection	Adult tree number D.B.H.≥5cm	Young tree number D.B.H.≥5cm	Total number
Pinus koraiensis		67/6	95/9	162/15
Fraxinus mandshurica		266/22	510/36	776/58
Juglans mandshurica		844/35	521/32	1365/67
Phellodendron amurense		58/8	18/6	76/14
Tilia amurnesis		72/9	35/5	107/14
Glycine soja			850/55	107/55
Total		1307/80	2029/143	2593/223

Note: Numbers after “/” are for trees in permanently occupied lands.

The proposed railway will, in form of tunnel, pass through the large natural forest slightly disturbed by human. Natural forests occupied by subgrades and bridges are mainly in compartments No.12, 14 and 36 in Tiannan Forest, which are about 1km from Beicigou Village. The 4hm^2 natural Quercus mongolica mixed forest for spoil ground is within a large man-made larch forest 100-500m east of Beicigou Village. The natural forest habitat to be occupied is majorly disturbed by human and not suitable for big wild animals. State key protected animals like wild boars and roe deer are roaming in this region. Most state key protected wild birds are mostly migratory animals in a large home range. Therefore, in the project construction period, the home range of nearby state key protected wild animals will be affected slightly.

Excavation and backfilling during construction will destroy the vegetation along the route and occupy forest and grass lands, which brings exposed earth surface and thus changes of partial eco-structure along the route. Exposed earth surface under rainwash will show soil loss and decreased fertility, and hence influence partial stability of the eco-system.

Other sections along the route show intensified human activities. Site survey found no habitats of state key protected wild animals. Railway construction will partially affect living environment of

nearby wild animals. According to site survey and analysis of key protected animal distribution range, the proposed railway region is not a habitat of rare animals. The project construction would only partially influence activities of wild animals, but not cause reduction of wild animal species.

Investigation shows that there're activities of wild boars and roe deer 5km south of CK41 in Three Lakes Nature Reserve. This project goes through this section in form of tunnel (Lafa Mountain Tunnel CK38+200~CK47+000), and has no influence on existing eco-corridor. Other key protected wild animals are mainly distributed in Songhuajiang River Three Lakes State Nature Reserve far from the railway route and not affected by the project construction.

- **Impact of Waste Water**

Waste oil dripped for leaked from construction machines and outdoor machines washed by rainwater may cause pollution. Drilling bits from bridge substructure construction may pollute water. Bridge piers may occupy river course, change water flow pattern and cause new river erosion in rain season. According to water flow, the engineering design has taken effective measures for the pier base concrete and protection measures against possible slope slide or collapse. Living sewage and rubbish from construction camps and stored construction materials may pollute the water system. The above pollutions may all affect growth of surrounding aquatic plants and habitation of aquatic animals.

The project is planned to set up Jiaohe West Station in the urban area of Jiaohe City located within the Nature Reserve. The station waste water drainage during operation period will cause some impact on the Nature Reserve.

- **Impact of Waste Gases**

During subgrade construction, large amount of dust due to excavation, backfilling, bulldozing, soil handling, cement and lime loading/unloading, transportation and mixing will dissipate into the air. Material transporting trucks and stored materials in wind will bring dust pollution. Especially when wind is strong or trucks are running fast, the dust pollution is even worse. This will affect surrounding plant growth and animal activities to some degree.

- **Impact of Noises**

Level of noises from construction material transportation trucks, excavators, loaders, bulldozers and graders are 76-98dB (A), which will cause some negative impact on the environment. This impact will disappear at the end of construction period.

- **Impact of Solid Disposals**

Abandoned construction soil and living rubbish of construction camps, if disposed improperly, will bring some negative influence to the environment along the railway. Bridge construction especially pile foundation excavation shall adopt proper spoil management and avoid random placement along riverside. It shall be put in designated places or filled in subgrade, avoiding riverside blocking and not smooth flood water release.

- Biodiversity Impact Assessment

In an approach of expert consultation, opinions have been solicited from experts of wild animal and plants protection as well as administrative departments of the Nature Reserve, finally 6 indicators of biodiversity assessment have been defined: eco-system, biotic communities (habitats), population/species, main protection targets, biological safety and relevant interest groups. The experts and organizations assigned a weight to each indicator and scored according to the degree of impact.

① Impact on Eco-system

A: Eco-system

A1 Type and uniqueness degree of eco-system

The eco-system in the proposed railway region belongs to the forest eco-system type. The Nature Reserve land to be occupied by the railway include man-made forests and natural secondary forests with man-made larch, spruce, Mongolian scotch pine, poplar and natural Quercus mongolica, Juglans mandshurica, elm, Fraxinus mandshurica, locust tree, Aceraceae, silver birch, hankowwillow, Pinus koraiensis, Fraxinus rhynchophylla, Tilia amurnesis, Phellodendron amurense, Tilia mandshurica, Pobulus davidiana, etc. They are distributed in limited number of places in northeast China and Far East area.

Degree of uniqueness	Score	Brief description
○ Not unique (0-10 points)	16	Logged trees and destroyed vegetation for the proposed railway do not include state first level protection plants and local unique plants, but include state second level protection plants: Pinus koraiensis, Fraxinus mandshurica, Phellodendron amurense, Juglans mandshurica, Tilia amurnesis and Glycine soja.
○ China, Far East (11-30 points)		
○ Northeast unique (31-50 points)		
○ Jilin unique (51-70 points)		
○ Local unique (71-100 points)		

A2 Impact on area of existing eco-system types in assessed region

This project is located at the edge of the experimental area and will cross large area of forest in form of tunnel. Earth pits and spoil grounds will mainly occupy man-made forests, therefore it has slight influence on existing eco-system areas in the Nature Reserve.

Type of land	Before construction (hm^2)	After construction (hm^2)	Change (+/-)	Margin (%)	Notes
	a	b	**b-a**	(b-a)/a	
Wood land	807621	807540	-81	0.01%	
Sparsely forested woodland	18263	18263			
Shrubbery land	15129	15129			
Young afforestation land	26034	26034			
Agricultural land	136506	136156	-350	0.26%	
Water area wet land	57305	57304	-1		
Other forestry	15395	15395			
Other land for construction	68457	68889	432	0.63%	
Total	1144710	1144710			

Influence degree	Score	Brief description
○ Slight (0-10 points)	18	Type of occupied forest lands is mainly man-made forest. Natural forests are mainly broadleaved mixed forest.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A3 What is the degree of the project construction influence on the above natural eco-system structure?

The fairly structured forest eco-system is mainly distributed near the lakes and in Songhuajiang Three Lakes State Level Nature Reserve. The occupied forest land location has big human disturbance originally. The earth pits will be original exposed sand quarries. Spoil grounds will be mainly farm land, with 25% of the total area. 93% of forest land occupied by spoil ground will be man-made forest. The influence on the natural eco-system structure will be minor.

Influence degree	Score	Brief description
○ Slight (0-10 points)	19	The proposed railway is located at the edge of the far lake area of the Nature Reserve. The non-tunnel section has big human disturbance originally. This project will have minor influence on the eco-system structure.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A4 What is the degree of the project construction influence on the eco-system service function?

The project construction has minor influence on area and structure of the forest eco-system, and thus a slight influence on its service function.

Influence degree	Score	Brief description
○ Slight (0-10 points)	15	After the project completed, the forest land will decrease by a small margin of 0.11% and thus will have a minor influence on the Nature Reserve forest eco-system service function.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A5 Degree of influence on aesthetic value, economic value and cultural value of original landscape

The new railway main line passing through forest land is 10.45% of the total length passing through the nature reserve. Earth pits has some influence on the landscape of the nature reserve. Temporary spoil lands after occupation shall be treated with general afforestation measures and thus will have no negative influence on the aesthetic value of the nature reserve. Therefore, this project has minor influence on aesthetic value, economic value and cultural value of the nature reserve.

Influence degree	Score	Brief description
○ Slight (0-10 points)	22	The new railway main line passing through forest land is 10.45% of the total length passing through the nature reserve. Therefore, it has minor influence on aesthetic value, economic value and cultural value of the nature reserve.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A6 Degree of soil erosion and possibility of occurrence of geological disasters in the assessed region?

Influence degree	Score	Brief description

○ Slight (0-10 points)	42	There's minor or medium influence on soil erosion. If spoil ground has not smooth water drainage, possibility of occurrence of geological disasters is bigger.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A7 Degree of decrease of green coverage in the assessed region? Green coverage in assessed region = green area in assessed region / total land area in assessed region × 100%.

Occupied land area / nature reserve area ×100%=81/1144710×100%=0.007%

Influence degree	Score	Brief description
○ Slight (0-10 points)	9	The decrease will be 0.007%, with a slight influence on the green coverage of the region.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

- Weight and score of indicators

Table 5-7-23 Summary of Scores of Eco-system Influence Indicators

Indicator	Influence degree score (range 0-100)	Indicator weight	Indicator score (score × weight)
A1	16	0.15	2.4
A2	18	0.15	2.7
A3	19	0.15	2.85
A4	15	0.15	2.25
A5	22	0.12	2.64
A6	42	0.15	6.3
A7	9	0.13	1.17
Total		1.0	20.31

② Impact on Biotic Communities (Habitats)

B: Biotic communities (habitats)

B1. Uniqueness of type of biotic communities (habitats) affected by the project?

In the region along the proposed railway, there're roaming animals like state key protection animals wild boars, roe deer and lynxes. There's no inhabiting large wild animals. The proportion of occupied natural forest is small and the influence on type of biotic communities (habitats) is minor.

B2. Project influence on biotic community (habitat) area?

The proposed railway has a minor influence on biotic community (habitat) area.

B3. Does the project affect the connectivity of the habitats?

The proposed railway goes through the nature reserve with 44.9% length in form of tunnel and 20.5% in form of bridges. The occupied forest land will have a very small influence on connectivity of the habitats.

B4. What is the degree of project influence on key species (e.g. constructive species, dominant species) of biotic communities?

The proposed railway has a slight influence on key species of biotic communities.

B5. What is degree of project influence on biotic community structure?

The proposed railway occupied land has no protection biotic communities. There're mainly man-made forests and natural secondary trees and shrubs. The railway will have a slight influence on structure of natural biotic communities in the nature reserve.

Indicator	B1	B2	B3	B4	B5
Name of affected biotic community (habitat)	Uniqueness	Area loss (hm^2)	If segmented	Key species	Community structure
Mouse	Not unique	81	Not		
Frogs	Not unique		Not		
Wild boars, roe deer and lynxes	Not unique		Not		
Influence degree	**Separate scores**				
Slight (0-10 points)	9	18	26	8	12
Minor (11-30 points)					
Medium (31-50 points)					
Major (51-70 points)					
Serious (71-90 points)					

Table 5-7-24 Summary of Scores of Influence on Biotic Communities (Habitats)

Indicator	Score of influence degree (range 0-100)	Indicator weight *	Indicator score (score×weight)
B1	9	0.2	1.8
B2	18	0.2	3.6
B3	26	0.2	5.2
B4	8	0.2	1.6
B5	12	0.2	2.4
Total		1	14.6

③ Impact on Population/Species

C: Population/species

C1. What is degree of threatening of project affected unique species?

Name of affected unique species	Distribution region			Degree of threatening			Pattern of influence
	Northeast China, Far East	Jilin	Nature Reserve	Small	Medium	Serious	
Pinus koraiensis	+			+			
Fraxinus mandshurica	+			+			
Juglans mandshurica	+			+			

Phellodendron amurense	+			+			
Tilia amurnesis	+			+			
Glycine soja	+			+			

Degree of threatening	Score	Brief description
○ None (0-10 points)	18	The proposed railway has a minor influence on above species.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C2. What are the protection species affected by the project? Do they also exist in unaffected areas?

Affected protection species	Protection level				Distribution			
	State level	Province level	IUCN	CITES	Within assessed region	Within Nature Reserve	Jilin	Northeast China, Far East
1. Plant								
Pinus koraiensis					+	+	+	+
Fraxinus mandshurica					+	+	+	+
Juglans mandshurica					+	+	+	+
Phellodendron amurense					+	+	+	+
Tilia amurnesis					+	+	+	+
Glycine soja					+	+	+	+
2. Animmal								

Influence degree	Score	Brief description
○ Slight (0-10 points)	24	There'll be minor influence on plant communities and animal habitats in the nature reserve.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C3. What is degree of project influence on food web/chain structure of important species (e.g. unique species, protection species and rare species)?

Influence degree	Score	Brief description
○ Slight (0-10 points)	22	There'll be a minor influence on food web/chain structure of important species in the nature reserve.
○ Minor (11-30 points)		

○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C4. What is degree of project influence on migration, dispersal and propagation of important species (e.g. unique species, protection species and rare species)?

Influence degree	Score	Brief description
○ Slight (0-10 points)	21	The project will have a minor influence on migration, dispersal and propagation of important species.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C5. What is the possibility of breakout of pests and plant diseases resulted by the project?

Possibility	Score	Brief description
○ None (0-10 points)	16	There's a small possibility of breakout of pests and plant diseases due to the project.
○ Small (11-30 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-25 Summary of Scores of Assessment Indicators of Impact on Population/Species

Indicator	Score of influence degree (range 0-100)	Indicator weight *	Indicator score (score×weight)
C1	18	0.2	3.6
C2	24	0.2	4.8
C3	22	0.2	4.4
C4	21	0.2	4.2
C5	16	0.2	3.2
Total		1.0	20.2

④ Impact on Main Protection Targets

D: Main protection targets

D1. Influence on population quantity of main protection targets in the nature reserve

Name of species	Quantity before development	Quantity after development	Change (+/-)	Margin （%）	Notes
	a	b	b-a	(b-a)/a	
1. Animal			只		
Aix galericulata			0	0	
Accipiter gentilis			0	0	
Accipiter nisus			0	0	

Name of species	Quantity before development	Quantity after development	Change (+/-)	Margin （%）	Notes
Accipiter virgatus			0	0	
Buteo buteo			0	0	
Buteo hemilasius			0	0	
Buteo lagopus			0	0	
Circus melanoleucos			0	0	
Circus cyaneus			0	0	
Falco subbuteo			0	0	
Falco vespertinus			0	0	
Falco tinnunculus			0	0	
Strix uralensis			0	0	
Asio flammeus			0	0	
Felis lynx			0	0	
Sus scrofa			0	0	
Capreolus pygargus			0	0	
2. Plant			Number		
Pinus koraiensis			-162	0	
Fraxinus mandshurica			-776	0	
Juglans mandshurica			-1365	0	
Phellodendron amurense			-76	0	
Tilia amurnesis			-107	0	
Glycine soja			-850	0	

D2. Influence on area of habitat of main protection targets in the nature reserve

Name of species	Habitat area before development (hm^2)	Habitat area after development (hm^2)	Change (+/-)	Margin （%）	Notes
	a	b	b-a	(b-a)/a	
1. Animal					
Aix galericulata			0	0	
Accipiter gentilis			0	0	
Accipiter nisus			0	0	
Accipiter virgatus			0	0	
Buteo buteo			0	0	
Buteo hemilasius			0	0	
Buteo lagopus			0	0	
Circus melanoleucos			0	0	
Circus cyaneus			0	0	
Falco subbuteo			0	0	
Falco vespertinus			0	0	
Falco tinnunculus			0	0	
Strix uralensis			0	0	

Asio flammeus			0	0	
Felis lynx			0	0	
Sus scrofa			0	0	
Capreolus pygargus			0	0	
2. Plant					
Pinus koraiensis			0.1	0	
Fraxinus mandshurica			0.5	0	
Juglans mandshurica			2	0	
Phellodendron amurense			0.1	0	
Tilia amurnesis			0.2	0	
Glycine soja			0.3	0	

- Indicator weights and scores

Table 5-7-26 Summary of Scores of Assessment Indicators of Influence on Main Protection Targets

Indicator	Score of influence degree (range 0-100)	Indicator weight *	Indicator score (score×weight)
D1	15	0.5	7.5
D2	15	0.5	7.5
	Total	1.0	15

⑤ Impact on Biological Safety

E: Biological safety

E1. Possibility and hazard degree of invasion of foreign species (or harmful lives) resulted by the project?

Possibility	Score	Brief description
○ None (0-10 points)	24	There's small possibility of causing invasion by foreign species (or harmful lives).
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Definite (71-100 points)		

E2. What is the possibility of loss of genetic resources in the nature reserve?

Possibility	Score	Brief description
○ None (0-10 points)	15	There's minor possibility of loss of genetic resources in the nature reserve resulted by the project.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-27 Summary of Scores of Assessment Indicators of Influence on Biological Safety

Indicator	Score of influence degree (range 0-100)	Indicator weight *	Indicator score (score×weight)
E1	24	0.5	12
E2	15	0.5	7.5
	Total	1.0	19.5

⑥ Impact on Relevant Interest Groups

Interest groups mean citizen groups or organizations having direct or indirect interest relations with the project.

Surrounding communities: rural communities with residents' production and living more or less relying on the nature reserve.

Assessment indicators: F: Relevant Interest Groups

F1. Support degree for the project by different interest groups like local government and the community people?

Support degree	**Score**	**Brief description**
○ Highly rejecting (71-100 points)	22	The proposed railway is beneficial to local government and community people and highly favored by them. For residential areas passed by the railway and places for spoil grounds, appropriate efforts for resident relocation and compensation shall be made.
○ Majority rejecting (51-70 points)		
○ Opinion divergence (31-50 points)		
○ Majority supporting (11-30 points)		
○ Highly supporting (0-10 points)		

F2. What is the degree of controversy about the project among different interest groups such as local governments, the nature reserve administration and community people?

Degree of controversy	**Score**	**Brief description**
○ None (0-10 points)	15	There's basically no controversy among different interest groups such as local government, the nature reserve administration and community people.
○ Small (11-30 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Great (71-100 points)		

F3. What is the contribution of the project to direct investment for management of the nature reserve?

Contribution scale	**Score**	**Brief description**
○ Totally none (71-100 points)	45	The project may add product sales and tourism income of the nature reserve, which are used for management of the nature reserve.
○ Basically none (51-70 points)		
○ Small (31-50 points)		
○ Big (11-30 points)		

○ Great (0-10 points)		

F4. What is the contribution of the project to improvement of social and economic situation in surrounding communities? (incl. industry re-structuring, employment opportunities, health and sanitation, culture and education, and social security, etc.)

Contribution scale	**Score**	**Brief description**
○ Totally none (71-100 points)	22	The project construction may increase job opportunities, stimulate local economic development and facilitate industry restructuring of the nature reserve.
○ Basically none (51-70 points)		
○ Small (31-50 points)		
○ Big (11-30 points)		
○ Great (0-10 points)		

F5. What is the degree of recognition of the project planned biodiversity protecting measures and restoring proposals by the nature reserve administration?

Measures, proposals and recognition	**Score**	**Brief description**
○ No measures (71-100 points)	24	Biodiversity protecting measures and restoring proposals planned in the project have been basically recognized by the nature reserve administration.
○ Big problem (51-70 points)		
○ Still to be improved (31-50 points)		
○ Basically recognized (11-30 points)		
○ Totally recognized (0-10 points)		

F6. What is the risk of hazards to local people's production & living and catching fire in the assessed region due to the project?

Hazard and risk	**Score**	**Brief description**
○ None (0-10 points)	39	The project during construction period may cause hazards to the environment. In fireproof period, construction personnel shall avoid using open fire and smoking, and eradicate fire potentials.
○ Small (11-30 points)		
○ Possible (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-28 Summary of Scores for Influence on Relevant Interest Groups

Indicator	Score (range 0-100)	Indicator weight *	Indicator scale (score×weight)
F1	22	0.15	3.3
F2	15	0.15	2.25
F3	45	0.15	6.75
F4	22	0.2	4.4
F5	24	0.15	3.6
F6	39	0.2	7.8
Total		1.0	28.1

⑦ Biodiversity Influence Index (BI) and Degree Rating

Table 5-7-29 Table of Calculation of Biodiversity Influence Index

Indicator	Score Si	Weight Wi*	Wi×Si
A Impact on bio-system	20.31	0.2	4.062
B Impact on communities (habitats)	14.6	0.15	2.19
C Impact on population/species	20.2	0.15	3.03
D Impact on main protection targets	15	0.19	2.85
E Impact on biological safety	19.5	0.15	2.925
F Impact on relevant interest groups	28.1	0.16	4.496
Total		1.0	19.55

Calculation method of biodiversity influence index:

$$BI=\sum(Wi\times Si) \qquad (i=A\ldots F)$$

The calculated biodiversity influence index BI=19.55.

According to the situation of project biodiversity influence, the influence degrees are classified in five grades, i.e. slight influence, small influence, medium influence, big influence and serious influence.

Table 5-7-30 Grading of Biodiversity Influence Degree

Grade	Sight	Small	Medium	Big	Serious
Influence index (BI)	BI<15	15≤BI＜35	35≤BI＜55	55≤BI＜75	BI≥75

Because biodiversity influence index BI=19.55<35, it is defined that the construction project has a small impact on biodiversity in the nature reserve.

（3） Preventative and Protective Measures

1) Plant Protecting and Restoring Measures

On the land to be occupied there're natural Pinus koraiensis, Fraxinus mandshurica, Juglans mandshurica, Phellodendron amurense, Tilia amurnesis and Glycine soja, which are state level II key protection wild plants. According to quantities given in Table 5-2-6, these plants shall be transplanted to nearby empty land before construction. They may also be used for railway greening and environment upgrading by being transplanted on sides of the railway.

2) Temporary Engineering Optimization

Since the railway line goes a long distance through the nature reserve, during construction, it can not be avoided that temporary facilities like construction sites, camps and spoil grounds are set up within the nature reserve. According to feasibility study documents, this project will have 6 spoil grounds distributed in the nature reserve. Among them, Nanshahezi Village spoil ground and Lianjiang Village spoil ground are located near DK26 – DK28 and closely adjacent to boundary of the nature reserve, with the nearest distance 2km to the nature reserve boundary DK24+800. These two spoil grounds are close to each other. In order to minimize impact on the nature reserve, this environment impact assessment suggests that the two spoil grounds are united into one and moved out of the boundary of the nature reserve. The other 4 spoil grounds are far from boundary of the nature reserve and main protection targets, and thus are suggested to keep. It is suggested that existing residential houses or factory buildings are possibly rented for other temporary facilities like construction site and camps, minimizing destroying of original land form in the nature reserve.

3) Preventative and Protective Measures in Construction Period

By enhancing construction arrangement design and coordination in construction stage, and reducing tunnel construction much temporary piling amount and time, to minimize occupation and destroying of earth surface vegetation.

During construction, a construction boundary shall be defined with fencing means to prohibit random construction worker walking and vehicle running out of the boundary. Engineering wastewater and living rubbish are strictly prohibited to discharge into rivers. Construction material storage places shall be away from water. Various goods and materials shall have rain protecting means together with surrounding open ditches, silting basins and protective walls to avoid being washed into rivers. Living wastes during construction periods shall be cleaned daily and collected centrally, with food wastes ret for fertilizers and other wastes transported to refuse dumps for disposal.

To avoid construction dust influence on growth of nearby vegetation, water sprinkling and covering measures shall be taken in areas of construction paths, construction sites and construction camps, preventing dust influence on wild animals and plants.

At the end of construction, construction sites shall be cleaned up timely with no waste materials or facilities remaining in rivers. Ecological environment restoration shall be made at construction sites to avoid soil erosion effect on water environment.

Construction personnel shall be strictly educated of environment protection sense and strictly prohibited to enter the nature reserve to destroy wild plants or kill wild animals. Warning signs for protecting wild plants and animals shall be set up on sides of the new railway.

4) Protecting Measures in Operation Period

In operation period, sewage treating facilities at Jiaohe West Station shall be appropriately maintained to ensure station sewage is discharged according to the standard.

（4） Opinions of Responsible Authorities

Jilin Province Forestry Department, with its file No.[2010] 368 dated July 29, 2010 “Official Reply about Jilin – Huichun High Speed Railway Passenger Line Passing through Songhuajiang Three Lakes Province Level Nature Reserve”, agreed the project line location proposal within the nature reserve. It also raised requirement that the project shall go through related national formalities, and shall minimize vegetation and environment destroy during construction and restore original form of the land for construction site at the end of the project.

In conclusion, the project construction influence index of biodiversity in Songhuajiang Three Lakes Province Level Nature Reserve is 19.55. It indicates that, the project has a slight influence on biodiversity in the nature reserve, and with adequate protecting and restoring measures during construction and operation periods, the project construction is feasible.

5.7.6 Analysis on impact of engineering construction on Mingyue Pine Mushroom Nature Reserve

To have in-depth understanding of the engineering construction's impact on the major ecological sensitive areas along the line, and provide the scientific decision-making basis to the competent authorities, and in consideration of this project's certain impact on Antu Mingyue Pine Mushroom Nature Reserve, the owner commissioned Forestry Survey & Design Academy of Jilin Province to prepare “Evaluation Report for New Jilin-Hunchun Special Passenger Railway Line's Impact on Biologic Diversity of An Tu Ming Yue Pine Mushroom Nature Reserve When Crossing Over It” report to forestry department of Jilin Province for approval. The following

section is written on basis of the above special evaluation report.

1. Overview of the nature reserve

(1) overview

Jilin Province's Ming Yue Pine Mushroom Nature Reserve is located in Ming Yue Basin at northern foot of Mt. Chang Bai Shang, in the northern part of An Tu County, in the middle westward zone of Yanbian Korean Autonomous Prefecture, in the east of Jilin Province(See Figure 5-7-9). Its geographical position is 128°37′30″-129°9′45″E，42°56′10″-43°26 ′N，total area of 120,000 hectares. The reserve is adjacent to Long Jing City in the east，border on Long County in the south, and Dun Hua City in the west. The area covers Ming Yue Town, Shi Men Town, Liang Bing Town and southeastern part of Chang Xing County. This reserve was established in March of 1999 upon the government's approval.

Figure 5-7-9 Scope of Ming Yue Pine Mushroom Nature Reserve

The reserve is located in the Ming Yue Basin between Mt. Mu Dan Ling, Mt. Ying E Ling, and Mt. Ha Er Ba Ling. Northern edge of the Ming Yue Basin is the southern part of Mt. Ha Er Ba Ling, and its western edge is the foot of Mt. Mu Dan Ling, and its southern edge is main body of Mt. Ying E Ling. The basin's southern edge is the 800-1100-meter mountain barrier, forming the water-shed of Bu Er Ha Tong River and hai Lang River. Its western border is the 600-900-meter Mt. Zhong Shan, the water-shed Mu Dan Jiang River and Bu Er Ha Tong River。 Its northern border doesn't reach the water-shed, with only the elevated and crumpled edge of Mt. Ying E Ling in geologic history as border, and is composed of the 600-900-meter Mt. Zhong Shan. To the south of this border are mostly the steep hills and low mountains, suitable for red pine's growth, and to its north is the slow Mt. Zhong Shan's belt above 800 meters, suitable for growing red pine and

white pine.

(2) Main protection targets

This nature reserve belongs to the Forest/wildlife-type one, and is the important nature reserve for precious edible mushroom in Jilin Province, with pine mushroom as its leading protected kind. Key protection is given to the precious pine mushroom in preservation of the natural environment and natural resources. Also, this reserve is a comprehensive nature reserve with functions for resource conservation, scientific research breeding, production & sales, and econtourism.

Main protected species include：

- **Living environment of precious, rare and endangered species：** The vegetation cover on the shady slope in the mountainous region above 800m in Ming Yue Basin is mainly composed of spruce and fir mixed broadleaf-conifer forest, and on the sunny slope composed of red pine or Japanese red pine mixed broadleaf-conifer forest. Special topography, soil and vegetation cover forms the distinct ecological environment in Ming Yue Basin, which can effectively regulate the air temperature, ground temperature and atmospheric humidity in the basin, forming the important ecological environment for subsistence and reproduction of many rare species like sable, red deer, black bear, goshawk , Manchurian walnut, Manchurian ash , cork-tree , etc.

- **Japanese red pine forest -- precious tree species yielding pine mushroom ：** Pine mushroom is the precious rare fungi with very high edible and pharmaceutical values, and the Japanese red pine is essential to grow the pine mushroom. As one of three natural Japanese red pine forests in Ji Lin Province, Ming Yue Basin is of great significance to protection of ecological diversity, restoration of damaged Japanese red pine forest's vegetation cover, development of pine mushroom production & sales, and scientific research, with high ecological, economic and scientific values.

- **Other rich precious wild plants：** There are 1250-odd kinds of plants in Ming Yue pine mushroom nature reserve, including 40-odd major economic plants, like red pine, Japanese red pine, sand-pine, etc. ； in addition, there are abundant ferns, fungi, lichens , and pseudopodia. Among the above species, many are listed as state protected ones, like Manchurian walnut, Manchurian ash, cork-tree, etc. , which are all the important state protected plants with great ecological value.

- **Precious wild animals resources：** A great variety of wildlife live in the reserve with a very rich germplasm gene Resources. According to preliminary survey，there are 150-odd kinds of higher animals, 28 kinds of beasts, 101 kinds of birds, 8 kinds of reptiles and 8 kinds of amphibious animals. In which， sable is the state Category I protected animal, and red deer, black bear, goshawk, kestrel, hazel grouse, Strix uralensis, etc. are listed as the state Category II protected animal, which is very typical in China even in the world and is of important ecological significance.

The pine mushroom growing area in the Ming Yue An Tu Pine Mushroom Reserve is mainly distributed where the Japanese red pines aggregate. They are distributed in Wen Man and Fu Xing in the southwest of the reserve（5~10km to the project line），Fu Shou and Dong Sheng in the South （above 10km to the project line）, and Qing Nong(above 7 km to the project line) in the north, all the above areas far away from this project line where only sporadic Japanese red pines are found.

2. Relationship bewteen engineering and reserve

（1）Analysis of reasons for impossibility of the engineering to move around the reserve

The principal control points on this sub-divisional line are locations of railway stations of Jilin-Hunchun Passenger Line in An Tu County, Yan Ji Urbanc Area and Tumen's Urban area. According to local government's opinion and the technical and economic requirements on the railway, An Tu West Station is set in the neighborhood of the county's government office building, and Yan Ji West Station is set in the Zhao Yang Chuan economic and technological development zone, Yan Ji City, and the existing Tu Men Station is introduced into the project in Tu Men, in which, the principal control points are An Tu County, and according to the reserve's plan, the whole An Tu county seat is within the scope of the reserve and An Tu County is an important economic foothold in this project, therefore, limited by the distribution of economic foothold along the line, engineering standards and topographical conditions along the line, the project can't move around Ming Yue pine mushroom nature reserve. The length of the line passing through the reserve is about 41.3 kilometres. See Figure 5-3-2 for relative location between the line and Songhua Jiang Three-lake Provincial-Level Reserve

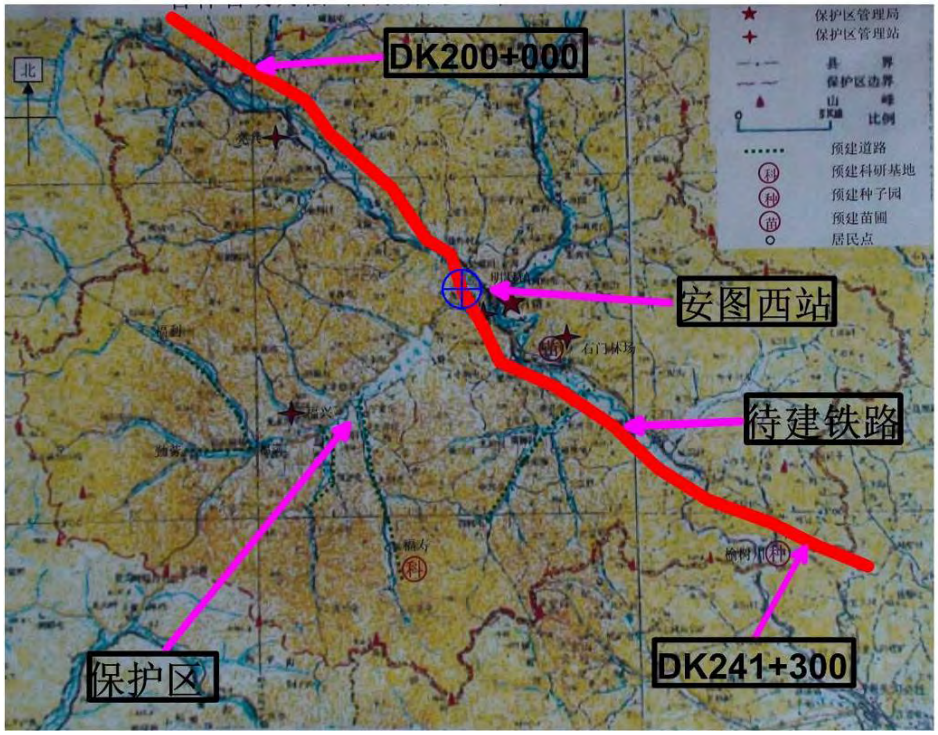


Figure 5-7-10 Relationship between An Tu Ming Yue Pine Mushroom Nature Reserve and the project line

（2）Location Relationship between engineering and reserve's location

Ming Yue Pine Mushroom Reserve is big, in which Changchun-Tumen Railway, No. 302 national highway, provincial highway and county highway pass through along the Bu Er Ha Tong Valley. The length of the line through the reserve is about 41.3 kilometres, mainly running along Bu Er Ha Tong Valley, roughly in parallel with the existing railways and highways nearby. Along the line are residential areas such as counties, villages and small towns, etc. , and along the line primarily the riverine area with low altitude.

3. Brief introduction of engineering in the reserve

This project enters the nature reserve from No. 14 Forest Team at Liang Bing Town in west-to-east direction, then passes through Liang Bing Town，Dong Ming Forest farm, Ming Yue Town, Shi Men Town, Shi Men Forest farm, and exit the reserve at No. 73 Forest Team at Shi Men Forest farm，and the mileage passing through the reserve is DK200+000～DK241+300, and the pass-through length is about 41.3 km.

In the reserve, there are 13 bridges, 6100m long（taking 14.8% of the total pass-through length）; 17.5 tunnels, 2287m long（taking 54.0% of the total pass-through length）; and the proportion of bridge and tunnel is 68.8%. There is one station -- An Tu West Station（DK215+700.00～DK217+250.00）, 1550m long(taking 3.8% of the total pass-through length); the railroad bed 11,363m long (taking 27.5% of the total pass-through length).It is planned to set 7 dumping grounds and 3 borrow pits in the reserve (all comes from muck discharging and used as temporary muck stock yard for railroad bed filling)

4. Impact Assessment of the project on the Mingyue Pine Mushroom Nature Reserve

1) Ecological status in the reserve

1) Biological diversity status

- Species diversity

Ming Yue Pine Mushroom Nature Reserve has rich species, forming a certain size of germplasm gene resource pool and a complicated ecosystem with their living environment. According to preliminary statistics, Ming Yue Pine Mushroom Nature Reserve has more than 1250 kinds of plants, and nearly 300 kinds of animals, and a great variety insects, pseudopodia, lichcn, tungi, ferns , etc. , in which the tree and shrub fungi and lichens take a major proportion(See Table 5-7-31). There are also rich animals' resources, in which many kinds are listed as state protected species but the state key protected wild animals and other important species are mostly distributed in sparsely-populated area, seldom affected by the engineering construction. See Table 5-7-32 for details.

Table 5-7-31 Preliminary statistics of animals and plants resources in Ming Yue pine mushroom nature reserve

Species of biological resources	Number	Representive resourrces
Eumycota	100-odd species	Ramaria flava , Hericium erinaceus , Tricholoma matsutake , Tie Shan ganoderma lucidum
Lichens	100-odd species	P.didactyla(With.)J.R.Laundon , Nephroma helveticum，cetraria islandica acharius, rasberry lecideine
Bryphyta	30-odd species	Broad-leave Campylopus flexuosus，black tile moss, Dicranum, funaria hygrometrica
Pteridophyta	50-odd species	Lycopodium clavatum, herba selaginellae, Equisetum pratense , Botrychium lunaria（L.）Sw.
Trees and Shrubs	1250-odd species	Japanese red pine , manchurian walnut , Mongolian oak, manchurian ash , cork-tree
Insecta	Hundreds of species	Eirenephilus longipennis , Coccinella septempunctata , Exeristesoides spectabilis
Reptilia	8 species	Eremias argus , Takydromus septentrionalis, Elaphe dione
Amphibia	8 species	Chinese frog , Hyla immaculata，Bufo bufo gargarizans
Aves	101 species	Goshawk , kestrel , hazel grouse , Cuculus micropterus
Mammalia	28 species	Black bear, red deer , sable , red fox

Table 5-7-32 Overview of state protected animal and plant species in Ming Yue Pine Mushroom Nature Reserve

Class of protected species	Name of species	Category
Animals	*Cervus elaphus*	State Category II protected plant
	Selenarctos thibetanus	State Category II protected plant
	Accipiter gentilis	State Category II protected plant
	Falco tinnunculus	State Category II protected

		plant
	Tetrastes bonasia	State Category II protected plant
	Strix uralensis	State Category II protected plant
Plants	Red pine	State Category II protected plant
	Amur linden	State Category II protected plant
	Fraxinus mandshurica	State Category II protected plant
	Phellodendron amurensis	State Category II protected plant

- Diversity of plant usage

The timber wood plants in the reserve mainly include Japanese red pine, red pine, sand-pine , Picea jezoensis var. microsperma，Manchurian ash, Manchurian walnut, cork-tree, Amur linden, Mongolian oak, white birch , etc.

The famous and precious medical plants mainly include ginseng , tangshen , Codonopsis lanceolata，radix platycodi , Lilium distichum Nakai, Ussuri fritillary, greater plantain, Chinese magnoliavine, wild ginger, sanguisorba, dahurian lily , inula flower, fiveleaf akebia, Bigleaf thorowax , etc.

The food plants include Berries, nut fruits, wild vegetables, fungi, etc. There are Tricholoma matsutake, jelly fungi, turkey foot fern, Hericium erinaceus, red pine nut, siebold walnut, Actinidia kolomikta (Maxim. & Rupr.) Maxim., amur grape, and so on. Berries not only can be eaten freshly but also processed for wine-making, making canned foods and fruit juice beverages, etc. with a very Delicious taste and rich nutrients. They are pure natural food with very high values.

In addition，the characteristic natural environment and a large number of lichens, pseudopodia, trees and shrubs in the reserve also provides rich materials for the studies in ecology, environmental science and biology and therefore this area has high value for the scientific research.

2) Status of vegetation cover

Due to difference in topography and soil developing procedure, the vegetation cover in the reserve has the characteristics of vertical zone, which can be roughly divided into three types, and distributed in regions at different altitudes, respectively.

On the bottom of the lowland, valley wetland or flat land at the altitude of 300-400 meters, the native vegetation is moss or wetland prairie. There are tall trees like white birch, willow, larch,

etc. , sparsely distributed. On the high land at the forest edge, there are rich herbs under the forest. The shrubs include Manchurian filbert, Schrenk mockorange, Euonymus altus (Thunb.) Sieb, etc. ; Herbs include Fourflower sedge, Maianthemum bifolium, etc. Onthe low wet bottomland, and poorly drained wetland, and perennial marshland are growing the typical swamland plants, herbs mainly including small-flowered sedge and Meyer sedge，and shrubs including queen of the meadow, Ural falsespiraea, etc. Due to human farming activities, the native vegetation of the valley flat land on Ming Yue Basin only survive in very few areas while most of the other part have been reclaimed as farmland.

At the altitude of 400-800 meters is the main part of the mountainous region in Ming Yue Basin, and also the major functional zone of the ming yue pine mushroom nature reserve. Now the vegetation cover is mainly secondary Japanese red pine -Mongolian oak mixed forest .As the Japanese red pine forest has long been chopped, the survived secondary mature forest is less than 40%, mainly composed of the secondary Mongolian oak, mixed with Dahurian birch, Ermans birch, Japanese elm, and Amur linden. On shady slope usually are white birch, aspen, etc. ， and the shrubs under forest is mainly the bicolor lespedeza, then filbert, Manchurian filbert, dahurian rhododendron, Rhododendron megalanthum Fang f.，etc. The herbal plants include radix platycodi, Changpai mountains ladybell, Fourflower sedge , etc.

At the altitude of 800-1100 meters is the secondary broad-leave mixed forest. The white pine is mostly growing on the shady slope, and red pine or Japanese red pine mixed on the sunny slope. The broadleaf trees mainly include Mongolian oak, mixed Manchurian ash Japanese elm, Dahurian birch, etc. The tree age of white pines is mostly 30-50 years, and the Japanese red pines are usually 80-120 years old. The survived red pines are only at 5-20 age class.

3) Social economic status

Total area of Ming Yue Pine Mushroom Nature Reserve is 120,000 hectares, in which, the forest land is over 80,000 hectares, accounting for 66.7% of the total area；100,000 hectares of the shrubs and tussock grass on waste mountain, accounting for 8.3 % of the total area；100,000 hectares of farmland, accounting for 8.3 % of the total area； 20，000 hectares of marshes, water surface , roadway, housing, etc., accounting for 16.7% of the total area.

The reserve covers Ming Yue Town, An Tu County, Shi Men Town, Liang Ming Town, and Chang Xing Town, and there are total 69 villages, total 26,368 households, total population of 89,150 people, in which, there are 15 villages in Ming Yue Town, 14 villages in Shi Men Town, 17 natural villages in Liang Bing Town, 19 villages in Fu Xing Town and 4 villages in Chang Xing Town.

The dwellers in the reserve make a living on forestry and relevant industries, and some of them work on plantation with the main crops of maize, soybean, paddy, sorghum, etc.

2) Construction environmental impact analysis

- Natural conditions of the nature reserve section passed through by the railway

The railway route goes in west-east direction and enters from Liangbing Town Compartment No.14 into the nature reserve, passes through Liangbing Town, Dongming Forestry Center, Mingyue Town, Shimen Town and Shimen Forestry Center, and leaves the nature reserve in Shimen Forestry Center Compartment No.73. The route direction within the nature reserve is substantially the same as Highway G302 and Changchun – Tumen Railway, which is also the flow direction of Buerhatong River. The forests along the route are mainly natural secondary forests with small quantity of man-made larch forest and Japanese red pine forest. Arbor tree species mainly include Quercus mongolica, silver birch, Aceraceae, larch, Japanese red pine, Fraxinus mandshurica, Tilia amurnesis, Tilia mandshurica, Pobulus davidiana, willow, etc. Shrub species mainly include Corylus mandshurica Maxim, Lespedeza formosa, Sorbaria kirilowii and elder bush. Herbaceous plants mainly include Carex callitrichos and Equisetum hiemale. There're many villages along the railway route and rivers with a lot of human activities and few of wild animals like field mouse and frogs. On the land occupied by the project, there's no densely distributed area of state key protection wild animals and no disturbance of state key protection animals.

- Environmental impact assessment

- Impact on Forest Eco-system

① Influence on eco-system by new railway land occupation

The project will mainly have bridges, tunnels, subgrades, borrow pits, spoil grounds, construction sites and camps within the nature reserve. According to preliminary estimation, the project will occupy 83.0hm^2 of forest land in the nature reserve. Site investigation shows that on the forest land to be occupied there're state key protection wild plants like Fraxinus mandshurica, Pinus koraiensis, Tilia amurnesis and Glycine soja, and local unique species Japanese red pine. Matsutake in Mingyue Antu Matsutake Nature Reserve is mainly distributed in central distribution areas of Japanese red pine, which are mainly in Fuman and Fuxing (5-10km away from the railway route) south west of the nature reserve, Fushou and Dongsheng (more than 10km away from the route) in the south, and Qingnong (more than 7km away from the route) in the north. These three areas are all far from the railway route. The occupied land shows no central distribution areas of Japanese red pine, with only sparse distribution, which is not suitable for growing of Matsutake. Therefore, the project construction will not cause negative influence on Matsutake in the nature reserve.

② Excavation and backfilling during construction will destroy the vegetation along the route and occupy forest and grass lands, which brings exposed earth surface and thus changes of partial eco-structure along the route. Exposed earth surface under rainwash will show soil loss and decreased fertility, and hence influence partial stability of the eco-system.

③ Influence on passing of wild animals

The project total length within the nature reserve will be more than 40 km, including 11,363m subgrade with 27.5% of the total length, 13 bridges 6,100m long with 14.8% of the total length, 17.5 tunnels 2287m long with 54.0% of the total length (bridge and tunnel total 68.8%), and 1 station (Antu West Station) 1,550m long with 3.8% of the total length. The project occupied land does not involve habitats of key protection wild animals, and may only cause slight influence on animal activities. Bridges and tunnels will basically not influence passing of wild animals. The only influence might be the subgrades, which will cut communication between wild animals on two sides. There're 31 culverts in the 11,363m subgrade within the nature reserve, with an average of 2.7 culverts per km of subgrade or 1 culvert in every 360m of subgrade. These culverts provide convenience for passing of animals on two sides of the subgrade, and thus there'll be basically no influence on them.

- Impact of Waste Water

Waste oil dripped for leaked from construction machines and outdoor machines washed by rainwater may cause pollution. Drilling bits from bridge substructure construction may pollute water. Living sewage and rubbish from construction

camps and stored construction materials under rainwash may pollute the water system. The above pollutions have slight influence, and may be reduced to acceptable degree through intensified measures, and won't affect growth of wild plants and animals in the nature reserve.

The project will set up Antu West Station in urban area of Antu County. During operation, the station waste water discharge will cause some influence to the nature reserve.

- Impact of Waste Gases

During subgrade construction, large amount of dust due to excavation, backfilling, bulldozing, soil handling, cement and lime loading/unloading, transportation and mixing will dissipate into the air. Material transporting trucks and stored materials in wind will bring dust pollution. Especially when wind is strong or trucks are running fast, the dust pollution is even worse. According to investigation of similar projects in this region, construction waste gases will have very limited influence on wild animals and plants.

- Impact of Solid Wastes

Tunnels necessary where the railway passes through mountains will produce large amount of muck. It is planned to provide 7 spoil grounds within the nature reserve and 3 temporary muck yards. Improper handling will affect forest vegetation and wild animals, and also affect land form, surface runoff and soil. Construction spoil soil and construction camp living rubbish, if disposed improperly, will cause some negative influence on the environment along the route. Bridge construction especially pile foundation excavation shall adopt proper spoil management with no random placement on riverside. It shall be put in designated places or filled in subgrade, avoiding riverside blocking and not smooth flood water release.

- Impact on Nature Reserve Biodiversity

In an approach of expert consultation, opinions have been solicited from experts of wild animal and plants protection as well as administrative departments of the Nature Reserve, finally 6 indicators of biodiversity assessment have been defined: eco-system, biotic communities (habitats), population/species, main protection targets, biological safety and relevant interest groups. The experts and organizations assigned a weight to each indicator and scored according to the degree of impact.

① Impact on Eco-system

A: Eco-system

A1 Type and uniqueness degree of eco-system

The eco-system in the proposed railway region belongs to the forest eco-system type. The Nature Reserve land to be occupied by the railway is natural secondary forest with poplar, willow, spruce, Mongolian scotch pine, Japanese red pine, larch and Fraxinus mandshurica. Distribution area of Japanese red pine is smaller than other species, and is mainly in limited places in Northeast China and Far East area.

Degree of uniqueness	Score	Brief description
○ Not unique (0-10 points)	16	Logged trees and destroyed vegetation for the

○ China, Far East (11-30 points)		proposed railway do not include state first level protection plants and local unique plants, but include state second level protection plants: Pinus koraiensis, Fraxinus mandshurica, Phellodendron amurense, Tilia amurnesis.
○ Northeast unique (31-50 points)		
○ Jilin unique (51-70 points)		
○ Local unique (71-100 points)		

A2 Impact on area of existing eco-system types in assessed region

This project is located at the edge of the experimental area and the south boundary of the nature reserve. Therefore, it has very small influence on existing eco-system area in the nature reserve.

Type of land	**Before construction (hm^2)**	**After construction (hm^2)**	**Change (+/-)**	**Margin (%)**	**Notes**
	a	b	**b-a**	(b-a)/a	
Wood land	76000	75917	-83	-0.11%	
Sparsely forested woodland	500	500	0		
Shrubbery land	2500	2500	0		
Grass land	1003	1003			
Water area wet land	3376	3376	0		
Other					
Total			0		

Influence degree	**Score**	**Brief description**
○ Slight (0-10 points)	26	The new railway and spoil grounds will occupy 83hm^2 forest land. Spoil grounds have some influence to the eco-system.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A3 What is the degree of the project construction influence on the above natural eco-system structure?

The well-structured forest eco-system of the nature reserve is mainly distributed beyond 50m north of the road. The forest land to be occupied is located at the edge of the forest, and will have a minor influence on structure of natural eco-system.

Influence degree	**Score**	**Brief description**
○ Slight (0-10 points)	27	The proposed railway is located in non-core zone of the nature reserve, and will have minor influence on the eco-system structure.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A4 What is the degree of the project construction influence on the eco-system service

function?

The project construction has minor influence on area and structure of the forest eco-system, and thus a slight influence on its service function.

Influence degree	Score	Brief description
○ Slight (0-10 points)	21	After the project completed, the forest land will decrease by a small margin of 0.11% and thus will have a minor influence on the nature reserve forest eco-system service function.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A5 Degree of influence on aesthetic value, economic value and cultural value of original landscape

Influence degree	Score	Brief description
○ Slight (0-10 points)	20	The proposed railway will be substantially constructed along original roads and railways. Therefore, it has minor influence on aesthetic value, economic value and cultural value of the nature reserve.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A6 Degree of soil erosion and possibility of occurrence of geological disasters in the assessed region?

Influence degree	Score	Brief description
○ Slight (0-10 points)	30	There's minor or medium influence on soil erosion. Possibility of occurrence of geological disasters is very small.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

A7 Degree of decrease of green coverage in the assessed region? Green coverage in assessed region = green area in assessed region / total land area in assessed region × 100%.

Occupied land area / nature reserve area ×100%=83/76000×100%=0.11%

Influence degree	Score	Brief description
○ Slight (0-10 points)	21	The decrease will be 0.11%, with a minor influence on the green coverage of the region.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

- Indicator weights and scores

Table 5-7-33 Summary of Scores of Eco-system Influence Indicators

Indicator	Influence degree score (range 0-100)	Indicator weight*	Indicator score (score×weight)
A1	15	0.15	2.25
A2	26	0.15	3.9

A3	27	0.15	4.05
A4	21	0.15	3.15
A5	20	0.12	2.4
A6	30	0.15	4.5
A7	21	0.13	2.73
Total		1.0	22.98

② Impact on Biotic Communities (Habitats)

B: Biotic communities (habitats)

B1. What is the uniqueness of the affected type of biotic communities (habitats)? There's no state key protection wild animals in the areas along the proposed railway. The railway will have minor or slight influence on Japanese red pine.

B2. What is the project influence on area of biotic communities (habitats)? The proposed railway has slight influence on area of biotic communities (habitats) in the nature reserve.

B3. Will the project affect connectivity of the habitats? The proposed railway will be located on south boundary of the nature reserve, and will have very small influence on connectivity of the habitats. Culverts will be provided as a means for small wild animals to cross the railway.

B4. What is the degree of project influence on key species (constructive species, dominant species) of biotic communities? There's slight influence on key species of biotic communities.

B5. What is the degree of project influence on structure of biotic communities?

On the land occupied by the project, there're mainly natural secondary tree species and shrubs, with no biotic communities to be protected. The influence on structure of natural biotic communities in the nature reserve is minor.

Indicator	B1	B2	B3	B4	B5
Name of affected biotic community (habitat)	Uniqueness	Area loss (hm^2)	Whether segmented	Key species	Community structure
Mouse	Not unique	83	No		
Frogs	Not unique		No		
Influence degree	**Separate scores**				
Slight (0-10 points)	13	17	16	15	16
Minor (11-30 points)					
Medium (31-50 points)					
Major (51-70 points)					
Serious (71-90 points)					

Table 5-7-34 Summary of Scores of Influence on Biotic Communities (Habitats)

Indicator	Score of influence degree (range 0-100)	Indicator weight *	Indicator score (score×weight)
B1	15	0.2	3.0
B2	17	0.2	3.4
B3	16	0.2	3.2
B4	15	0.2	3.0

B5	16	0.2	3.2
	合计 Total	1	15.8

③ Impact on Population/Species

C: Population/Species

C6. What is the degree of being threatened of unique species affected by the project?

Name of affected unique species	Distribution region			Degree of being threatened			Type of influence
	Northeast China, Far East	Jilin	The Nature Reserve	Slight	Medium	Serious	
Fraxinus mandshurica	+			+			
Pinus koraiensis	+			+			
Phellodendron amurense	+			+			
Tilia amurnesis	+			+			
Japanese red pine	+			+			

Degree of being threatened	**Score**	**Brief description**
○ **None (0-10 points)**	**21**	The proposed railway will have minor influence on above species.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C7. What are the protection species affected by the project? Do they also appear in un-affected regions?

Protection species affected by the project	Protection level				Distribution			
	State level	Province level	IUCN	CITES	Assessed region	Nature Reserve	Jilin	Northeast China, Far East
1. Plant								
Fraxinus mandshurica					+	+	+	+
Pinus koraiensis					+	+	+	+
Phellodendron amurense					+	+	+	+
Tilia amurnesis					+	+	+	+
2. Animals								

Influence degree	**Score**	**Brief description**

○ Slight (0-10 points)	27	There'll be minor influence on plant communities and animal habitats in the nature reserve.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C8. What is the degree of project influence on food web/chain structure of important species (e.g. unique species, protection species and rare species)?

Influence degree	Score	Brief description
○ Slight (0-10 points)	28	There'll be minor influence on food web/chain structure of important species.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C9. What is the degree of project influence on migration, dispersal and propagation of important species (e.g. unique species, protection species and rare species)?

Influence degree	Score	Brief description
○ Slight (0-10 points)	29	The project will have minor influence on migration, dispersal and propagation of important species.
○ Minor (11-30 points)		
○ Medium (31-50 points)		
○ Major (51-70 points)		
○ Serious (71-100 points)		

C10. What is the possibility of breakout of pests and plant diseases resulted by the project?

Possibility	Score	Brief description
○ None (0-10 points)	17	Possibility of breakout of pests and plant diseases resulted by the project is small.
○ Small (11-30 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-35 Summary of Indicator Scores of Influence on Population/Species

Indicator	Influence degree score (range 0-100)	Indicator weight*	Indicator score (score×weight)
C1	21	0.2	4.2
C2	27	0.2	5.4
C3	28	0.2	5.6
C4	29	0.2	5.8
C5	17	0.2	3.4
Total		1.0	24.4

④ Impact on Main Protection Targets

D: Main protection targets

D1. Influence on population quantity of main protection targets in the nature reserve

Name of species	Quantity before development	Quantity after development	Change (+/-)	Margin (%)	Notes
	a	b	**b-a**	(b-a)/a	
1. Animals					
Martes zibellina			0	0	
Cervus elaphus			0	0	
Selenarctos thibetanus			0	0	
Accipiter gentilis			0	0	
Falco tinnunculus			0	0	
Tetrastes bonasia			0	0	
Strix uralensis			0	0	
2. Plants					
Tricholoma matsatake			0	0	
Japanese red pine and Quercus mongolica forest			0	0	

D2. Influence on area of habitats of main protection targets in the nature reserve

Name of species	Habitat area before development (hm^2)	Habitat area after development (hm^2)	Change (+/-)	Margin (%)	Notes
	a	b	**b-a**	(b-a)/a	
1. Animals					
Martes zibellina			0	0	
Cervus elaphus			0	0	
Selenarctos thibetanus			0	0	
Accipiter gentilis			0	0	
Falco tinnunculus			0	0	
Tetrastes bonasia			0	0	
Strix uralensis			0	0	
2. Plants			0	0	
Tricholoma matsatake			0	0	
Japanese red pine and Quercus mongolica forest			0	0	
Total					

- Indicator weights and scores

Table 5-7-36 Summary of Indicator Scores of Influence on Main Protection Targets

Indicator	Influence degree score (range 0-100)	Indicator weight*	Indicator score (score×weight)
D1	23	0.5	11.5

D2	22	0.5	11.0
Total		1.0	22.5

⑤ Impact on Biological Safety

E: Biological Safety

E1. Possibility and hazard degree of invasion of foreign species (or harmful lives) resulted by the project?

Possibility	Score	Brief description
○ None (0-10 points)	26	There's possibility of invasion by foreign species (or harmful lives), but the possibility is small.
○ Small (11-30 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

E2. What is the possibility of loss of genetic resources in the nature reserve?

Possibility	Score	Brief description
○ None (0-10 points)	20	Possibility of loss of genetic resources in the nature reserve is small.
○ Small (11-30 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-37 Summary of Indicator Scores of Influence on Biological Safety

Indicator	Influence degree score (range 0-100)	Indicator weight*	Indicator score (score×weight)
E1	26	0.5	13
E2	20	0.5	10
Total		1.0	23

⑥ Impact on Relevant Interest Groups

Interest groups refer to citizen groups or organizations directly or indirectly relevant to the project.

Surrounding communities: Rural communities whose residents' production and living rely more or less on the nature reserve.

Assessment indicators: F: Relevant Interest Groups

F7. Support degree for the project by different interest groups like local government and community people?

Support degree	Score	Brief description
○ Highly rejecting (71-100 points)	13	The proposed railway will benefit local governments and communities, and is highly favored by them.
○ Majority rejecting (51-70 points)		
○ Opinion divergence (31-50 points)		
○ Majority supporting (11-30		

points)		
○ Highly supporting (0-10 points)		

F8. What is the degree of controversy about the project among different interest groups such as local governments, the nature reserve administration and community people?

Degree of controversy	**Score**	**Brief description**
○ None (0-10 points)	19	There's basically no controversy about the project among different interest groups like local governments, the nature reserve administration and community people.
○ Small (1130 points)		
○ Medium (31-50 points)		
○ Big (51-70 points)		
○ Great (71-100 points)		

F9. What is the contribution of the project to direct investment in management of the nature reserve?

Contribution scale	**Score**	**Brief description**
○ Totally no (71-100 points)	29	The project may add product sales and tourism income of the nature reserve, which can be used for management of the nature reserve.
○ Basically no (51-70 points)		
○ Small (31-50 points)		
○ Big (11-30 points)		
○ Great (0-10 points)		

F10. What is the contribution of the project to improvement of social and economic situation in surrounding communities? (incl. industry re-structuring, employment opportunities, health and sanitation, culture and education, and social security, etc.)

Contribution scale	**Score**	**Brief description**
○ Totally no (71-100 points)	26	The project construction may increase job opportunities, stimulate local economic development and facilitate industry restructuring of the nature reserve surrounding communities.
○ Basically no (51-70 points)		
○ Small (31-50 points)		
○ Big (11-30 points)		
○ Great (0-10 points)		

F11. What is the degree of recognition of the project planned biodiversity protecting measures and restoring proposals by the nature reserve administration?

Measures, proposals and recognition	**Score**	**Brief description**
○ No measure (71-100 points)	21	Biodiversity protecting measures and recovering proposals for the project have been basically recognized by the nature reserve administration.
○ Big problem (51-70 points)		
○ Still to be improved (31-50 points)		
○ Basically recognized (11-30 points)		
○ Totally recognized (0-10 points)		

F12. What is the risk of hazards to local people's production & living environment and catching fire in the assessed region due to the project?

Hazard and risk degree	Score	Brief description
○ None (0-10 points)	43	The project during construction period may cause hazards to the environment. In fireproof period, construction personnel shall avoid using open fire and smoking, and eradicate fire potentials.
○ Small (11-30 points)		
○ Possible (31-50 points)		
○ Big (51-70 points)		
○ Definite (71-100 points)		

- Indicator weights and scores

Table 5-7-38 Summary of Indicator Scores of Influence on Relevant Interest Groups

Indicator	Indicator (range 0-100)	Indicator weight*	Indicator score (score×weight)
F1	13	0.15	1.95
F2	19	0.15	2.85
F3	29	0.15	4.35
F4	26	0.2	5.2
F5	21	0.15	3.15
F6	43	0.2	8.6
Total		1.0	26.1

⑦ Biodiversity Influence Indicator and Degree Rating

Table 5-7-39 Calculation of Biodiversity Influence Indicators

Indicator	Score Si	Weight Wi*	Wi×Si
A Impact on bio-system	22.98	0.2	4.6
B Impact on Communities (Habitats)	15.8	0.15	2.37
C Impact on Population/Species	24.4	0.15	3.66
D Impact on Main Protection Targets	22.5	0.19	4.28
E Impact on Biological Safety	23.0	0.15	3.45
F Impact on Relevant Interest Groups	26.1	0.16	4.18
Total		1.0	22.54

Calculation of biodiversity influence indicator:

$$BI=\sum(Wi\times Si) \qquad (i=A\ldots F)$$

The calculated biodiversity influence indicator BI=22.54

According to the situation of project biodiversity influence, the influence degrees are classified in five grades, i.e. slight influence, small influence, medium influence, big influence and serious influence.

Table 5-7-40 Grading of Biodiversity Influence Degree

Grade	Slight influence	Small influence	Medium influence	Big influence	Serious influence
Influence indicator (BI)	BI<15	15≤BI＜35	35≤BI＜55	55≤BI＜75	BI≥75

Because biodiversity influence indicator BI=22.54<35, the construction project will have

a small influence on the nature reserve biodiversity.

3) Protecting Measures

- Plant Protecting and Restoring Measures

On the land to be occupied there're natural Pinus koraiensis, Fraxinus mandshurica, Tilia amurnesis and Phellodendron amurense, which are state level II key protection wild plants. These plants shall be transplanted to nearby empty land before construction. Japanese red pine is a rare species of protection value. It may be transplanted locally to sides of the railway for greening and environment upgrading.

Table 5-7-41 Table of Statistics of Transplanted Wild Plants

Unit: stem number

Tree species	Protection level	Total stem numbers	Main part of construction	Temporary construction
Total		4125	3775	350
Fraxinus mandshurica	Level II	79	16	63
Pinus koraiensis	Level	3533	3523	10
Tilia amurnesis	Level	135	25	110
Phellodendron amurense	Level	15	6	9
Japanese red pine		363	205	158

- Preventative and Protecting Measures in Construction Period

During construction, a construction boundary shall be defined with fencing means to prohibit random construction worker walking and vehicle running out of the boundary. Engineering wastewater and living rubbish are strictly prohibited to discharge into rivers. Construction material storage places shall be away from water. Various goods and materials shall have rain protecting means together with surrounding open ditches, silting basins and protective walls to avoid being washed into rivers. Living wastes during construction periods shall be cleaned daily and collected centrally, with food wastes ret for fertilizers and other wastes transported to refuse dumps for disposal.

To avoid construction dust influence on growth of nearby vegetation, water sprinkling and covering measures shall be taken in areas of construction roads, construction sites and construction camps, preventing dust influence on wild animals and plants.

At the end of construction, construction sites shall be cleaned up timely with no waste materials or facilities remaining in rivers. Ecological environment restoration shall be made at construction sites to avoid soil erosion effect on water environment.

Construction personnel shall be strictly educated of environment protection sense and strictly prohibited to enter Japanese red pine areas to pick Matsutake, destroy Japanese red pine trees or kill wild animals. Warning signs for protecting wild plants and animals shall be set up on sides of the new railway.

- Protecting Measures in Operation Period

In operation period, sewage treating facilities at Antu West Station shall be appropriately maintained to ensure station sewage is discharged according to the standard.

5. Opinions of Responsible Authorities

Jilin Province Forestry Department, with its file No.[2010] 367 dated July 29, 2010 "Official Reply about Jilin – Huichun High Speed Railway Passenger Line Passing through Antu Mingyue Province Level Nature Reserve", agreed the project line location proposal within the nature

reserve. It also raised requirement that the project shall go through related national formalities, and shall minimize vegetation and environment destroy during construction and restore original form of the land for construction site at the end of the project.

In conclusion, the project construction influence index of biodiversity in Tricholoma Matsutake Nature Reserve is 22.54. It indicates that, the project has a slight influence on biodiversity in the nature reserve, and with adequate protecting and restoring measures during construction and operation periods, the project construction is feasible.

5.8 Ecological Protection, Restoration & Compensation Measures and Investment Estimation

Investment estimation for ecological protection measures (including water and soil loss treatment measures) is given in Table 5-7-42. The total investment will be RMB437,742,900, among which RMB428,131,700 has been included in the engineering design. This assessment suggests that an additional investment RMB9,611,200 is added for protection measures.

Table 5-7-42 Estimation of Total Investment for Ecological Protection Measures (incl. water and soil conservation measures)

Unit: 0’000 RMB

Item			Unit	Engineering quantity			Investment sub-total	Jilin City	Yanbian Autonomous Prefecture
				Sub-total	Hilly land	Plain land			
Protection for rail line works	I. Engineering measures						39889.02	9538.68	30350.34
	Embankme-nt slope protection	M7.5 stone masonry slope protection	m^3	620720.31	372432.19	248288.12	15280.62	3654.06	11626.56
		M7.5 stone masonry drain	m^3	283073.54	169844.12	113229.42	6967.38	1666.11	5301.27
	Cutting slope protection	M7.5 stone masonry slope protection	m^3	482881.85	289729.11	193152.74	11888.31	2842.86	9045.45
		M7.5 stone masonry drain	m^3	70767.69	42460.62	28307.08	1741.85	416.53	1325.32
		Geogrid	m^2	6848821.70	4109293.02	2739528.68	3768	901.04	2866.96
	Topsoil stripping		$\times 10^4 m^3$	298.13	178.88	119.25	242.86	58.08	184.78
	II. Afforesting measures						877	209.72	667.28
	Subgrade slope protection	Shrubs	Stem	779067	467441	311626	95.5	22.84	72.66
		Arbor threes	Stem	92250	55350	36900	363.4	86.9	276.5
		Greening seeds	m^2	2285741	1371444.6	914296.4	418.1	99.98	318.12
	III. Temporary measures						615.84	147.27	468.58
	Temporary sand bag protection for topsoil stripping		m^3	1935.26	1161.16	774.10	14.86	3.56	11.31
	Temporary grass protection for topsoil		hm^2	138.83	83.30	55.53	13.38	3.20	10.19

Item		Unit	Engineering quantity			Investment sub-total	Jilin City	Yanbian Autonomous Prefecture
			Sub-total	Hilly land	Plain land			
	stripping							
	Soil drainage ditch	m^3	4127.97	2476.78	1651.19	3.6	0.87	2.74
	Temporary sand bag protection for allocated earth and stone	m^3	23600	14160	9440	184	44	140
	Temporary dense mesh covering for allocated earth and stone	0’000 m^2	2297.3	1378.38	918.92	400	95.65	304.35
	Investment sub-total					41381.86	9895.66	31486.19
Protection for station and yard works	I. Engineering measures					818.03	195.62	622.41
	Stone masonry drainage ditch for stations and yards	m^3	33230.76923	19938.46154	13292.30769	818.03	195.62	622.41
	II. Afforesting measures					101.7	24.32	77.38
	Arbor greening	Stem	7960.11	4776.07	3184.05	30.33	7.25	23.08
	Shrub greening	Stem	579072.71	347443.63	231629.09	71.23	17.03	54.19
	Investment sub-total					919.73	219.94	699.80
Protection for borrow pits	I. Engineering measures					40.53	9.69	30.84
	Stone masonry intercepting and drainage ditches	m^3	1642.92	985.75	657.17	40.53	9.69	30.84
	IV. Land preparation works					152.92	36.57	116.35
	Land reclamation	hm^2	160	96	64	152.92	36.57	116.35
	Investment sub-total					193.45	46.26	147.19
Protection for constructi-on roads	II. Afforesting measures					7.8	1.87	5.93
	Grass greening	hm^2	77.68	46.61	31.07	7.8	1.87	5.93
	III. Temporary measures					29.82	7.13087	22.69
	Soil drainage ditch	m^3	48556.42	29133.85	19422.57	29.82	7.13	22.69
	Investment sub-total					37.62	9	28.62
Protection for other temporary works	Total area	hm^2	6459.03	3875.42	2583.61			
	III. Temporary measures					3.93	0.94	2.99
	Soil drainage ditch	m^3	6268.57	3761.14	2507.43	3.93	0.94	2.99
	IV. Land preparation works					122	29.17	92.83
	Surface recovering for hardened site	hm^2	62.85	37.71	25.14			
	Land reclamation	hm^2	127.61	76.57	51.04	122	29.17	92.83
	Investment sub-total					125.93	30.11	95.82
Cost of vegetation transplantation of Songhuajiang Three Lakes Province Level Nature Reserve						120.0	120.0	
Cost of vegetation transplantation of Tricholoma Matsutake Nature Reserve						250.0		250.0
Cost of ecological compensation and recovering of Salmon State Level Aquatic Germplasm Resources Nature Reserve						620.0		620.0
Cost of ecological compensation of fish resources in Songhuajiang River, Jiaohe River, Kudanjiang						125.7	65	60.7

Item	Unit	Engineering quantity			Investment sub-total	Jilin City	Yanbian Autonomous Prefecture
		Sub-total	Hilly land	Plain land			
River and Gayahe River							
Total investment					43774.29	10385.97	33388.32

5.9 Conclusion and Suggestions

5.9.1 Assessment on Ecological Environment Situation

(1) In the eco-system of the railway occupied area, forest lands and farm lands are dominant with a percentage of 41.8% and 38.1% each. It means forest lands and farm lands are main control component for quality of ecological environment of the area.

(2) Average productivity of the assessed area is 7.21t/hm^2.a, much higher than the threshold value 1.82t/hm^2.a of bearing capacity of an eco-system of same grade. It indicates that this eco-system has a big bearing capacity and the nature system stability is high.

(3) Soil loss along the railway line is mainly slight and light water erosion. In the railway line passed region, Dunhua City and Antu County are Jilin Province key preventative protection area; Yanji City, Tumen City and Longjing City are Jilin Province Key Supervision Area; Jilin City urban area, Jiaohe City and Huichun City are Jilin Province Key Treatment Area. The region belongs to Northeast China Black Soil Area with a soil loss tolerance of 200t/（km^2.a）.

5.9.2 Assessment on Ecological Environment Impact

(1) After the railway has been put into operation, average productivity of the nature system in the assessed region will be lowered by 0.30 t/hm^2.a from the present 7.21t/hm^2.a to 6.91t/hm^2.a, a percent of 4.2% comparing to the original value.

(2) After the project has been implemented, the land use pattern of the assessed region will be partially changed, and areas and quantities of various vegetation types will subsequently change. However, forest land and farm land are still dominant with a total percent of 76.3%. Therefore, the project construction will have slight influence on the landscape pattern and will not change quality of ecological environment in this region.

5.9.3 Situation of Ecologically Sensitive Areas

Main line of this project will pass through ecologically sensitive areas in form of tunnels and bridges. With adequate vegetation restoration measures and soil protection measures, it will not have big influence on Mingyue Matsutake Nature Reserve, ~~Riguan Mountain Forest Park~~ and Songhuajiang Three Lakes Nature Reserve.

5.9.4 Other Impacts

Design of bridges of this project has considered given flood frequency, flood prevention, irrigation and drainage requirement. Selection of bridge span and headroom has considered crossed roads and rivers navigation, and ensure no influence on river flood prevention, irrigation & drainage, road traffic and river navigation. The project has taken corresponding protection measures for subgrade slopes, bridge/culvert abutment cones and tunnel side slopes. Reclamation and vegetation restoration measures have been taken to temporary works like borrow pits, construction roads and big temporary works, to effectively prevent development of soil erosion and reach corresponding soil retaining effect.

5.9.5 Suggestions

(1) Intensify supervision and management during construction period, and construct strictly according to the design. Constructors shall enhance their teams' environment sense to ensure safe and environment-friendly construction with temporary spoils being placed at designed locations. Land for temporary construction use shall be strictly controlled in principle of consistency of temporary land and permanent land. Construction materials and machines shall be stored at designated placed and transportation vehicles shall run in designated routes, to minimize destroy to surface vegetation.

(2) Subgrade slopes in forest parks, nature reserves and areas of high landscaping requirement shall have as much biological protection as possible. In sections difficult to plant grass, based on engineering protection measures, planting of climbing plants can be considered.

(3) In bid invitation, the project owner shall include information for ecological protection into bidding documents to enhance construction personnel's environment sense for agriculture, forest and water. Meanwhile, it shall also clarify responsibilities and obligations of constructors during construction period. Before kick-off of the project, the project owner shall invite related environment protection experts to train related persons of the project owner and constructors about environment related laws and regulations such as Environmental Protection Law of the People's Republic of China, Law of the People's Republic of China on Water and Soil Conservation and Forest Law of the People's Republic of China, to enhance construction personnel's environment sense and regulate their construction behavior and thus minimize destroy of surrounding ecological environment during construction.

6. Evaluation of Acoustical Environment Influences

6.1 Introduction

This newly built railway from Jilin to Huichun is located in Jilin Province starting from Jilin in the west and ending at Huichun City of the Yanbian Korean Autonomous Prefecture. It passes through the Chanyi District, Longtan District and Jiaohe City within the area of Jilin City, and the Dunhua City, Antu County, Yanji City, Tumen City and Huichun City within the Yanbian Korean Autonomous Prefecture.

This acoustical environment evaluation includes current situation and forecasting evaluation of sensitive buildings along the route to provide basis for noise control measures.

6.1.1 Ranges of Evaluation

Based on features of this project and environments along the route, ranges of the acoustical environments evaluation covers all ranges the project involved in the direction of length and ranges 200m away to the central line of outer rails on both sides in the direction of width.

6.1.2 Evaluation Class and Working Contents

According to Technical Guidelines for Noise Impact Assessment (HJ2.4-2009), working class of this acoustical environment evaluation is defined as first class mainly including the following contents:

（1） Current Situation Investigation and Evaluation: evaluating environmental noise situation before completion of the project through site-survey, investigation and current environmental noise monitoring.

（2） Forecasting and evaluation: evaluating noise degrees and ranges and sensitive points meeting the requirements or not based on related evaluation standards and forecasted environmental noise of the year of design within the zone to be evaluated combined with project features.

（3） Noise Prevention Measures and Investment Estimation: according to the forecasting results, analyzing main noise sources affecting situation and the reason of sensitive points exceeding the standard so to establish the principle of noise control, make focused protection measures, analyze technological and economical feasibilities and estimate investments.

6.1.3 Evaluation Standards

The standards applied to this acoustical environment evaluation are listed in Table 6-1.

Table 6-1: Acoustical Environment Influence Evaluation Standards

Category	Serial No.	Description	Functional Zone Category and Standard Values	Range of Application
Quality Standards	GB3096-2008	*Acoustical Environment Quality Standard*	Class 2 Zone: daytime 60dBA, At night 50dBA	60m or above away from the central line of outer rails
			Class 4b Zone: daytime 70dBA, At night 60dBA	Within the rage of 30~60m away from the central line of outer rails
	HF[2003] No.94: *Notice of Issues on Environment Noise during Environment Influences Evaluation of Construction Projects including Roads, Railways (Light Railways)and etc.*		Daytime 60dBA, At night 50dBA	Outdoor area of especially sensitive buildings like school and hospital. School without accommodation and hospital without in-patient department don't require noise control at night.
Discharge Standards	GB12525-90	Amended Plans of *Noise Limits and Measurement Methods along Railway Routes*	Daytime 70dBA, At night 70dBA	30m away from the central line of outer rails
	GB12523-2008	*Noise Limits of Construction Sites*	Defined by characters of adjacent sensitive points within the construction boundary and construction working type	Construction sites and sidewalks

6.2 Current Situation Monitoring and Evaluating

6.2.1 Acoustical Environment Current Situation Investigation

This project mainly passes through border areas of countryside and towns. There are 107 noise sensitive points along the route, of which 11 school and 96 residential areas. Based on project design files and filed survey results, scale and distribution situation of these noise sensitive points refer to Table 1 of Annex 3.

6.2.2 Acoustical Environment Current Situation Monitoring

1. Measuring Standards and Regulations

Measurements of current environment noise within the area mostly affected by existing railways shall be evaluated as per GB 12525-90 Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line and TB/T3050-2002 Technical Regulations of Measuring Environmental Noise along the Railway Line. The evaluated area within the newly built railway is mainly affected by social life and traffic noise and the current environmental noise measuring shall be measured as per GB3096-2008 Environmental Quality Standard for Noise.

2. Measuring Implement Plan

（1） This acoustical environment current situation monitoring uses AWA6270B+ noise

statistic analysis meter. All meters for measuring (including source calibrator) shall be checked for qualification by Measurement Identification Department annually before using. The AWA6221 source calibrator shall be calibrated every time before and after using.

（2） Measuring Time and Methods

a) Sensitive Points on Both Sides of the Existing Railway

Current Situation: select an typical hour within the period of daytime (6:00~22:00) and nighttime (22:00~6:00 next day) and measure the continuous equivalent sound level A of daytime and night time at the measuring points. Meanwhile, record exposed sound level, speed, train cars passed, sound level of whistling and working time of every train when it is passing through.

Background Data: measure the continuous equivalent sound level A for 10min (measuring 20min within the area where traffic noise having obvious influences) within the selected typical period of daytime (6:00~22:00) and nighttime (22:00~6:00am next day) to represent environment noise level of daytime and nighttime.

b) Sensitive Points on Both Sides of the New Railway

Current Situation Data (Background Data): measure the continuous equivalent sound level A for 10min (measuring 20min within the area where traffic noise having obvious influences) within the selected typical period of daytime (6:00~22:00) and nighttime (22:00~6:00am next day) to represent environment noise level of daytime and nighttime.

(3) Measuring and Evaluating Data

Noise measurement of this evaluation is continuous equivalent sound level A and used as evaluation data.

3. Points Arrangement Principle

Purpose of the environment noise current situation monitoring is to provide basic information for understanding current acoustical environmental situation alongside the railway line, and scientific data for forecasting the noise influences of different areas and sensitive points alongside the line after completion of the project. This project mainly passes through margin areas of countryside and town. Major current situation noises are existing noises of railway, social life, and road traffic. For the current environmental noise monitoring, monitoring section of all sensitive points shall be arranged on both sides of the railway. Therefore, the measured results can reflect the acoustical environment character of the evaluated area and provide scientific basis for railway noise forecasting.

4. Noise Monitoring Points Arrangement Statement and Monitoring Results

There will be 107 sections arranged for current environmental noise monitoring. Monitoring points positioning and monitoring results see Table 2 of Annex 3. ~~Monitoring section arrangement refers to Drawing 1 to Drawing 107.~~

6.2.3 Acoustical Environment Current Situation Analysis and Evaluation

We can come to a conclusion as follows based on the results of the current noise situation monitoring alongside the line.

1. Sensitive Points on Both Sides of the New Railway Line

There are totally 94 sensitive points within the evaluation ranges of the new railway line on both sides, which includes 8 school and 96 residential areas. The current situation is mainly effected by social life and road traffic noises.

（1）Residential Area

Residential areas within the evaluated range on both sides of the new railway line, current sound level is 40.7~60.4dBA during daytime and 29.4~49.1dBA during night time. Current sound level of four sensitive points exceeds the 55dBA limit value of Class I area during daytime defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.6~5.4dBA higher than the standard. Current sound level of four sensitive points exceeds the 45dBA limit value of Class I area during nighttime defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.1~4.1dBA higher than the standard.

（2）School

School within the evaluated range on both sides of the new railway line, current sound level is 43.2~60.8dBA during daytime and 31.9~49.5dBA during night time. During daytime, the AIXIN kinder garden is located beside the main road of the village, the current sound level exceeds the 60dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.1~0.8dBA higher than the standard. During nighttime, the 50dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) can be met.

2. Sensitive Points on Both Sides of the Existing Railway Line

There are totally 13 sensitive points within the evaluation ranges on both sides of the new railway line, which includes 3 school and 10 residential areas. The current situation is mainly effected by railway noises. Based on the results of the current acoustical environmental situation monitoring and site survey for the sensitive points alongside the railway line, it is a common problem that measured values exceed the standards because the whistling noise has a noticeable effect.

(1) Residential Area

a) Within the range of 30m away from the railway to be built

Current sound level of the area within the range of 30m away from the railway is 60.9~65.9dBA during daytime and 61.9~68.8dBA during nighttime.

b) At the point of 30m away from the boundary of the railway to be built

Current sound level of the area at the point of 30m away from the railway is 55.9~73.3dBA during daytime and 55.4~72.6dBA during nighttime. Within the existing railway sections where parallel to or across the new railway, the pure railway noise at the 30m boundary is 57.7~61.2dBA during daytime and 60.5~63.9dBA during nighttime. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

c) Within the range of Class IV Area

The area within the range of 30m~60m away from the new line on both sides , the current sound level is 53.7~70.4dBA during daytime and 49.8~69.3dBA during night time. Current sound level of one point exceeds the 70dBA limit value of Class 4B area during daytime defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.4dBA higher than the standard. Current sound level of seven sensitive points exceeds the 60dBA limit value of Class 4B area during nighttime defined in Environmental Quality Standard for Noise (GB3096-2008) with 2.6~9.3dBA higher than the standard.

d) Within the range of Class II Area

The area outside the range of 60m away from the new line on both sides, the current sound level is 47.0~70.5dBA during daytime and 44.2~69.5dBA during night time. Current sound level of two points exceeds the 60dBA limit value of Class II area during daytime defined in Environmental Quality Standard for Noise (GB3096-2008) with 7.0~10.5dBA higher than the standard. Current sound level of four sensitive points exceeds the 50dBA limit value of Class II area during nighttime defined in Environmental Quality Standard for Noise (GB3096-2008) with 1.8~19.5dBA higher than the standard.

(2) School

School within the evaluated range on both sides of the new railway line, current sound level is 47.5~70.6dBA during daytime and 46.9dBA during night time. During daytime, the current sound level of the TIEDONG kinder garden exceeds the 60dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) with 10.6dBA higher than the standard. During nighttime, the 50dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) can be met.

To sum up, the results of current acoustical environment monitoring of this project refers to Table 6-2.

Table 6-2: Results of Current Acoustical Environment Monitoring Along the Line

Areas			Current Data（dBA）		Values exceeding the standards（dBA）		Number of total sensitive points	Number of sensitive points exceeding the standard
			daytime	nighttime	daytime	nighttime		
New Line	Residential Area		40.7～60.4	29.4～49.1	0.6～5.4	0.1～4.1	86	4
	School		43.2～60.8	31.9～49.5	0.1～0.8	/	8	1
Existing LIne	Residential Area	Within 30m	60.9～65.9	61.9～68.8	-	-	6	-
		30~60m	53.5～70.4	49.8～69.3	0.4	2.6～9.3	8	7
		Over 60m	47.0～70.5	44.2～69.5	7.0～10.5	1.8～19.5	10	4
	School		47.5～70.6	46.9	10.6	/	3	1

6.3 Forecasting Evaluation

6.3.1 Forecasting Methods

Main noise source after the completion of the project is movement noise of train. Based on 'Notice of Printing and Issuing Guidance on Railway Construction Project Environmental Evaluation Vibration Source Strength Values and Controlling Principles' (TJ[2010]No.44), type method shall be used for forecasting to calculate railway noise sound level A of every sensitive points after the project starts running.

1. Forecasting Formula

Basic forecasting calculation formula of the noise equivalent sound level Leq,T at the forecasting point caused by train running is:

$$L_{Aeq,p} = 10\lg\left[\frac{1}{T}\left(\sum_i n_i t_{eq,i} 10^{0.1\left(L_{po,t,i}+C_{t,i}\right)} + \sum_i t_{f,i} 10^{0.1\left(L_{po,f,i}+C_{f,i}\right)}\right)\right] \quad \text{（formula 6-1）}$$

where:

T —— defined evaluation time in s;

n_i —— number of type i train passed through during time period T;

$t_{eq,i}$ —— equivalent passing time of type i train in s;

$L_{p0,t,i}$ —— noise emission source strength of type i train on the maximum vertical direction, as A weighted sound pressure level or band sound pressure level in dB;

$C_{t,i}$ —— noise correction of type i train, as A weighted sound pressure level or band sound pressure level correction in dB;

$t_{f,i}$ —— working time of fixed sound source in s;

$L_{p0,f,i}$ —— noise emission source strength of fixed sound source, as A weighted sound pressure level or band sound pressure level in dB

$C_{f,i}$ ——noise correction of fixed sound source, as A weighted sound pressure level or band sound pressure level in dB

2. Calculation of Equivalent Time t_{equila}

Equivalent passing time of type i train teq,I is calculated as follows:

$$t_{eq,i} = \frac{l_i}{v_i}\left(1 + 0.8\frac{d}{l_i}\right) \qquad \text{（formula 6-2）}$$

Where:

l_i —— length of type i train in m;

v_i —— running speed of type i train in m/s;

d —— distance between forecasting points to the line in m.

3. Train Running Noise Correction $C_{t,i}$

The train running noise correction Ci shall be calculated as follows:

$$C_{t,i} = C_{t,v,i} + C_{t,\vartheta} + C_{t,t} + C_{t,d,i} + C_{t,a,i} + C_{t,g,i} + C_{t,b,i} + C_{t,h,i} + C_w \qquad \text{（formula 6-3）}$$

Where:

$C_{t,v,i}$ —— train running noise speed correction, can be calculated based on analogy test data, standard method or related information, in dB.

$C_{t,\vartheta}$ —— train running noise vertical directivity correction, dB；

$C_{t,t}$ ——correction of noise influences from railway and track structure, can be calculated based on analogy test data, standard method or related information, in dB;

$C_{t,d,i}$ —— train running noise geometric divergence loss, in dB;

$C_{t,a,i}$ —— train running noise atmospheric absorption, in dB;

$C_{t,g,i}$ —— noise attenuation due to ground effect of train running noise, in dB;

$C_{t,b,i}$ —— train running noise barrier diffraction attenuation, in dB;

4. Calculation of Fixed Sound Source Correction $C_{f,i}$

It will be sectional complete closed line after completion of the project without locomotive whistling, and therefore fixed sound source correction will not be considered during forecasting calculation.

5. Train Running Speed Correction $C_{t,v,i}$

Based on design information, target speed of passenger train of the main line is 250km/h; designed speed of passenger train of Changtu and Longshu liaison line is 120km/h; designed speed of freight train is 80km/h.

6. Railway Line Structure Correction $C_{t,t}$

All main line of this project shall be laid inter-sectional seamless line with a line

structure correction of 0dBA.

7. Calculation of Geometric Divergence Loss $C_{t,d,i}$

Train noise emission geometric divergence loss Ct,d,I is calculated as follows:

$$C_{\mathrm{t,d},i} = -10\ \lg \frac{d \arctan \frac{l}{2d_0} + \frac{2l^2}{4d_0^{\ 2} + l^2}}{d_0 \arctan \frac{l}{2d} + \frac{2l^2}{4d^{\ 2} + l^2}} \qquad \text{（formula 6-4）}$$

Where:

d_0 —— reference distance of source strength, in m;

d —— distance from the forecasting points to the line, in m;

l —— length of the train, in m

8. Calculation of Air Sound Absorption $C_{t,a,i}$

$$C_{t,a,i} = -\alpha s \qquad \text{（formula 6-5）}$$

Where:

α —— pure-tone attenuation due to air absorption, in dB/m;

s —— sound propagation distance, in m.

9. Calculation of Ground Sound Absorption $C_{t,g,i}$

$$C_{\mathrm{t,g},i} = -4.8 + \frac{2h_{\mathrm{m}}}{d}\left(17 + \frac{300}{d}\right) \qquad \text{（formula 6-6）}$$

Where:

h_{m} —— average ground clearance of propagation distance, in m;

d —— distance from the sound source to a receiving point, in m;

10. Calculation of Barrier Insertion Loss $C_{t,b,i}$

$$C_{t,\mathrm{b},i} = \begin{cases} -10\ \lg \dfrac{3\pi\sqrt{\left(1-t^2\right)}}{4\arctan\sqrt{\dfrac{1-t}{1+t}}}, & t = \dfrac{40 f\delta}{3c} \le 1 \\ -10\ \lg \dfrac{3\pi\sqrt{\left(t^2-1\right)}}{2\ln\left(t+\sqrt{t^2-1}\right)}, & t = \dfrac{40 f\delta}{3c} > 1 \end{cases} \qquad \text{（formula 6-7）}$$

Where:

f —— sound wave frequency, in Hz;

δ —— sound path difference, $\delta = a+b-c$, in m;

c —— sound speed, $c = 340$ m/s.

11. Calculation of Vertical Directivity Correction $C_{t,\vartheta,i}$

Train running noise emission vertical directivity correction Ct,θ,I shall be calculated as follows:

When $-10^{\circ} \le \vartheta < 24^{\circ}$, $C_{t,\vartheta,i} = -0.012(24-\vartheta)^{1.5}$

when $24^{\circ} \le \vartheta < 50^{\circ}$, $C_{t,\vartheta,i} = -0.075(\vartheta-24)^{1.5}$ （formula 6-8）

when $\vartheta < -10^{\circ}$, $C_{t,\vartheta,i} = C_{t,-10^{\circ}}$

when $\vartheta > 50^{\circ}$, $C_{t,\vartheta,i} = C_{t,50^{\circ}}$

where:

ϑ —— the angle between the direction of sound source to forecasting point and the horizontal plane, in degree.

Note: the mathematical model of this formula is established based on the research information from ORE which an institute belongs to UIC.

6.3.2 Forecasting Technical Parameters

Technical parameters for noise forecasting calculation are set as follows based on related design documents:

i. Tracks

Main line of this project shall use ballasted track. Changtu and Longshu liaison line shall be designed using heavy track with ballasted track structure. The whole line shall be laid inter-section seamless line.

ii. Train Traffic

This line and existing train numbers refer to Table 6-3 and Table 6-4.

Table 6-3 Existing Train Numbers in: pair/day

Section	Current Situation			In the near future（2020 年）			Future（2030 年）			Remarks
	Passenger train	Freight train	total	Passenger train	Freight train	total	Passenger train	Freight train	total	
Jiang Mi Feng ～La Fa	11	12/15	23/26	2	12	14	4	15	19	Nearby the existing Jilin Station, about 3.5km newly built passenger train line parallel to and intercrossing with the existing line.
La Fa ～ Dun Hua	12	12/15	24/27	2	14	16	4	17	21	Nearby the existing Dunhua Station, about 3.5km newly built passenger train line parallel to and intercrossing with the existing line.
Dun Hua～ Chao Yang Chuan	11	12/15	23/26	2	12	14	4	15	19	Nearby the existing Jilin Station, about 3.5km newly built passenger train line parallel to and

										intercrossing with the existing line.
Chao Yang Chuan ～Yan Ji	11	14/17	25/28	2	16	18	4	19	23	
Yan Ji～Qu Shui	10	14/17	24/27	4	24	28	8	29	37	
Qu Shui～Tu Men	12	24/27	36/39	5	34	39	10	41	51	
Tu Men～West Hui Chun		8	8	1	17	18	2	19	21	Nearby the existing Tumen Station, about 3km newly built passenger train line parallel to and intercrossing with the existing line.

Table 6-4: Train Numbers of This Line in Pair/Day

Section	Passenger Train	
	In the near future （2020）	In the future （2030）
Ji Lin – Long Tan Shan	11	17
Ji Lin – West Yan Ji	70	95
West Yan Ji – North Hui Chun	23	34

iii. Forecasting Year

In the near future: 2020; in the future: 2030

iv. Length of Train

MU train of this project is designed to compose 8 and 16 units. The length of 8-unit MU train is 214m, and length of 16-unit is 428m. In the near future (year 2020), the flow rate of 8-unit and 16-unit MU is 53:17 from Jilin to Yanji, and 16:7 from Yanji to Huichun.

v. Train Running Speed

Based on design information, target speed of passenger train of the main line is 250km/h; designed speed of passenger train of Changtu and Longshu liaison line is 120km/h; designed speed of freight train is 80km/h. The forecasting speed of every sensitive point shall be considered the actual train running speed.

vi. Traffic Distribution during Daytime and Nighttime

Based on design information, passenger train flow rate of daytime and nighttime is 4:1 on the existing Changtu Line, while the freight train flow rate is 17:15. For this project, MU train flow rate of daytime and nighttime is 88:12 on the main line. The flow rate on Changtu and Longshu liaison line shall use the average value.

vii. Sound Source Strength

Target speed of passenger train of the main line is 250km/h using ballastless track. Designed speed of passenger train of Changtu and Longshu liaison line is 120km/h; designed speed of freight train is 80km/h. Based on 'Notice of Printing and Issuing

Guidance on Railway Construction Project Environmental Evaluation Vibration Source Strength Values and Controlling Principle (2010 amended edition)' (TJ[2010]No.44), the train sound source strength used for this evaluation refers to Table 6-5 and Table 6-6.

Table 6-5: MU Sound Source Strength

in dBA

Train speed, km/h	Embankment Line	Bridge Line
	Ballasted Track	Ballasted Track
160	79.5	73.5
170	80.0	74.0
180	81.0	75.0
190	81.5	75.5
200	82.5	76.5
210	83.5	77.5
220	84.5	78.5
230	85.5	79.5
240	86.0	80.0
250	86.5	80.5

Line condition: high-speed railway, seamless, 60kg/m steel track, rail level in good condition, concrete sleeper, straight, embankment line; bridge line: 13.4m wide bridge, box beam, with 1m high protection wall.
Position of reference point: 25m away from the center of train running line, 3.5m above the rail level.

Based on design information, bridge line of this project has 12.2m wide bridge and 0.75m high protection wall, which is different with the bridge line conditions listed in Table 6-5 and therefore the source strength of the bridge line in the table shall be corrected. This evaluation forecasting increases 3dBA based on the source strength of bridge line in the table 6-5.

Table 6-6: Sound Source Strength of Passenger Trains with a Speed of 160km/h or less

Speed, km/h	50	60	70	80	90	100	110	120
Source strength, dBA	72.0	73.5	75.0	76.5	78.0	79.5	81.0	82.0

Line condition: Class I or high-speed railway, seamless, 60kg/m steel track, rail level in good condition, concrete sleeper, straight, embankment line; for the source strength of bridge line of normal railway, 3dBA shall be added based on the value listed in the above table.
Position of reference point: 25m away from the center of train running line, 3.5m above the rail level.

6.3.3 Forecasting Results and Evaluation

According to the relative position between major acoustical environmental sensitive points alongside the line and the line, type of lines in different sections, and train running speed, the acoustical environmental data of all sensitive points has been forecasted. The results are listed in the table and see Table 3 of Annex 3 for details.

From the forecasting calculation, main sensitive points that acoustical environment exceed the standard are concentrated on high-speed running sections after the completion of this project. The reason is that train running noise source strength is relatively higher. Conclusion of the noise

influences alongside the railway line to be built in the near future (2020) is as follows.

1. Sensitive points on both sides of the new railway line

（1）Residential Area

1) Within the range of 30m away from the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points within the range of 30m away from the new railway line after completion of the project is: 48.3~62.4dBA during daytime and 42.1~56.8 during nighttime, and respectively increased 4.2~18.7dBA and 8.8~24.4dBA compared to the current data.

2) At the point of 30m away from the boundary of the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points on the boundary of 30m away from the central line of the outer tracks of the new line is: 44.2~63.0dBA during daytime and 39.1~57.4 during nighttime, and respectively increased 0.5~21.4dBA and 1.9~27.0dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

3) Functional Area

a) Within the range of Class IV Area

For the area within the range of 30m~60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 47.5~62.3dBA during daytime and 41.0~56.6dBA during night time, and respectively increased 1.3~18.1dBA and 3.5~23.7dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008).*

b) Within the range of Class II Area

For the area outside the range of 60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 44.1~58.7dBA during daytime and 35.2~52.8dBA during night time, and respectively increased 0.4~15.6dBA and 1.3~21.1dBA compared to the current data. The data of daytime meet the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008).* During nighttime, there are 40 sensitive points exceed the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008*) with 1.9~2.8dBA higher than the standard.

(2) School

There are 8 schools within the evaluated range on both sides of the new railway line, the forecasting value of continuous equivalent sound level A is: 46.2~61.1dBA during daytime and 37.9~50.7dBA during night time, and respectively increased 0.3~11.9dBA and 1.1~17.4dBA compared to the current data. During daytime, the forecasted data of Aixin Kinder Garden exceed the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 0.7~1.1dBA higher than the standard. During nighttime, the forecasted data of No.2 Yanbian Special Education School and Aixin Kinder Garden exceed the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 0.6~0.7dBA higher than the standard.

2. Sensitive points on both sides of the existing railway line

The acoustical environment alongside the existing railway line is comparatively seriously influenced by train whistling since the existing railway is not enclosed. The new line will be a sectional complete closed line after completion, the train whistling noise influences will be greatly weakened. Therefore, the forecasting data of the sensitive points affected by the existing line will be decreased comparing to the current value. Among those points, including Yuyuan Residential Area, Weibei Residential Area, Liaodong San Residential Area, Xintiandi Department, Weiye Garden Residential Area, Huaxi Yayuan, New Changbei Residential Area, Yong'an village (on the right side of the railway), Bohai Street Aimin Bystreet, and six places like the special education school for disables in the Yumen City, are closer to the new line than to the existing line. Their forecasting data is relatively decreased less with 0.1~2.6dBA during daytime and 0.6~9.7dBA during nighttime. Zhushi Juyi Residential Area, Liaodong Yi Residential Area, the shanty town, Yong'an Village (on the left side of the line), Tielu Residential Area, Tiedong Community, Linjian Village, six places in Bajiazi Village are future to the new line than to the existing line. Their forecasting data is relatively decreased more with 0.1~13.4dBA during daytime and 0.6~20.8dBA during nighttime. The Elementary School of Jiefang Dong Road, and Tiedong Kinder Garden are affected by the existing railway and roads, road noise is even louder. Therefore, the forecasting data is basically same as the current data.

(1) Residential Area

1) Within the range of 30m away from the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points within the range of 30m away from the new railway line after completion of the project is: 54.8~60.5dBA during daytime and 49.3~54.8 during nighttime, and respectively decreased 0.5~11.1dBA and 8.9~19.5dBA compared to the current data.

2) At the point of 30m away from the boundary of the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points on the boundary of 30m away from the central line of the outer tracks of the new line is: 50.2~63.0dBA during daytime and 47.7~57.4 during nighttime, and respectively decreased 0.1~13.4dBA and 4.4~20.8dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

3) Functional Area

a) Within the range of Class IV Area

For the area within the range of 30m~60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 50.3~70.3dBA during daytime and 44.1~59.4dBA during night time, and respectively decreased 0.1~10.7dBA and 3.2~18.6dBA. During nighttime, there is one sensitive point exceeds the 70dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for Class 4b area with 0.3dBA higher than the standard. During nighttime, all meet the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for Class 4b area.

b) Within the range of Class II Area

For the area outside the range of 60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 45.5~70.5dBA during daytime and 36.0~59.2dBA during night time, and

respectively decreased 0.2~10.0dBA and 0.6~18.6dBA compared to the current data. During daytime, there are two sensitive points exceed the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 0.8~10.5dBA higher than the standard. During nighttime, there are two sensitive points exceed the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 9.1~9.2dBA higher than the standard.

(2) School

There are 3 schools within the evaluated range on both sides of the new railway line, the forecasting value of continuous equivalent sound level A is: 47.4~70.7dBA during daytime and 39.9dBA during night time, and respectively decreased 0.1dBA and 7.0dBA compared to the current data. During daytime, the forecasted data of Tiedong Kinder Garden exceed the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 10.7dBA higher than the standard. During nighttime, all meet the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008*) for class II area.

To sum up, the forecasting noise results of the project running in the near future refer to Table 6-7.

Table 6-7: Forecasting Noise Results of the Project Running in the Near Future

Section			Forecasting data in the near future （dBA）		Values exceeding the standards（dBA）		Number of sensitive points	Number of sensitive points exceeding the standard
			Daytime	Nighttime	Daytime	Nighttime		
New Line	Residential Area	Within 30m	48.3～62.4	42.1～56.8	-	-	49	-
		30~60m	47.5～62.3	41.0～56.6	/	/	69	/
		Outside 60m	44.1～58.7	35.2～52.8	/	1.9～2.8	86	69
	Schools		46.2～61.1	37.9～50.7	0.7～1.1	0.6～0.7	8	2
Existing line	Residential Area	Within 30m	54.8～60.5	49.3～54.8	-	-	6	-
		30~60m	50.3～70.3	44.1～59.4	0.3	/	8	1
		Outside 60m	45.5～70.5	36.0～59.2	0.8～10.5	9.1～9.2	10	2
	Schools		47.4～70.7	39.9	10.7	/	3	1

6.3.4 Typical Railway Line Noise Forecasting Values and Protection Distance

This evaluation forecasts noise sound level and protection control distance under the typical condition of this project to provide references for land use and planning alongside the railway line. Under uncovered condition, pure railway noise forecasting data and protection control distance of this project refer to Table 6-8 and Table 6-9.

Table 6-8: Railway Noise Forecasting Data of Typical Embankment and Bridge Line

Section	Line Type	height（m）	30m		60m		120m		200m	
			daytime	Night time	daytime	Night time	daytime	Night time	daytime	Night time
Jilin - Yanji	embankment	4	65.1	59.5	59.5	53.8	55.3	49.6	52.3	46.7
	bridge	11	61.9	56.3	58.8	53.2	53.4	47.8	50.0	44.3
Yanji - Huichun	embankment	4	60.4	55.3	54.8	49.6	50.6	45.4	47.7	42.6
	bridge	11	57.2	52.1	54.1	49.0	48.7	43.5	45.3	40.2

Note:

1. Forecasting line condition is seamless line.
2. Forecasting environmental condition is open, no building obstacle.

Table 6-9: Noise Influences Protection Control Distance of Typical Embankment and Bridge Lines

Section	**Line Type**	**Height（m）**	**Control Distance（m）**				
			Daytime		**Nighttime**		
			70dBA	60dBA	70dBA	60dBA	50dBA
Jilin-Yanji	Embankment	4	<30	48	<30	<30	94
		6	<30	52	<30	<30	99
		8	<30	56	<30	<30	104
	Bridge	11	<30	<30	<30	<30	77
		18	<30	<30	<30	<30	84
		22	<30	<30	<30	<30	86
Yanji-Huichun	Embankment	4	<30	<30	<30	<30	49
		6	<30	<30	<30	<30	53
		8	<30	<30	<30	<30	57
	Bridge	11	<30	<30	<30	<30	31
		18	<30	<30	<30	<30	<30
		22	<30	<30	<30	<30	<30

Note:

1. Control distance is the distance to the central line of the outer tracks.
2. Forecasting line condition is seamless line.
3. Forecasting environmental condition is open, no building obstacle.

Based on Table 6-9, it is recommended not to build or expand noise sensitive buildings like school, hospital and residential areas within the range 104m of both sides of embankments and 86m of both sides of bridges.

6.4 Noise Pollution Protection Measures

6.4.1 Technical and Economical Comparison of Noise Pollution Protection Measures

At present, railway noise pollution is mainly protected and controlled from three aspects: noise source, transmission way, and sensitive points. Besides using low-noise vehicle, tracks and rail bed and etc source control measures, transmission way control such as setting sound barrier and green belt and sound receiving point protection such as function replacement of sensitive houses and building sound insulation are also popular measures. Technical and economical comparison of various noise pollution protection measures refers to table 6-10.

Table 6-10: Technical and Economical Comparison of Noise Pollution Protection Measures

Measures	Analysis	Technical comparison	Suitable sensitive point type
Improve locomotive performances	Reduce noise source fundamentally	Require higher technology	Whole line noise protection and control
Noise reduction of track structure	Reduce noise source fundamentally	Require higher technology	Whole line noise protection and control
Setting sound barrier	Noise reduction 6~8dBA, improving indoor and outdoor acoustical environment without affecting social life, but shall watch type of the barrier matching the surroundings	Technology feasible	Applied to embankment and bridge sections, where closer to railway line, building density relatively high, sensitive buildings mainly are medium and low height. Having little effect on sensitive points relatively far away from the line
Setting sound insulation window	Noise reduction more than 25dBA, but affecting vision and ventilation and having influences on social life	Having certain impact on social life	Applied to small size, house loosely arranged residential area; or noise reduction is great and sound barrier cannot meet the requriement
Setting green belt	10m wide green belt combing arbor and shrub can reduce noise 1~2dBA; 30m wide green belt can reduce noise 2~3dBA; this can beautify environment but require more land and removal work.	Beautifying environment, alleviating vision fatigue, and having limit noise reduction result, shall be used as an assistant measure	Spare land available in the boundary of railway land. It is not recommended to use extra land for green belt since land sources alongside the line are extremely precious.
Sensitive points function replacement and removing	Avoiding railway noise influences fundamentally, but more difficult to implement	Require re-settling	It is hard to satisfy the original function after engineering measures have been taken; or applied to small size, old architectural sensitive points and can be considered together with vibration protection.

6.4.2 Principles of Noise Pollution Protection and Basis of Choosing Measures

Based on the principle of national environmental protection ‘prevention first, combining prevention with control, taking comprehensive control measures’ and ‘who created pollution who

should take the responsibilities', along with the strategy policy of 'social benefits combining with economical and environmental benefits', combining with the characters of this project, environmental conditions alongside the line, size and characters and of sensitive points as well as ranges and degrees affected by railway noise, corresponding measures shall be taken to prevent and control noise pollution.

Foundation of Choosing Noise Pollution Protection and Control Measures:

（1）For those sensitive points closer to the line, buildings having bigger size and centralized arranged, setting sound barrier has the highest priority as prevention and control measure to ensure acoustical environment quality of the section.

（2）For those sensitive points relatively far from the line, buildings having smaller size and loosely arranged, architectural sound insulation shall be used, i.e. setting ventilation and sound insulation windows as prevention and control measure.

For those sensitive points located at 30m away to the central line of outer tracks of the railway to be built whose forecasting data during daytime and nighttime meet the 70dBA/70dBA standard limit requirement defined by *Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line* (amended edition) (GB 12525-90), but exceed the 70dBA/60dBA standard limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008*) for class IV area, and those sensitive points outside 60m away form the central line of outer tracks whose forecasting data during daytime and nighttime meet the 70dBA/60dBA standard limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class IV area but exceed the 60dBA/50dBA standard limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area, corresponding noise prevention and control measures shall be taken according to the size of their buildings.

6.4.3 Noise Pollution Protection and Control Measures

Based on the above noise pollution control principles, combining with characters of this project, situation of sensitive points exceeding the standard and environmental conditions alongside the line, proper noise pollution prevention and control measures shall be taken for the sensitive points. The measures taken and investment refer to Table 4 of Annex 3.

There are 71 sensitive points exceeding the standard alongside the line with 0.3~10.7dBA higher than the standard during daytime and 0.6~9.2dBA higher than the standard during nighttime. Along the whole line, 44 places toalling710 families involved in moving require an investment of 140.75 million yuan. 56 sound barriers totaling 33,600m shall be set which will cost 113.2885 million yuan. 15 insulation windows totaling 1,060m2 shall be installed which requires an investment of 0.53million yuan. It will spend 254.5685 million yuan to invest on noise pollution prevention and control for the whole line. Sound level of all sensitive points will meet the functional requirements after the above measures have been taken.

6.5 Construction Noise Environment Influences Evaluation

6.5.1 Sound Source Analysis

Main work of this line includes subgrade construction, bridge and tunnel construction, and station

construction. During construction, fixed sound source like bulldozer, excavating machine, pile driver and flow source like transit mixer truck, road roller and various transporting vehicles will produce very loud noise. Noise of main construction machine and transporting refer to table 6-11.

Table 6-11: Noise of Construction Machine and Transportation

in: dB

Construction Period	Description	Distance between measuring point and noise source （m）	A sound level	Average value
Earthwork	Bulldozer	10	78～96	88
	Excavating machine	10	76～84	80
	Loading machine	10	81～84	82
	Rock drill	10	82～85	83
	Road breaking machine	10	80～92	85
	Truck	10	75～95	85
Piling	Diesel piling	10	90～109	100
	Drop hammer piling	10	93～112	105
Constructing	Grader	10	78～86	82
	Road roller	10	75～90	83
	Rivet machine	10	82～95	88
	Concrete mixer	10	75～88	82
	Generator	10	75～88	82
	Air compressor	10	80～98	88
	Vibrorammer	10	70～82	76
Decorating	Hoister	10	84～86	85
	Heavy cranes	10	85～95	90

6.5.2 Noise Standard of Construction Field

Working noise of different period of construction refers to Table 6-12.

Table 6-12: Noise Limit of Construction Field

in: leg (dB)

Construction period	Main noise source	Noise limit	
		Daytime	Nighttime
Earthwork	Bulldozer, excavating machine, loading machine	75	55
Piling	Various piling machine	85	Construction prohibited
Constructing	Concrete mixer, vibrorammer, electrical saw	70	55
Decorating	Crane, lifter	65	55

6.5.3 Control Distance from Construction Machine to Construction Field

All machine used for construction shall try to meet of requirements of distance control and equivalent sound level limit of construction field. Working machine of different construction period requires certain working space when start running. Certain working space is provided when construction machine is operating and therefore noise source is point source.

The equivalent continuous sound level A of the forecasting point can be calculated as follows:

$$L_{eq,T} = 10\lg\left[\frac{1}{T}\sum_{i=1}^{n} n_i t_{eq,i} 10^{0.1(L_{p0,i}+C_i)}\right]$$

Noise attenuation formula is as follows:

$$L_A = L_O - 20\lg(r_A/r_0)$$

Where:

L_A – sound level of the place having a distance of r_A to the sound source, in dB;

L_O - sound level of the place having a distance of r0 to the sound source, in dB;

Control distance of construction machine to the boundary of construction field shall be calculated based on the actual situation of various machines. The working time is calculated on 8, 10 and 12 hours during daytime and 1, 2, 3 hours during nighttime. Construction machine is calculated on 1, 2 and 3. Control distance of construction machine is calculated and given in Table 6-13.

Table 6-13: Estimated Control Distance of Typical Construction Machine Unit: m

Construction machine	Limit of boundary of construction field（dB）		Working time（hour）		One machine working		Two machines working		Three machines working	
	daytime	Night time	daytime	Night time	daytime	Night time	daytime	Night time	daytime	Night time
Bulldozer	75	55	8	1	32	158	45	223	55	274
			10	2	35	223	50	316	61	387
			12	3	39	274	55	387	67	474
Road breaking machine	75	55	8	1	22	112	32	158	39	194
			10	2	25	158	35	224	43	274
			12	3	27	194	39	274	47	335
Loading machine, road breaking machine	75	55	8	1	18	89	25	126	31	154
			10	2	20	126	28	178	34	218
			12	3	22	154	31	218	38	266
Grader, road roller, generator, concrete mixer	70	55	8	1	28	79	40	112	49	137
			10	2	31	112	45	158	55	194
			12	3	34	137	49	194	60	237

6.5.4 Policy of Construction Noise Prevention and Control

If environmental noise pollution produced during construction, the construction company shall take corresponding noise reduction measures according to Law of the Peoples Republic of China on the Prevention and Control of Environmental Noise Pollution, Noise Limit on the Boundary of Construction Field and relative local regulations.

(1) Arrange construction fields reasonably which shall be away from residential area and etc sensitive points as far as possible. Construction machines shall be arranged reasonably within the boundary of construction field. Machines producing louder noise shall be arranged on the further side of the field away from the residential area.

(2) Plan construction fields rationally and scientifically. Based on actual field distribution or estimated field noise, noise reduction measures, such as anti-vibration pad, covering and acoustic hood, shall be taken if noise exceeds the standard, especially on the side where sensitive points located.

(3) Schedule working time rationally. Operating occurring louder noise shall be scheduled during daytime. If it requires continuous operation or has special demands due to production technology which has to work during 22:00pm to 6:00am, construction company and owner shall apply for approval from local construction administrative authority and environmental protection authority before construction begins. Construction

during nighttime shall not began until approved. Construction company and builders shall notice the residents and companies around the construction field and announce the construction period.

（4） Measures shall be taken to reduce construction noises as much as possible when working at night. There shall be corresponding management system and noise reduction measures for man-made noises which shall be strictly controlled. Vehicles that transports material at night are not allowed to blow the horn when entering the construction field. Loading and unloading shall be handled with care to reduce noise as much as possible.

（5） Plan construction access road and passing time for trucks reasonably which shall not pass through villages or shall be away from villages to reduce transportation noise impacts on residents.

（6） Do enough propaganda work and advocate scientific management and civilized construction. Construction company shall come to an understanding with local government and residents before construction begins. Meanwhile, construction workers shall be educated with environmental protection concept to reduce man-made noise pollution during construction.

（7） Environmental management and monitoring plan has been made in this report which shall be strictly followed by all related construction companies during construction.

6.6 Conclusion of Acoustical Environment Evaluation

There are totally 107 sensitive points distributed in the evaluation ranges alongside the line including 11 schools and 96 residential areas.

6.6.1 Evaluation of Current Situation

1. Sensitive Points on both sides of the new line

There are totally 94 sensitive points within the evaluation ranges of the new railway line on both sides, which includes 8 schools and 96 residential areas. The current situation is mainly effected by social life and road traffic noises. Current sound level is 40.7~60.8dBA during daytime and 29.4~49.5dBA during night time. During daytime, all sensitive points meet the 60dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) except for the AIXIN Kinder Garden. It is located beside the main road of the village, current sound level during daytime is 60.1~60.8dBA exceeding the 60dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.1~0.8dBA higher than the standard. During nighttime, all sensitive points meet the 50dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008).

2. Sensitive points on both sides of the existing line

There are totally 13 sensitive points within the evaluation ranges on both sides of the new railway line, which includes 3 school and 10 residential areas. The current situation is mainly effected by railway noises.

(1) Residential Area

1) Within the range of 30m away from the railway to be built

Current sound level of the area within the range of 30m away from the railway is 60.9~65.9dBA during daytime and 61.9~68.8dBA during nighttime.

2) At the point of 30m away from the boundary of the railway to be built

Current sound level of the area at the point of 30m away from the railway is 55.9~73.3dBA during daytime and 55.4~72.6dBA during nighttime. Within the existing railway sections where parallel to or across the new railway, the pure railway noise at the 30m boundary is 57.7~61.2dBA during daytime and 60.5~63.9dBA during nighttime. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

3) Within the range of Class IV Area

The area within the range of 30m~60m away from the new line on both sides , the current sound level is 53.7~70.4dBA during daytime and 49.8~69.3dBA during night time. Current sound level of one point exceeds the 70dBA limit value of Class 4B area during daytime defined in Environmental Quality Standard for Noise (GB3096-2008) with 0.4dBA higher than the standard. Current sound level of seven sensitive points exceeds the 60dBA limit value of Class 4B area during nighttime defined in Environmental Quality Standard for Noise (GB3096-2008) with 2.6~9.3dBA higher than the standard.

4) Within the range of Class II Area

The area outside the range of 60m away from the new line on both sides, the current sound level is 47.0~70.5dBA during daytime and 44.2~69.5dBA during night time. Current sound level of two points exceeds the 60dBA limit value of Class II area during daytime defined in Environmental Quality Standard for Noise (GB3096-2008) with 7.0~10.5dBA higher than the standard. Current sound level of four sensitive points exceeds the 50dBA limit value of Class II area during nighttime defined in Environmental Quality Standard for Noise (GB3096-2008) with 1.8~19.5dBA higher than the standard.

(2) School

School within the evaluated range on both sides of the new railway line, current sound level is 47.5~70.6dBA during daytime and 46.9dBA during night time. During daytime, the current sound level of the TIEDONG kinder garden exceeds the 60dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) with 10.6dBA higher than the standard. During nighttime, the 50dBA limit value of Class II area defined in Environmental Quality Standard for Noise (GB3096-2008) can be met.

6.6.2 Forecasting Evaluation

1. Sensitive points on both sides of the new railway line

(1) Residential Area

1) Within the range of 30m away from the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points within the range of 30m away from the new railway line after completion of the project is: 48.3~62.4dBA during daytime and 42.1~56.8 during nighttime, and respectively increased 4.2~18.7dBA and 8.8~24.4dBA compared to the current data.

2) At the point of 30m away from the boundary of the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points on the boundary of 30m away from the central line of the outer tracks of the new line is: 44.2~63.0dBA during daytime and 39.1~57.4 during nighttime, and respectively increased 0.5~21.4dBA and 1.9~27.0dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

3) Functional Area

a) Within the range of Class IV Area

For the area within the range of 30m~60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 47.5~62.3dBA during daytime and 41.0~56.6dBA during night time, and respectively increased 1.3~18.1dBA and 3.5~23.7dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008).*

b) Within the range of Class II Area

For the area outside the range of 60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 44.1~58.7dBA during daytime and 35.2~52.8dBA during night time, and respectively increased 0.4~15.6dBA and 1.3~21.1dBA compared to the current data. The data of daytime meet the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008).* During nighttime, there are 40 sensitive points exceed the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* with 1.9~2.8dBA higher than the standard.

(2) School

There are 8 schools within the evaluated range on both sides of the new railway line, the forecasting value of continuous equivalent sound level A is: 46.2~61.1dBA during daytime and 37.9~50.7dBA during night time, and respectively increased 0.3~11.9dBA and 1.1~17.4dBA compared to the current data. During daytime, the forecasted data of Aixin Kinder Garden exceed the 60dBA limit requirement defined by Environmental Quality Standard for Noise (GB3096-2008) for class II area with 0.7~1.1dBA higher than the standard. During nighttime, the forecasted data of No.2 Yanbian Special Education School and Aixin Kinder Garden exceed the 50dBA limit requirement defined by Environmental Quality Standard for Noise (GB3096-2008) for class II area with 0.6~0.7dBA higher than the standard.

2. Sensitive points on both sides of the existing railway line

(1) Residential Area

1) Within the range of 30m away from the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points within the range of 30m away from the new railway line after completion of the project is: 54.8~60.5dBA during daytime and 49.3~54.8 during nighttime, and respectively decreased 0.5~11.1dBA and 8.9~19.5dBA compared to the current data.

2) At the point of 30m away from the boundary of the railway to be built

The forecasting value of continuous equivalent sound level A of the sensitive points on the boundary of 30m away from the central line of the outer tracks of the new line is: 50.2~63.0dBA during daytime and 47.7~57.4 during nighttime, and respectively decreased 0.1~13.4dBA and 4.4~20.8dBA compared to the current data. Both meet the70dBA/70dBA limit requirement defined by Emission Standards and Measurement Methods of Railway Noise on the Boundary alongside Railway Line (amended edition) (GB 12525-90).

3) Functional Area

a) Within the range of Class IV Area

For the area within the range of 30m~60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 50.3~70.3dBA during daytime and 44.1~59.4dBA during night time, and respectively decreased 0.1~10.7dBA and 3.2~18.6dBA. During nighttime, there is one sensitive point exceeds the 70dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for Class 4b area with 0.3dBA higher than the standard. During nighttime, all meet the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for Class 4b area.

b) Within the range of Class II Area

For the area outside the range of 60m away from the central line of outer tracks of the new line, the forecasting value of continuous equivalent sound level A is: 45.5~70.5dBA during daytime and 36.0~59.2dBA during night time, and respectively decreased 0.2~10.0dBA and 0.6~18.6dBA compared to the current data. During daytime, there are two sensitive points exceed the 60dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 0.8~10.5dBA higher than the standard. During nighttime, there are two sensitive points exceed the 50dBA limit requirement defined by *Environmental Quality Standard for Noise (GB3096-2008)* for class II area with 9.1~9.2dBA higher than the standard.

(2) School

There are 3 schools within the evaluated range on both sides of the new railway line, the forecasting value of continuous equivalent sound level A is: 47.4~70.7dBA during daytime and 39.9dBA during night time, and respectively decreased 0.1dBA and 7.0dBA compared to the current data. During daytime, the forecasted data of Tiedong Kinder Garden exceed the 60dBA limit requirement defined by Environmental Quality Standard for Noise (GB3096-2008) for class II area with 10.7dBA higher than the standard. During

nighttime, all meet the 50dBA limit requirement defined by Environmental Quality Standard for Noise (GB3096-2008) for class II area.

6.6.3 Noise Pollution Prevention and Control Measures

The evaluation put forward a noise control plan based on the principle of 'people-oriented, technically sound, economically viable, and the environment coordinated'.

（1）Plan and develop the Land on both sides of the line rationally

It is recommended that local planning department to plan and develop the land on both sides of the line rationally according to the railway noise forecasting results of this project. The principle is not to build or expand noise sensitive buildings like school, hospital and residential areas within the range 104m of both sides of embankments and 86m of both sides of bridges.

（2）Take corresponding noise pollution prevention and control measures for sensitive points exceeding the standard

There are 71 sensitive points exceeding the standard alongside the line with 0.3~10.7dBA higher than the standard during daytime and 0.6~9.2dBA higher than the standard during nighttime. Along the whole line, 44 places toalling710 families involved in moving require an investment of 140.75 million yuan. 56 sound barriers totaling 33,600m shall be set which will cost 113.6395 million yuan. 15 insulation windows totaling 1,060m2 shall be installed which requires an investment of 0.53million yuan. It will spend 254.9195 million yuan to invest on noise pollution prevention and control for the whole line.

In summary, the noise impacts of this project on environments alongside the line can be controlled after effective planning, management and engineering protection measures have been taken.