THE REPUBLIC OF TAJIKISTAN
MINISTRY OF TRANSPORT

DATA COLLECTION SURVEY ON A ROAD BETWEEN DUSHANBE AND KURGAN-TYUBE IN THE REPUBLIC OF TAJIKISTAN

FINAL REPORT

NOVEMBER 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CTI ENGINEERING INTERNATIONAL CO., LTD.

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Exchange Rate

April 2015
1TJS = 21.819 Japanese Yen
1US$ = 5.45 Tajikistan Somoni
1US$ = 119.03Japanese Yen

SUMMARY

1 INTRODUCTION

1.1 Background of the Study

The Republic of Tajikistan (hereinafter referred to as "Tajikistan") has about 30,000km of total road network with roughly 65% of freight transport and 99% of passenger transport depending on the road network.

The Dushanbe – Kurgan-Tyube road section (hereinafter referred to as the "DK road") of the Dushanbe-Nihzny Pyanj road, connects Dushanbe with Kurgan-Tyube (one of the largest city in Khatlon). However, the opening of the Nihzny Pyanj Bridge at the border with Afghanistan has led to a dramatic increase in the traffic volume in recent years which contributed much to the deterioration of the pavement condition of this road section. Due to insufficient information, majority of the road section was not considered in the previous maintenance projects, except for the road sections that were improved under ADB financing. Under such conditions, the Tajikistan government thus considers the improvement and widening of the existing DK road as an urgent priority.

This Study is undertaken to accumulate sufficient information that will be used to define the scope of work for the DK road improvement.

1.2 Objectives of the Study

The Study objectives are to:

- Investigate the current status of the road network development in the vicinity of the study area, the traffic demand and the necessary improvement works for the DK road,
- Review the development plans for the DK road that will contribute to a safe and smooth traffic flow in this area, and
- Propose to the Tajikistan government an effective and appropriate scope for the project feasibility.

1.3 Study Area

The Study area covers Khatlon province and the Regions of Republican Subordination (RRS), specifically the DK road section (approximately 93km of road length).

2 NATIONAL DEVELOPMENT PLAN AND ROAD DEVELOPMENT PLAN

2.1 National Development Plan Phases

The NDS 2015 summarizes challenges of the development after collapse of USSR in 3 phases as shown below;

Initial Phase : Post-Soviet development 1992-1997	Creation of political stability and basic market mechanisms. GDP was shrunk, inflation rose to several thousand percent. The foundations were laid for development of the economy and in 1997 economic growth was achieved for the first time.
Second Phase : 1997-1999	After Post-Soviet development phase, strong economic growth indicators started in 2000, annual growth in GDP was 9.3%. Inflation fell to 6-7%, the country's poverty rate reduced from 81% in 1999 to 64% in 2003.
New Phase : After 1999	The economic development after 1999. Many of the problems of the transitional period were dealt with in the previous phases. The phase for market transformation.

2.2 Road Development Plan

Tajikistan has "National Target Development Strategy for Transport Sector of the Republic of Tajikistan to the Year 2025 (hereinafter referred as Transport NDS 2025)" to provide long-term development in the Transport Sector which includes a road development plan.

3 SOCIO-ECONOMIC AND PHYSICAL CONDITIONS OF THE PROJECT AREA

3.1 Population

Number of population, growth rate and density is shown in **Table 3.1-1**.

TABLE 3.1-1 NUMBER OF POPULATION IN THE REPUBLIC OF TAJIKISTAN (YEAR 2000 – YEAR 2013)

		Area (1,000 km2)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Population (1,000 persons)	Republic of Tajikistan	142.6	6,264.6	6,371.2	6,487.1	6,598.8	6,718.9	6,842.2	6,965.5	7,096.9	7,250.8	7,417.4	7,621.2	7,807.2	7,987.4	8,161.1
	GBAR	64.1	207.4	208.3	208.8	209.5	206.8	206.4	206.3	203.1	203.7	204.8	206.5	208.5	210.2	212.1
	Sogd Region	25.2	1,901.8	1,928.1	1,954.6	1,983.3	2,015.8	2,047.9	2,079.5	2,113.8	2,153.4	2,197.9	2,247.6	2,298.8	2,349.0	2,400.6
	Khatlon Region	24.6	2,198.4	2,236.2	2,280.7	2,323.0	2,368.4	2,413.2	2,457.6	2,504.6	2,559.3	2,618.3	2,698.6	2,765.8	2,831.7	2,898.6
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	97.8	100.9
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	231.4	214.8
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	77.0	101.6
	RRS	28.6	1,377.6	1,407.0	1,438.0	1,466.1	1,497.9	1,530.4	1,564.1	1,601.2	1,641.2	1,685.2	1,737.4	1,786.1	1,832.2	1,874.0
	Dushanbe City	0.1	579.4	591.6	605.0	616.9	630.0	644.3	658.0	674.2	693.2	711.2	731.1	748.0	764.3	775.8
Growth Rate (%)	Republic of Tajikistan	-	-	1.7%	1.8%	1.7%	1.8%	1.8%	1.8%	1.9%	2.2%	2.3%	2.7%	2.4%	2.3%	2.2%
	GBAR	-	-	0.4%	0.2%	0.3%	-1.3%	-0.2%	0.0%	-1.6%	0.3%	0.5%	0.8%	1.0%	0.8%	0.9%
	Sogd Region	-	-	1.4%	1.4%	1.5%	1.6%	1.6%	1.5%	1.6%	1.9%	2.1%	2.3%	2.3%	2.2%	2.2%
	Khatlon Region	-	-	1.7%	2.0%	1.9%	2.0%	1.9%	1.8%	1.9%	2.2%	2.3%	3.1%	2.5%	2.4%	2.4%
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2%
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-7.2%
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.9%
	RRS	-	-	2.1%	2.2%	2.0%	2.2%	2.2%	2.2%	2.4%	2.5%	2.7%	3.1%	2.8%	2.6%	2.3%
	Dushanbe City	-	-	2.1%	2.3%	2.0%	2.1%	2.3%	2.1%	2.5%	2.8%	2.6%	2.8%	2.3%	2.2%	1.5%
Density (persons/km^2)	Republic of Tajikistan	142.6	43.9	44.7	45.5	46.3	47.1	48.0	48.8	49.8	50.8	52.0	53.4	54.7	56.0	57.2
	GBAR	64.1	3.2	3.2	3.3	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3
	Sogd Region	25.2	75.5	76.5	77.6	78.7	80.0	81.3	82.5	83.9	85.5	87.2	89.2	91.2	93.2	95.3
	Khatlon Region	24.6	89.4	90.9	92.7	94.4	96.3	98.1	99.9	101.8	104.0	106.4	109.7	112.4	115.1	117.8
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RRS	28.6	48.2	49.2	50.3	51.3	52.4	53.5	54.7	56.0	57.4	58.9	60.7	62.5	64.1	65.5
	Dushanbe City	0.1	5,794.0	5,916.0	6,050.0	6,169.0	6,300.0	6,443.0	6,580.0	6,742.0	6,932.0	7,112.0	7,311.0	7,480.0	7,643.0	7,758.0

Source: Agency on Statistics under President of the Republic of Tajikistan

3.2 Economic Development (GDP)

Gross Domestic Product (herein after GDP) in Tajikistan is shown in **Table 3.1-2**.

TABLE 3.1-2 GDP IN TAJIKISTAN FROM 2000 TO 2013

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GDP (Constant Price at Million Somoni)		75.0	82.0	90.0	99.0	109.0	117.0	125.0	134.0	145.0	151.0	161.0	172.0	185.0	199.0
Growth Rate (%)		8.3%	10.2%	9.1%	10.2%	10.6%	6.7%	7.0%	7.8%	7.9%	3.9%	6.5%	7.4%	7.5%	7.4%
Sectoral Economic Output	Primary	-	-	-	-	-	-	-	-	28.7	28.1	31.6	40.9	43.1	42.0
	Secondary	-	-	-	-	-	-	-	-	35.5	37.0	40.1	38.7	40.9	46.2
	Tertiary	-	-	-	-	-	-	-	-	80.8	85.9	89.4	92.4	101.0	110.8
Growth Rate (%)	Primary	-	-	-	-	-	-	-	-	-	-2.2%	12.4%	29.7%	5.3%	-2.6%
	Secondary	-	-	-	-	-	-	-	-	-	4.1%	8.4%	-3.5%	5.6%	12.9%
	Tertiary	-	-	-	-	-	-	-	-	-	6.4%	4.0%	3.4%	9.4%	9.7%

Source: IMF and Agency on Statistics under President of the Republic of Tajikistan

3.3 Import and Export

Major import countries of Tajikistan are The Kyrgyz Republic at 132,491 thousand tons, China at 119,217 thousand tons and Turkey at 84,243 thousand tons. Major export country is Turkey at 76,613 thousand tons.

Source: MOT

FIGURE 3.1-1 MAJOR IMPORT AND EXPORT COUNTRIES

3.4 Poverty Level

The poverty rate of 78% in Khatlon Region where the DK Road is located is higher than Tajikistan's poverty rate of 64%. On the other hand, the poverty rate of 49% in Dushanbe City is much lower than that of Tajikistan. Poverty rate of residents along the DK Road especially in the Khatlon Region is quite high.

3.5 Number of Vehicles Registered

Number of vehicles registered in year 2010 to 2014 is shown in **Table 3.1-3**.

TABLE 3.1-3 NUMBER OF VEHICLES REGISTERED IN YEARS 2010 TO 2014

Area	Type of Vehicle	Number of Vehicle Registered (veh)					Growth Rate (%)
		2010	2011	2012	2013	2014	2014 - 2010
RRS	Passenger Car	293,676	310,554	329,016	350,353	367,189	5.7%
	Truck	37,395	35,424	36,346	36,942	39,345	1.3%
	Total	331,071	345,978	365,362	387,295	406,534	5.3%
	Persons/veh	-	-	5.6	5.3	-	-
Dushanbe City	Passenger Car	42,303	43,982	49,542	50,303	55,799	7.2%
	Truck	4,309	3,826	3,587	3,452	4,358	0.3%
	Total	46,612	47,808	53,129	53,755	60,157	6.6%
	Persons/veh	-	-	15.4	15.4	-	-
Khatlon Region	Passenger Car	73,735	73,563	74,958	79,728	84,386	3.4%
	Truck	8,131	6,735	7,307	6,868	6,934	-3.9%
	Total	81,866	80,298	82,265	86,596	91,320	2.8%
	Persons/veh	-	-	37.8	36.4	-	-
Kurgan-Tyube City	Passenger Car	51,990	51,493	52,888	57,146	60,518	3.9%
	Truck	4,307	4,715	5,287	3,272	4,059	-1.5%
	Total	56,297	56,208	58,175	60,418	64,577	3.5%
	Persons/veh	-	-	1.5	1.8	-	-

Source: MOT

4 TRANSPORT SECTOR OVERVIEW

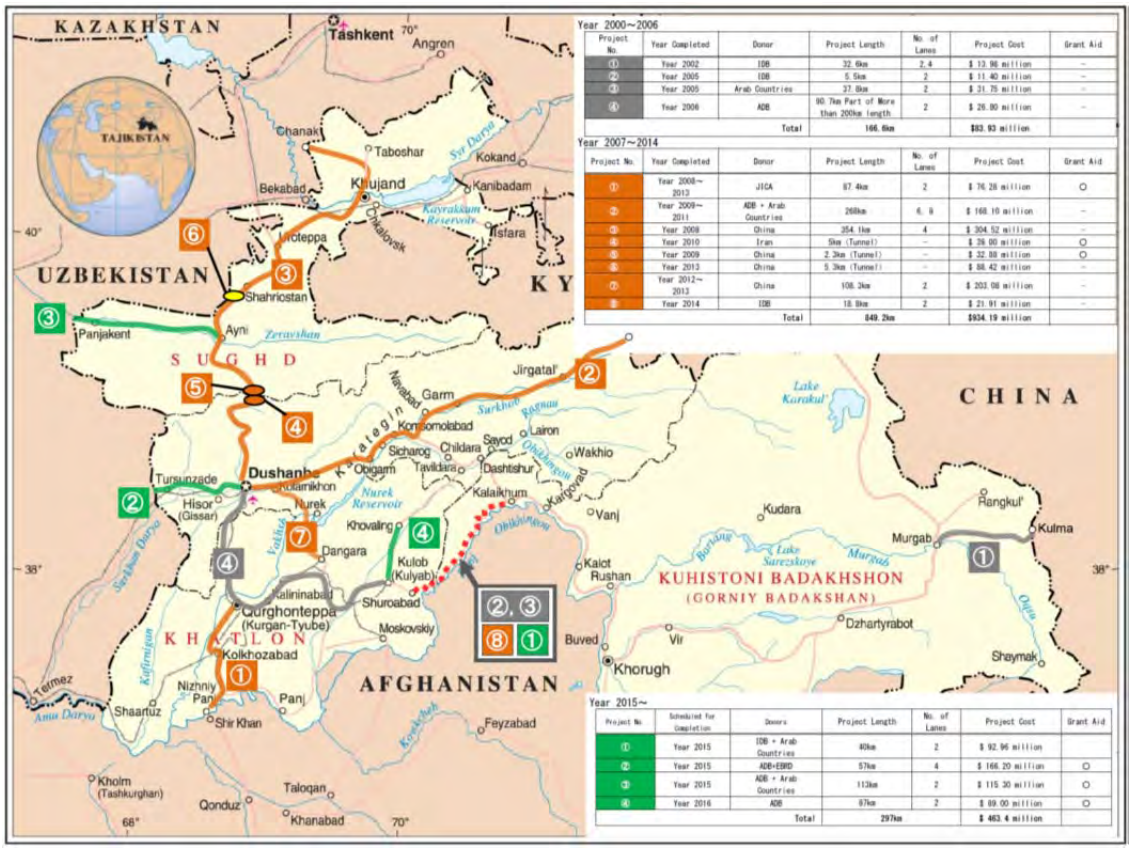
4.1 Organization of the Ministry of Transport

The Ministry of Transport (MOT) is responsible for road, rail and air transport. The central office has 90 staffs. Field offices comprise 6 State Enterprise of Transport Management (SETM) and 61 State Enterprise of Highway Maintenance (SEHM).

Gissar SETM → Rudaki SEHM
Kurgan-Tyube SETM → Khuroson SEHM
Bohtar SEHM

4.2 Road Sector

MOT is responsible for the 3 kinds of roads, namely (1) International Road, (2) National Road and (3) Local Road. About 8.6% to 11.1% of national budget was allocated to MOT. MOT allocated 4.2% to 5.4% of its budget to road maintenance. Past and present foreign-assisted road projects are shown in below;



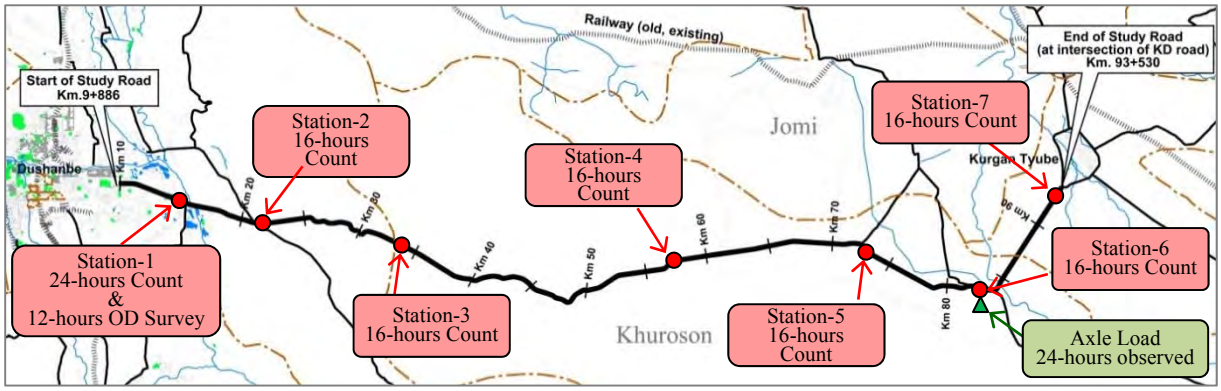
Source: MOT

Figure 4.2-1 PAST AND PRESENT FOREIGN – ASSISTED ROAD PROJECTS

5 TRAFFIC STUDY

5.1 Traffic Surveys Undertaken

The JICA Study Team has carried out the following traffic surveys: 1) Traffic Count Survey, 2) Roadside OD Interview Survey, 3) Axle Load Survey and 4) Travel Speed Survey under this project.

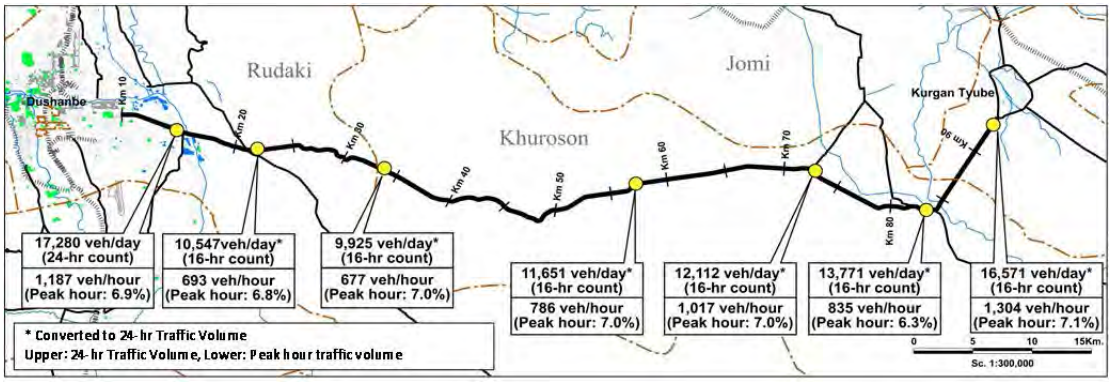


Source: JICA Study Team

FIGURE 5.1-1 TRAFFIC SURVEY STATION UNDER JICA STUDY

5.2 Traffic Volume

The result of traffic volume observed by the JICA Study Team is shown in **Figure 5.2-1**.

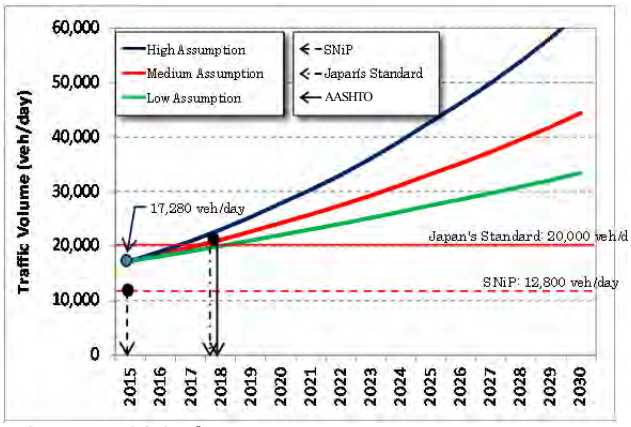


Source: JICA Study Team

FIGURE 5.2-1 TRAFFIC VOLUME AT TRAFFIC SURVEY STATIONS

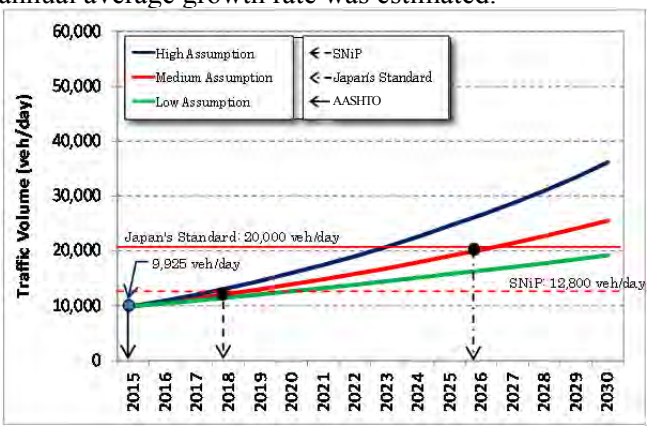
5.3 Traffic Demand Forecast

Future traffic volume of DK Road based on defined annual average growth rate was estimated.



Source: JICA Study Team

FIGURE 5.3-1 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-1 (DUSHANBE)



Source: JICA Study Team

FIGURE 5.3-2 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-3 (MOUNTAINOUS)

6 EXISTING DK ROAD CONDITIONS AND PROBLEMS

6.1 Number of Lanes and Cross-section

The number of lanes of the existing DK Road is shown in the **Table 6.1-1**.

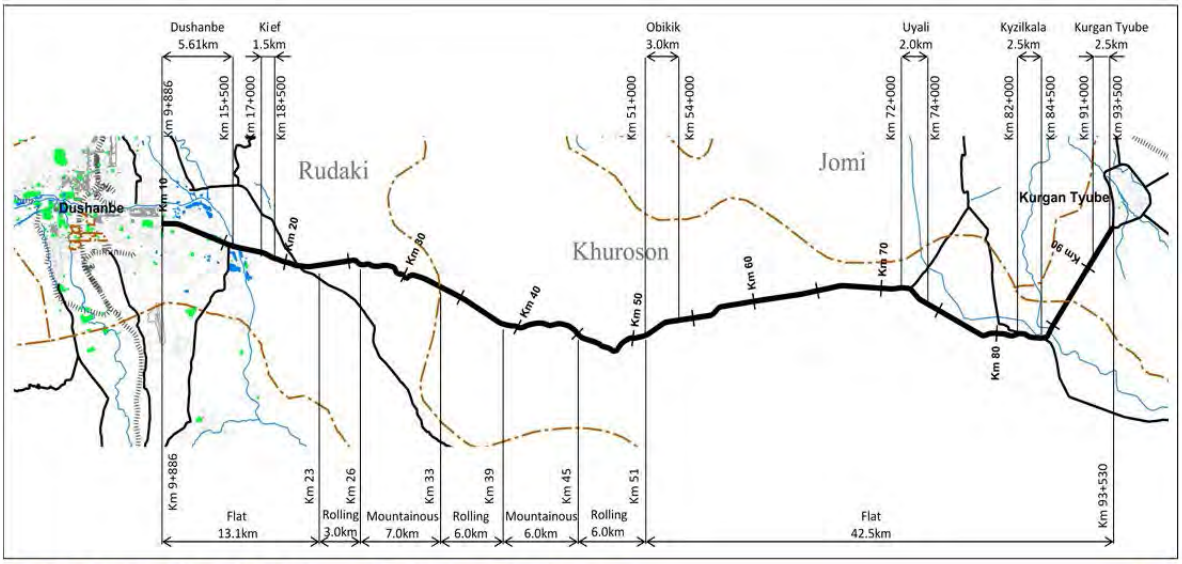
TABLE 6.1-1 LIST OF NUMBER OF LANES

Km	Number of Lanes	Length(Km)
Km.9+886(Start Point)～Km.15+030 (Within Dushanbe City)	4	5.14
Km.15+030～Km.93+530 (End Point)	2	78.50
	Total	83.64

Source : JICA Study Team

6.2 Horizontal Alignment and Vertical Alignment

In regards to the DK road horizontal alignment, if SNiP Class III is applied 15 sections of the road alignment need to be improved to comply with the minimum radius of curvature. As the result of the profile survey conducted from Km.23 to Km.45 of the existing DK road, at least 1.8 kms of the road section have gradients in excess of 5% for the rolling terrain and 3.8 kms of the road section have gradients in excess of 6% in the mountainous areas. Moreover, 3.2 kms of the road section in the rolling terrain and 9.7 kms in the mountainous areas have gradients in excess of 4%.



Number of Horizontal Curves Along the Alignment Requiring Geometric Improvement									Total
AH Standard	R > 350	OK	-	-	-	-	2	-	5
	R > 210	-	OK	-	OK	-	3	-	
	R > 80	-	-	OK	-	OK	-	-	
SNiP Class III	R > 600	OK	-	-	-	-	11	-	16
	R > 300	-	OK	-	OK	-	3	-	
	R > 100	-	-	2	-	OK	-	-	

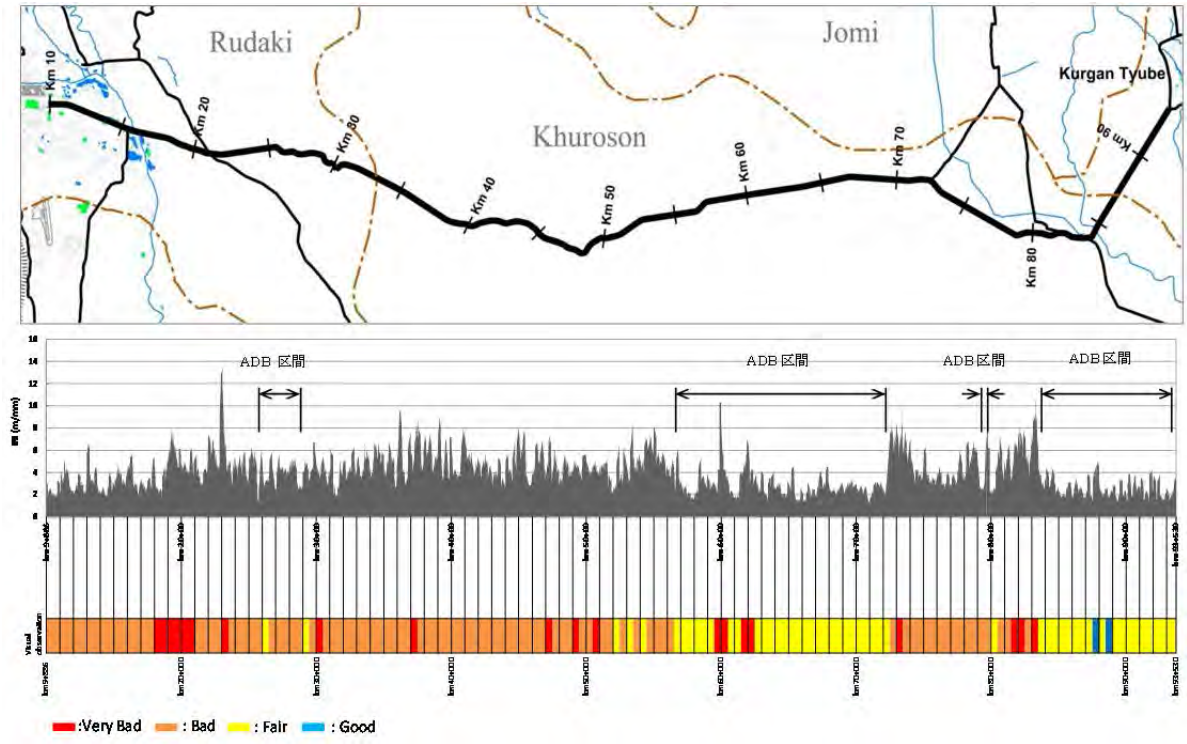
Profile: Length (km) of Road Section with Gradient Exceeding 5%, 6% or 7%									
Rolling	Over 5%	-	1.2	-	0.6	-	No Data	-	
Mountainous	6%- 7%	-	-	1.5	-	1.2	No Data	-	
	Over 7%	-	-	0.8	-	0.3	No Data	-	
SNiP	Over 4%	-	1.7	6.6	1.5	3.1	No Data	-	

FIGURE 6.2-1 EXISTING HORIZONTAL ALIGNMENT AND VERTICAL PROFILE ISSUES OF DK ROAD

6.3 Pavement Condition

6.3.1 Existing Pavement Conditions

Visual assessment was undertaken in accordance with the criteria shown in **Figure 6.3-1**.



Source: JICA Study Team

FIGURE 6.3-1 RESULTS OF VISUAL ASSESSMENT AND INTERNATIONAL ROUGHNESS INDEX (IRI)

6.3.2 Test Pitting Result

In order to investigate thickness of existing pavement structure and bearing value in terms of CBR of base courses and subgrade, test pitting was undertaken.

TABLE 6.3-1 RESULTS OF TEST PITTING

Material	THK (cm)	CBR(%)
Asphalt Concrete	30	-
Base Course	40	-
Sub-base Course	20	7,15,21
Asphalt	10	-
Base Course	20	
Sub-grade	-	17,15,15

TP-1

Material	THK (cm)	CBR(%)
Asphalt Concrete	20	-
Base Course	8	-
Asphalt Concrete	10	
Base Course	40	-
Sub-base Course	20	6,21,10
Asphalt	10	
Base Course		
Sub-grade	-	22,18,29

TP-2

Material	THK (cm)	CBR(%)
Asphalt Concrete	20	-
Base Course	40	-
Asphalt Concrete	5	-
Base Course	20	
Sub-grade	-	15,18,10

TP-3

Material	THK (cm)	CBR(%)
Asphalt Concrete	28	-
Base Course	46	-
Sub-grade	-	29,25,29

TP-4

Material	THK (cm)	CBR(%)
Asphalt Concrete	5	-
Base Course	60	-
Sub-grade	-	10,13,11

TP-5

Material	THK (cm)	CBR(%)
Asphalt Concrete	12	
Base Course	60	
Asphalt Concrete	10	
Base Course	30	
Sub-grade		11,10,8

TP-6

6.4 Bridges

A summary of existing bridges, based on bridge inventory along the DK road, a total of 16 bridges cross various road obstructions as follows:

- Major Rivers – Two bridges, the Kofarnihon River Bridge with a total length of 297.0m and the Vakhsh River Bridge with a total length of 333.0m.
- Small to Intermediate River – Six bridges.
- Irrigation Canal – Three bridges.
- Abandoned Railways – Four bridges.
- Interchange – One bridge.

6.5 Culverts and Flood Section

There are about 76 culverts (box culvert and pipe culvert) along the DK road. Interviews with SEHM and nearby residents indicated flooded areas in at least four road sections with three sections at culvert locations with insufficient flood discharge capacity and one location without cross-drainage facility.

CULVERT INVENTORY SUMMARY				
Terrain	Station (Km)		No. of Box Culverts (BC)	No. of Pipe Culverts (PC)
	From	To		
Flat	Km 09+886	Km 23+000	4	18
Rolling	Km 23+000	Km 26+000	1	3
Mountainous	Km 26+000	Km 33+000	2	10
Rolling	Km 33+000	Km 39+000	2	-
Mountainous	Km 39+000	Km 45+000	1	4
Rolling	Km 45+000	Km 51+000	4	4
Rolling	Km 51+000	Km 93+530	6	17

BOX CULVERT INVENTORY				
Box Culvert No.	Station (Km)	No. Barrel	Opening	
			Width (m)	Height (m)
BC-01*	Km 17 + 940	2	8.00	2.00
BC-02	Km 19 + 016	1	2.50	2.50
BC-03	Km 19 + 653	2	8.00	2.50
BC-04	Km 23 + 130	1	4.00	1.30
BC-05	Km 23 + 482	1	4.50	2.50
BC-06	Km 26 + 909	1	1.00	2.10
BC-07	Km 32 + 986	1	1.00	0.40
BC-08	Km 35 + 605	1	3.00	2.50
BC-09*	Km 36 + 089	1	3.85	2.60
BC-10	Km 44 + 547	1	4.00	3.00

BOX CULVERT INVENTORY				
Box Culvert No.	Station (Km)	No. Barrel	Opening	
			Width (m)	Height (m)
BC-11	Km 45 + 196	1	2.00	2.50
BC-12*	Km 45 + 869	1	2.50	3.25
BC-13	Km 47 + 584	1	3.90	1.60
BC-14	Km 47 + 740	1	3.90	2.50
BC-15	Km 60 + 886	1	1.00	0.45
BC-16	Km 61 + 193	1	1.00	0.45
BC-17	Km 73 + 575	1	2.50	2.00
BC-18	Km 75 + 027	1	3.00	2.50
BC-19	Km 82 + 895	1	2.00	2.50
BC-20	Km 87 + 642	1	1.05	0.50

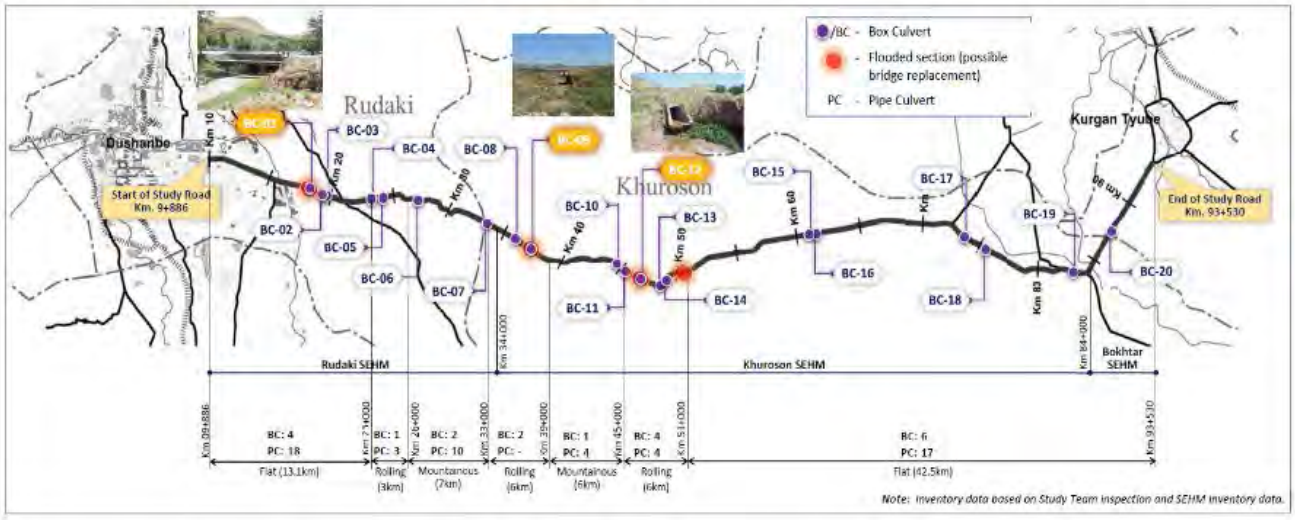


FIGURE 6.5-1 CULVERTS ALONG DUSHANBE – KURGAN-TYUBE ROAD

6.6 Traffic Safety Facilities

D-K Road has rolling and mountainous sections with deep valley on one side and flat sections with high embankment of more than 3 meters. Various types of guardrails such as W-beam Type guardrail and New Jersey Type Barrier should be provided.

6.7 Traffic Accidents

Location of traffic accidents from 2010 to 2014 is shown in **Figure 6.7-1**.

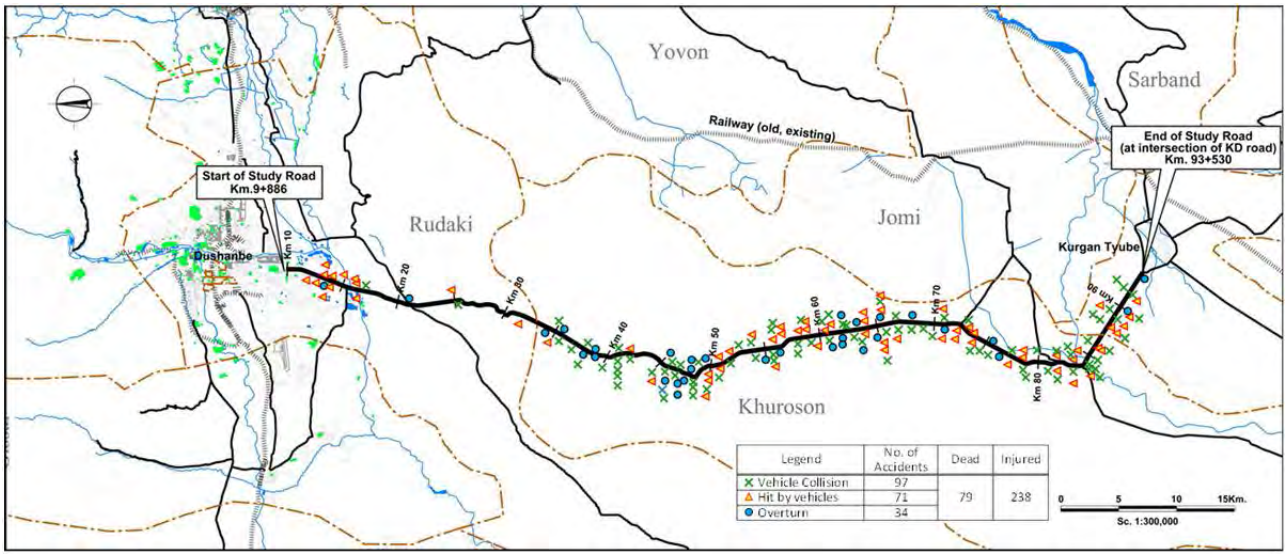


FIGURE 6.7-1 LOCATION OF TRAFFIC ACCIDENTS

7 ENVIRONMENTAL AND SOCIAL CONSIDERATION INFORMATION

7.1 Environmental Impact Assessment

In Tajikistan, the Environmental Impact Assessment (hereinafter referred to as "EIA") is specified in the "Law on Environmental Protection (2011)" and the "Law on Ecological Expertise (2011)". It is conducted as a component of the State Ecological Expertise (hereinafter referred to as "SEE"). Procedures and assessment system of EIA are prescribed in "Resolution No. 509, Procedure of Environmental Impact Assessment."

Committee on Environmental Protection under the Government of the Republic of Tajikistan (hereinafter referred to as "CEP") is the authority responsible for environmental protection such as ecological expertise of planned and ongoing activities, environmental monitoring and management of protected areas. The Committee also has the authority to issue the Conclusion of SEE based on the result of SEE.

7.2 Land Use along DK Road

Land Use along DK Road is shown in **Figure 7.2-1**.

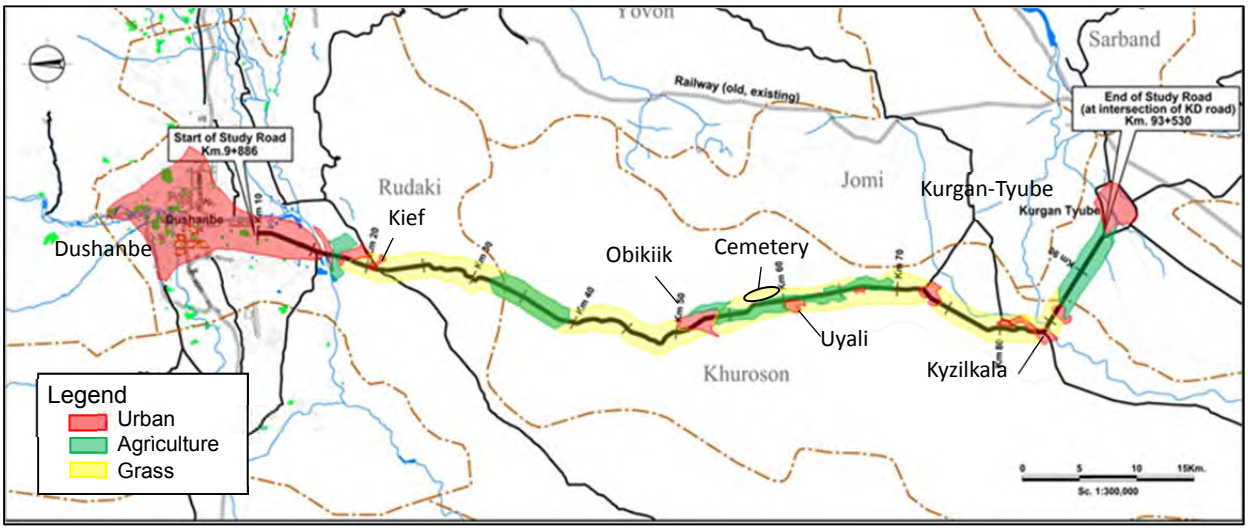


FIGURE 7.2-1 LAND USE MAP ALONG DK ROAD

7.3 ROW and Land Acquisition

The Right-of-Way of DK Road is 50m, and is 25m from the center of the road at both sides is secured as ROW. However, there are some buildings within ROW. Therefore, 30m is the recommended ROW for widening in the urban sections as the result of the survey and with the discussion with MOT.

7.4 Environmental and Social Consideration Issues

Some issues of environmental and social consideration to be taken into were identified in the survey as follows:

- Poverty rate in Khatlon Region where DK Road is located is quite high (78% in 2003) as mentioned in "3.1.4 Poverty Level". People living in poverty possibly exist around the DK road. Therefore, EIA study and initial baseline survey need to be carefully conducted.
- There is a cemetery with more than 15 graveyards on the slope of a hill between Obikiik and Uyali along the DK Road. Widening plan shall be advanced giving due consideration to the cemetery, although widening to the opposite side is now planned.
- There are lots of roadside stalls along the DK Road including a part of shops along the road. Some of them are not authorized to sell goods but they may be considered in planning the resettlement and compensation according to JICA Guidelines for Environmental and Social Considerations as provisions are unconfirmed in laws and regulations of Tajikistan at present.

8 DK ROAD IMPROVEMENT PLAN

8.1 Geometric Design Standards to be adopted

Comparison of geometric design standards of Asian Highway (AH) Standards, Tajikistan Design Standards (SNiP) and Japan's Standards are shown in **Table 8.1-1**.

TABLE 8.1-1 COMPARISON OF GEOMETRIC DESIGN STANDARDS

Road Class		2-Lane Road				4-Lane Road			
		AH Standard (Class II)	SNiP (Class II)	SNiP (Class III)	Japan's Standard (Type-3, Class 2&3)	AH Standard (Class I)	SNiP (Class I-a)	SNiP (Class I-b)	Japan's Standard (Type-3, Class 1&2)
Design Speed (km/hr)	Flat	80	120	100	60	100	150	120	80
	Rolling	60	100	80	-	80	120	100	-
	Mountainous	40~50	60	50	40~50	50	80	60	60
Lane Width (m)		3.50	3.75	3.50	3.25	3.50	3.75	3.75	3.50
Shoulder Width (m)		2.50	3.75	2.50	0.75	3.00	3.75	3.75	1.25
Center Median (m)		-	-	-	-	3.00	6.00	6.00	1.75
Minimum Horizontal Curve (m)	Flat	210	800	600	150	350	1,200	800	280
	Rolling	115	600	300	-	210	1,000	600	-
	Mountainous	50~80	150	100	60~100	80	300	150	150
Maximum Vertical Grade (%)	Flat	4	3.5	3.5	5	4	3.5	3.5	4
	Rolling	5	3.5	3.5	-	5	3.5	3.5	-
	Mountainous	6~7	4	4	6~7	6~7	4	4	5
Road Width (m)		40	100 (50)	100 (50)	-	40	100 (50)	100 (50)	-

Japan's Standard: National Road Type 3
- Traffic Volume: 4,000 - 20,000 veh/day, Flat section Class 2, Mountainous Section Class 3
- Traffic Volume: Over 20,000 veh/day, Flat section Class 1, Mountainous Section Class 2

Source: AH Standards, SNiP, Japan's Standards

8.2 Number of Lanes and Proposed Typical Cross Sections

Timing of widening to a 4-lane road (2-lane for each direction) was estimated and summarized in **Table 8.2-1.**

TABLE 8.2-1 TIMING OF WIDENING TO A 4-LANE ROAD AT TRAFFIC SURVEY STATION

Traffic Station	Timing of Widening to a 4-lane Road
Traffic Survey Station-1 (Km. 15)	Widening before the end of 2017
Traffic Survey Station-2 (Km. 22)	Widening before the end of 2022
Traffic Survey Station-3 (Km. 32)	Widening before the end of 2021
Traffic Survey Station-4 (Km. 57)	Widening before the end of 2021
Traffic Survey Station-5 (Km. 73)	Widening before the end of 2020
Traffic Survey Station-6 (Km. 84)	Widening before the end of 2019
Traffic Survey Station-7 (Km. 93)	Widening before the end of 2017

Source: JICA Study Team

If only the existing 2-lane road is improved, most of the sections suffer traffic congestion by the time of completion of the existing road improvement and widening to a 4-lane road must start during the implementation of the existing 2-lane road improvement. Thus, widening to a 4-lane road needs to be planned at this stage.
Nonetheless, the following 2 scenarios are studied;

DK ROAD DEVELOPMENT SCENARIO

Scenario-1: Only the existing 2-lane is improved.

Scenario-2: Widening to a 4-lane road (In addition to improvement of the existing 2-lane road. Additional 2-lane to make DK Road 4-lane is constructed.

Major civil work components of each scenario are as follows;

MAJOR CIVIL WORK COMPONENT

Scenario-1	− Pavement improvement − Reconstruction of deteriorated bridges − Construction of new bridges at flood section − Improvement/construction of box-culverts − Construction of roadside drainage − Provision of road safety facilities
Scenario-2	− Same works as Scenario-1 for the existing road − Construction of additional 2-lane road

8.2.1 Typical Cross Sections

(1) Typical Cross Section of Scenario-1

Typical cross section is shown in **Figure 8.2-1.**

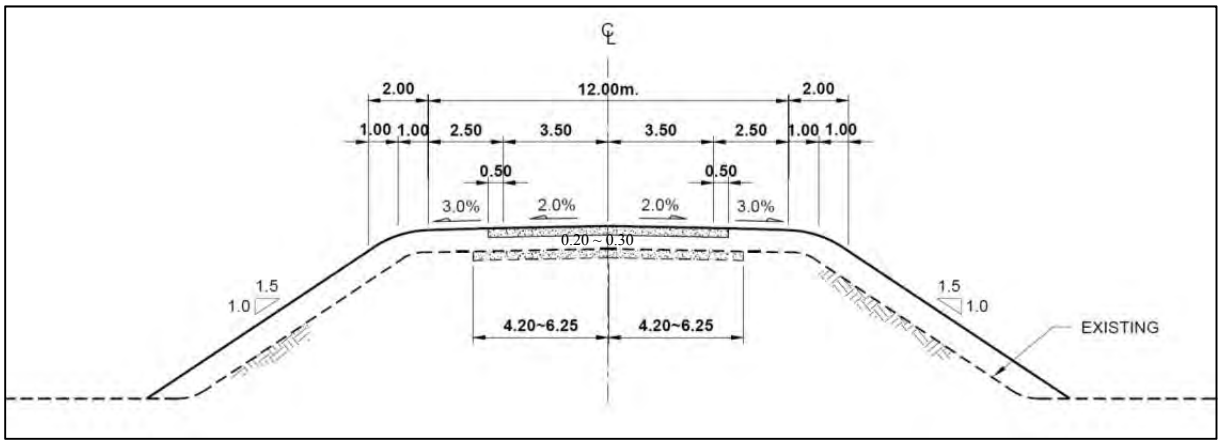


FIGURE 8.2-1 TYPICAL CROSS SECTION OF IMPROVEMENT OF EXISTING 2-LANE ROAD

(2) Typical Cross Section of Scenario-2

There are two (2) cases to be compared;

Case-1: The Center Line of a 4-lane road is selected at the same location as the existing center line. Both sides of the existing road are widened.

Case-2: The Center Line of a 4-lane road is selected at the existing pavement edge, thus only one side is widened.

The typical road cross section of a 4-lane road is shown in **Figure 8.2-2**.

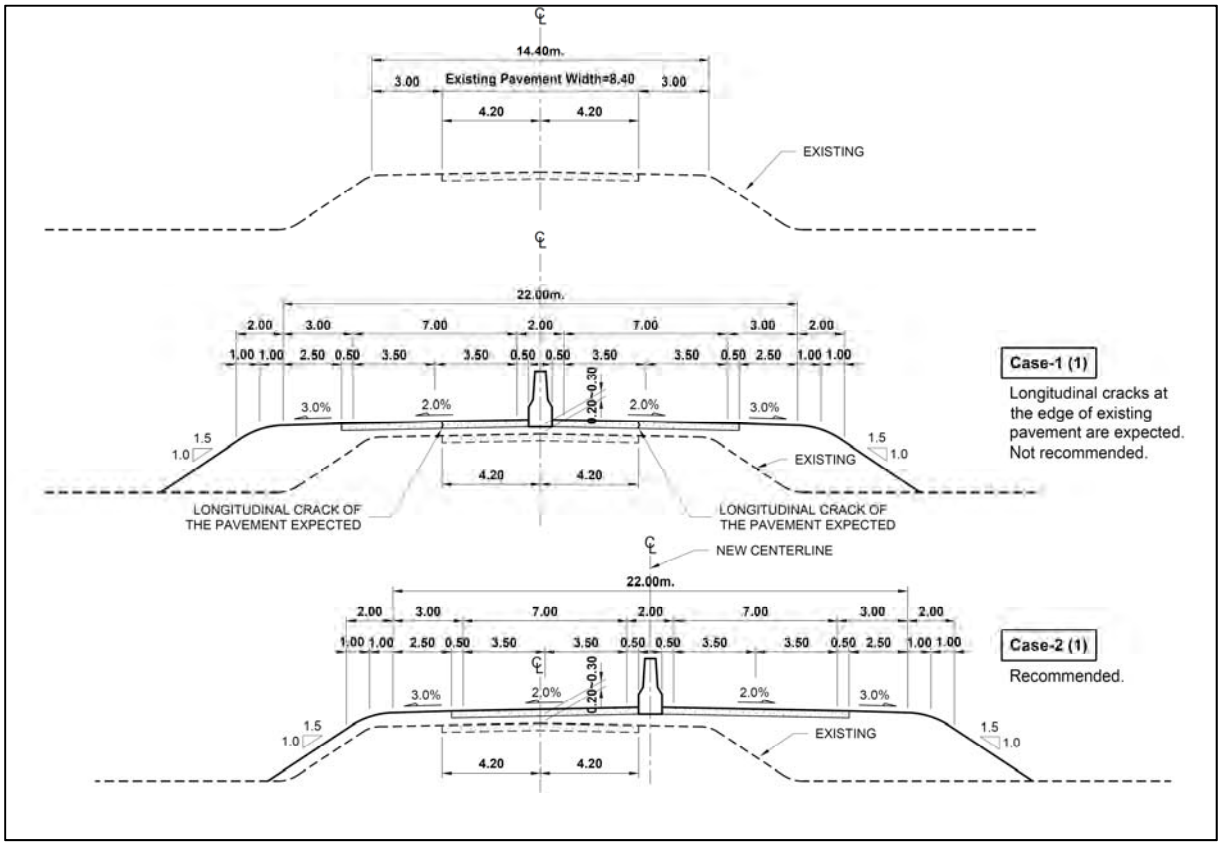


FIGURE 8.2-2 TYPICAL CROSS SECTION PATTERN-1: EXISTING PAVEMENT WIDTH=8.40M.

8.2.2 Widening Policy

As shown in **Figure 8.2-3**, valley at the rolling and mountainous terrains is quite deep, therefore, widening to mountain side is recommended to reduce the construction cost of high embankment. There is an old road space between Km. 55 to Km. 70 at the right side of the existing road where the space for road construction is available.

FIGURE 8.2-3 Widening to 4-Lane: Right Side, or Left Side or Both Side

8.3 Horizontal and Vertical Alignment Improvement

Geometric design standards of Asian Highway are recommended to be adopted for the DK Road.

AH STANDARDS (CLASS II) FOR HORIZONTAL CURVE AND VERTICAL GRADE

	Terrain		
	Flat	Rolling	Mountainous
Minimum Horizontal Curve (m)	350	210	80
Maximum Vertical Grade (%)	4	5	6 ~ 7

Source: AH Standards

8.4 Pavement Improvement of Existing Road and Additional 2-lane Road Pavement Structure

The pavement structure of additional 2-lane has been computed in **Table 8.4-1** in accordance with AASHTO Guide for Design of Pavement Structure, 1993 with cumulative ESAL values computed in 5.6 CBR Value of Sub-grade has been assumed to be 8 based on the excavation survey.

TABLE 8.4-1 REQUIRED THICKNESS OF PAVEMENT BASED ON ESAL AND CBR VALUE

	Section (Km)	Length (m)	Cumulative 18 kip ESAL (W18)	CBR value of Sub - grade	Required Pavement (SN)	AS surface Course (cm)	AS Binder Course (cm)	Base Course (cm)	Sub-base Course (cm)	Planed (SN)
Existing Road	9+886 - 15+018	5,132				5	5	Min. 20cm	-	
Addt'l 2-Lane Road	9+886 - 93+530	80,644	7,500,000	8	3.748	5	5	20	30	3.790>3.748 OK

Source: JICA Study Team

8.5 Bridge Improvement/Replacement of Existing Bridges and Additional 2-lane Bridges

The proposed improvement for existing bridges is summarized in **Table 8.5-1**.

TABLE 8.5-1 PROPOSED IMPROVEMENT MEASURES FOR EXISTING BRIDGES AND WIDENING TO 4-LANES

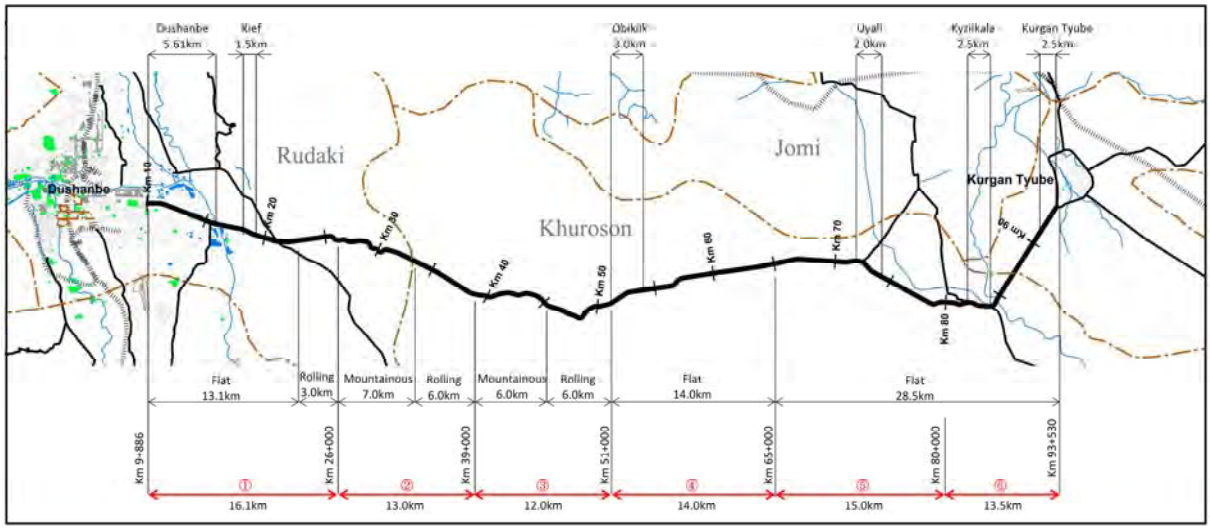
Br. No.	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
B-1	Minor repair	(Already 4-lane bridge)
B-7, B-11	Replace with new 4-lane bridge	
B-3	Replace with new bridge (Partially)	Construct additional 2-lane bridge
B-15, B-16	Replace with new bridge	
B-4, B-5, B-6, B-12	Replace with box culvert	
Others	Repair	

8.6 Characteristics of Each Segment

8.6.1 Characteristics of Each Segment

Characteristics of each segment are summarized in **Table 8.6-1** for Scenario-1, **Table 8.6-2** for Scenario-2.

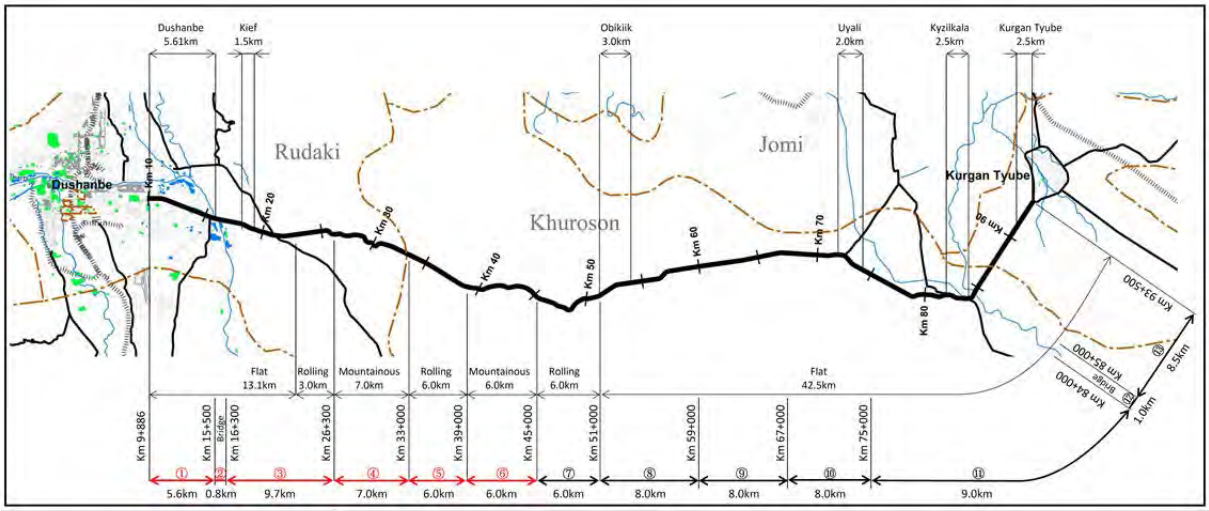
TABLE 8.6-1 CHARACTERISTICS OF EACH SEGMENT: SCENARIO-1



		Segment					
		①	②	③	④	⑤	⑥
Distance (km)		16.1km	13.0km	12.0 km	14.0 km	15.0 km	13.5 km
Terrain		Flat, Rolling	Mountainous, Rolling	Mountainous, Rolling	Flat	Flat	Flat
Urban Section		Dushanbe City (5.6km) Kief (1.5km) **Total = 7.1 km**	None	None	**Obikiik (3.0km)**	**Uyali (2.0km)**	Kyzilkala (2.5km) Kurgan Tyube (2.5km) **Total = 5.0km**
Traffic Volume (2015)		10,500 ~ 17,300 ~ above	9,900 ~ 10,500	9,900 ~ 11,600	11,600 ~ 12,200	12,200 ~ 13,700	13,700 ~ 11,600 ~ above
Pavement Condition		2nd Worst	Worst	Worst	2nd Worst	2nd Worst	2nd Worst
Traffic Accidents (Past 5 years)		17 (1.06/km)	12 (0.92/km)	37 (3.08/km)	41 (2.93/km)	38 (2.53/km)	57 (4.22/km)
Preliminary Scope of Civil Work	Pavement Work	Base Course: 38,000 m² A(1) Concrete Base Course (5cm) = 211,000 m² A(2) Concrete Base Course (5cm) = 211,000 m²	48,000 m² 162,000 m² 162,000 m²	34,000 m² 112,000 m² 112,000 m²	45,000 m² 138,000 m² 138,000 m²	46,000 m² 130,000 m² 130,000 m²	56,000 m² 166,000 m² 166,000 m²
	Bridge Work	Replacement: n=2, L=51m Rehabilitation: n=3, L=344m Bridge to Culvert: n=1, L=3m	n = 1, L = 16m n = 0, L = 0m n = 1, L = 4m	n = 2, L = 72m n = 0, L = 0m n = 1, L = 6m	n = 0, L = 0m n = 3, L = 103m n = 0, L = 0m	n = 1, L = 38m n = 1, L = 17m n = 1, L = 8m	n = 2, L = 24m n = 1, L = 130m n = 0, L = 0m
	Reconstruction of Culvert	n = 1 L = 3.0 m	n = 1 L = 4.0 m	n = 1 L = 6.0 m	-	n = 1 L = 8.0 m	-
Number of Buildings to be removed	Houses	0	0	0	0	0	0
	Buildings	0	0	0	0	0	0
	Other Structure	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Proposed Implementation Priority Group		1	3	3	2	2	1

Source: JICA Study Team

TABLE 8.6-2 CHARACTERISTICS OF EACH SEGMENT: SCENARIO-2



			Segment					
			①	②	③	④	⑤	⑥
Distance (km)			5.6 km	0.8 km	9.7 km	7.0 km	6.0 km	6.0 km
Terrain			Flat	Flat	Flat, Rolling	Mountainous	Rolling	Mountainous
Urban Section			**Dushanbe (5.6km)**	None	**Kief (1.5km)**	None	None	None
Traffic Volume (2015)			17,300 ~ above	10,500 ~ 17,300	9,900 ~ 10,500	9,900 ~ 10,500	9,900 ~ 11,600	9,900 ~ 11,600
Year Widening Required			2017	2017	2022	2021	2021	2021
Traffic Accidents (Past 5 years)			9 (1.61/km)	1 (1.25/km)	7 (0.72/km)	1 (0.10/km)	11 (1.83/km)	10 (1.66/km)
Preliminary Scope of Civil Work	Pavement Work	Existing 2-Lane	Base Course: 3,000m³ AC Concrete Binder Course (5cm) = 50,000m² AC Concrete Wearing Course (5cm) = 50,000m²	2,000m³ 5,000m² 5,000m²	35,000m³ 77,000m² 77,000m²	24,000m³ 54,000m² 54,000m²	22,000m³ 48,000m² 48,000m²	22,000m³ 48,000m² 48,000m²
		New 2-Lane	Base Course: 4,000m³ AC Concrete Binder Course (5cm) = 50,000m² AC Concrete Wearing Course (5cm) = 50,000m²	3,000m³ 5,000m² 5,000m²	45,000m³ 77,000m² 77,000m²	22,000m³ 54,000m² 54,000m²	17,000m³ 48,000m² 48,000m²	19,000m³ 48,000m² 48,000m²
	Bridge Work	Reconstruction of Existing Bridge	Replacement: n=0, L=0m Rehabilitation: n=1, L=14m Bridge to Culvert: n=0, L=0m	n=0, L=0m n=1, L=297m n=0, L=0m	n=2, L=51m n=1, L=33m n=1, L=3m	n=0, L=0m n=0, L=0m n=1, L=4m	n=1, L=16m n=0, L=0m n=0, L=0m	n=0, L=0m n=0, L=0m n=0, L=0m
		Cons'n of New 2-Lane Bridge	-	n=1, L=297m	n=1, L=18m	-	n=1, L=16m	-
	Culverts Work	Reconstruction (n), (m)	-	-	n=1, L=3m	n=1, L=4m	-	-
		Extension (n), (m)	-	-	n=4, L=19m	n=3, L=6m	n=1, L=4m	n=1, L=4m
	Side Drainage Length (m)		0m	0m	2,300m	5,600m	6,000m	5,800m
	Earthwork Work	Reconstruction (m³)	0	0	7,000	0	0	0
		Extension (m³)	46,000	33,000	664,000	1,215,000	127,000	527,000
Number of Buildings to be removed	Houses		0	0	1	0	0	0
	Buildings		0	2	5	0	2	1
	Other Structure		0	1	0	1	0	0
	Total		0	3	6	1	2	1
Proposed Implementation Priority Group			1	2	5	5	4	4

			Segment						
			⑦	⑧	⑨	⑩	⑪	⑫	⑬
Distance (km)			6.0 km	8.0 km	8.0 km	8.0 km	9.0 km	1.0 km	8.5 km
Terrain			Rolling	Flat	Flat	Flat	Flat	Flat	Flat
Urban Section			None	**Obikiik (5.6km)**	None	**Uyali (2.0km)**	**Kyzilkala (2.5km)**	None	**Kurgan Tyube (2.5km)**
Traffic Volume (2015)			9,900 ~ 11,600	9,900 ~ 11,600	11,600 ~ 12,200	11,600 ~ 12,200	12,200 ~ 13,700	13,700 ~ 16,600	13,700 ~ 16,600
Year Widening Required			2021	2021	2021	2020	2019	2017	2017
Traffic Accidents (Past 5 years)			18 (3.00/km)	32 (4.00/km)	29 (3.63/km)	18 (2.25/km)	30 (3.33/km)	2 (2.00/km)	34 (4.00/km)
Preliminary Scope of Civil Work	Pavement Work	Existing 2-lane	Base Course: 22,000 m³ AC Concrete Base Course (5cm) = 48,000 m² AC Concrete Base Course (5cm) = 48,000 m²	29,000 m³ 64,000 m² 64,000 m²	29,000 m³ 64,000 m² 64,000 m²	29,000 m³ 64,000 m² 64,000 m²	32,000 m³ 72,000 m² 72,000 m²	6,000 m³ 13,000 m² 13,000 m²	27,000 m³ 60,000 m² 60,000 m²
		New 2-lane	Base Course: 28,000 m³ AC Concrete Base Course (5cm) = 48,000 m² AC Concrete Base Course (5cm) = 48,000 m²	37,000 m³ 64,000 m² 64,000 m²	38,000 m³ 64,000 m² 64,000 m²	37,000 m³ 64,000 m² 64,000 m²	41,000 m³ 72,000 m² 72,000 m²	9,000 m³ 13,000 m² 13,000 m²	33,000 m³ 60,000 m² 60,000 m²
	Bridge Work	Reconstruction of Existing Bridge	Replacement: n=2, L=72m Rehabilitation: n=0, L=0m Bridge to Culvert: n=1, L=6m	n=0, L=0m n=3, L=103m n=0, L=0m	n=0, L=0m n=0, L=0m n=0, L=0m	n=1, L=38m n=0, L=0m n=0, L=0m	n=0, L=0m n=1, L=17m n=1, L=8m	n=0, L=0m n=1, L=330m n=0, L=0m	n=2, L=24m n=0, L=0m n=0, L=0m
		Const'n of New 2-lane Bridge	n = 2, L = 72m	n = 3, L = 95m	-	n = 1, L = 38m	-	n = 1, L = 330m	n = 2, L = 24m
	Culverts Work	Reconstruction (n), (m)	n = 1, L = 6m	-	-	-	n = 1, L = 8m	-	-
		Extension (n), (m)	n = 4, L = 16m	-	n = 2, L = 2m	n = 1, L = 3m	n = 4, L = 21m	-	n = 1, L = 1m
	Side Drainage Length		1,400 m	6,000 m	8,000 m	5,200 m	1,500 m	0 m	1,500 m
	Earthwork Work	Rough Cut Volume (m³)	0	18,000	0	0	22,000	0	28,000
		Rough Embankment Volume (m³)	625,000	195,000	264,000	265,000	170,000	92,000	150,000
Number of Building to be removed	Houses		0	1	0	2	3	0	0
	Buildings		2	4	4	7	6	1	6
	Other Structure		0	0	1	1	0	2	1
	Total		2	5	5	10	9	3	7
Proposed Implementation Priority Group			4	4	3	3	1	2	1

Source: JICA Study Team

8.6.2 Implementation Priority of Each Segment

(1) Implementation Priority of Scenario-1

Priority of each segment was evaluated as shown in **Table 8.6-3**.

TABLE 8.6-3 SEGMENT PRIORITIZATION OF SCENARIO-1

Evaluation Item	Point	Segment-①	Segment-②	Segment-③
Pavement Condition	10	2nd Worst (8 points)	Worst (9 points)	Worst (10 points)
Traffic Volume	10	2nd Highest (10 points)	3rd Highest (4 points)	Highest (4 points)
Total Point	20	18	13	14
Priority Group	Rank	1	4	3
	Priority	1st Priority Group	4th Priority Group	3rd Priority Group

Evaluation Item	Point	Segment-④	Segment-⑤	Segment-⑥
Pavement Condition	10	2nd Worst (7 points)	2nd Worst (7 points)	2nd Worst (6 points)
Traffic Volume	10	2nd Highest (8 points)	3rd Highest (8 points)	Highest (10 points)
Total Point	20	15	15	16
Priority Group	Rank	2	2	1
	Priority	2nd Priority Group	2nd Priority Group	1st Priority Group

Source: JICA Study Team

(2) Implementation Priority of Scenario-2

Priority of each segment was evaluated as shown in **Table 8.6-4**.

TABLE 8.6-4 SEGMENT PRIORITIZATION OF SCENARIO-2

Evaluation Item	Point	Segment-①	Segment-②	Segment-③	Segment-④	Segment-⑤
Present Traffic Level	10	17,300 ~ above (Highest) (10 Points)	10,500 ~ 17,300 (2nd highest) (9 Points)	9,900 ~ 10,500 (6th highest) (5 Points)	9,900 ~ 10,500 (6th highest) (5 Points)	9,900 ~ 11,600 (5th highest) (6 Points)
Year When a 4-lane Road Required	10	2017 (1st) (10 Points)	2017 (1st) (10 Points)	2022 (5th) (6 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)
Traffic Accidents	15	9 (1.61/km) (4th) (10 Points)	1 (1.25/km) (5th) (9 Points)	7 (0.72/km) (6th) (7 Points)	1 (0.10/km) (7th) (5 Points)	11 (1.83/km) (4th) (10 Points)
Pavement Condition of Existing Road	5	3rd Worst (3 Points)	3rd Worst (3 Points)	Worst (5 Points)	2nd Worst (4 Points)	2nd Worst (4 Points)
Total Points	40	33	31	23	21	27
Priority Group		1	2	5	5	4

Evaluation Item	Point	Segment-⑥	Segment-⑦	Segment-⑧	Segment-⑨	Segment-⑩
Present Traffic Level	10	9,900 ~ 11,600 (5th highest) (6 Points)	9,900 ~ 11,600 (5th highest) (6 Points)	9,900 ~ 11,600 (5th highest) (6 Points)	11,600 ~ 12,200 (4th highest) (7 Points)	11,600 ~ 12,200 (4th highest) (7 Points)
Year When a 4-lane Road Required	10	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2020 (3rd) (8 Points)
Traffic Accidents	15	10 (1.66/km) (4th) (10 Points)	18 (3.00/km) (3rd) (12 Points)	32 (4.00/km) (1st) (15 Points)	29 (3.63/km) (2nd) (14 Points)	18 (2.25/km) (3rd) (12 Points)
Pavement Condition of Existing Road	5	3rd Worst (3 Points)	2nd Worst (4 Points)	4th Worst (2 Points)	3rd Worst (3 Points)	3rd Worst (3 Points)
Total Points	40	27	29	30	30	30
Priority Group		4	4	3	3	3

Evaluation Item	Point	Segment-⑪	Segment-⑫	Segment-⑬
Present Traffic Level	10	12,200 ~ 13,700 (3rd highest) (8 Points)	13,700 ~ 16,600 (2nd highest) (9 Points)	12,200 ~ 13,700 (Highest) (10 Points)
Year When a 4-lane Road Required	10	2019 (2nd) (9 Points)	2017 (1st) (10 Points)	2017 (1st) (10 Points)
Traffic Accidents	15	30 (3.33/km) (2nd) (13 Points)	2 (2.00/km) (3rd) (12 Points)	34 (4.00/km) (1st) (15 Points)
Pavement Condition of Existing Road	5	2nd Worst (4 Points)	5th Worst (1 Points)	5th Worst (1 Points)
Total Points	40	34	32	35
Priority Group		1	2	1

Source: JICA Study Team

9 PRELIMINARY COST ESTIMATE

Roughly estimated project cost is summarized in **Table 9.1-1**.

TABLE 9.1-1 ROUGHLY ESTIMATED PROJECT COST

	Scenario-1	Scenario-2
Construction Cost	10,168 M. ¥en (466 M. TJS) (85.4 M. US$)	31,886 M. ¥en (1,461 M. TJS) (267.9 M. US$)
Detailed Design Cost	406 M. ¥en (18.6 M. TJS) (3.4 M. US$)	1,275 M. ¥en (58.4 M. TJS) (10.7 M. US$)
Construction Supervision Cost	610 M. ¥en (27.9 M. TJS) (5.1 M. US$)	1,913 M. ¥en (87.6 M. TJS) (16.1 M. US$)
ROW Acquisition/Compensation Cost	0	77 M. ¥en (3.56 M. TJS) (0.65 M. US$)
Total	11,184 M. ¥en (512.5 M. TJS) (93.9 M. US$)	35,151 M. ¥en (1,610.6 M. TJS) (295.4 M. US$)

Source: JICA Study Team

10 RECOMMENDATIONS

10.1 Needs of the Project

(1) The Project is the Government's High Priority Project.

Based on Tajikistan's 2015 National Development Strategy.

(2) The Project Constitutes a Part of Important International Highway.

Project road is a section of Asian Highway (AH) No. 7 and is also regarded as one of the most important corridors in CAREC connecting Tajikistan with Afghanistan and Pakistan in the south and the Kyrgyz Republic and Russia in the north.

(3) The Project Plays an Important Role as Domestic and International Commodity Transport Route Corridor.

Tajikistan is a landlocked country, and commodity transport highly relies on road transport.

(4) Traffic on the Project Road is Rapidly Increasing Requiring a 4-lane (or dual 2-lane) Road.

Current traffic volume is 17,300 ~ 9,930 veh./day with 7.5% to 9.3% past annual growth. With projected 7% per annum future growth, the road sections near Dushanbe City and Kurgan-Tyube City require widening to 4-lane road by 2017 and even least traffic section requires a widening by 2022.

(5) The Project Will Greatly Contribute to Reduction of Traffic Accidents.

- There are many traffic accidents and lives of road users have been lost. Major causes of traffic accidents are: i) over speeding and ii) risky overtaking.
- Over speeding should be controlled by strict enforcement of traffic rules and regulations and provisions of warning signs, rumble strips and traffic safety measures.
- Risky overtaking can be drastically reduced by widening to a 4-lane road, since overtaking utilizing the opposite direction lane can be eliminated.

(6) The Project Contributes to Reduction of Transport Cost and Travel Time.

- Pavement condition of existing 2-lane road is aggravating with International Roughness Index (IRI) exceeding 4.0 at most sections and 6.0 at many sections. High IRI requires higher transport cost. By improving the pavement condition, transport cost will be reduced and travel time will also be reduced.
- Lower transport cost and lesser travel time will contribute to economic and social development of the Region and the country as a whole.

(7) The Project Will Contribute to Reduction of Poverty Level of Khatlon Region.

The project is located mostly in Khatlon Region where the poverty level is high at 78% in 2003. Cheaper travel cost and faster travel time contributed by the project will activate economic activities and provide more opportunities for job chances and intention to produce more, all of which will contribute to reduction of poverty level of Khatlon Region.

10.2 Expected Project Effects

The project will bring about various effects as summarized in **Table 10.2-1.**

TABLE 10.2-1 EXPECTED EFFECTS OF THE PROJECT

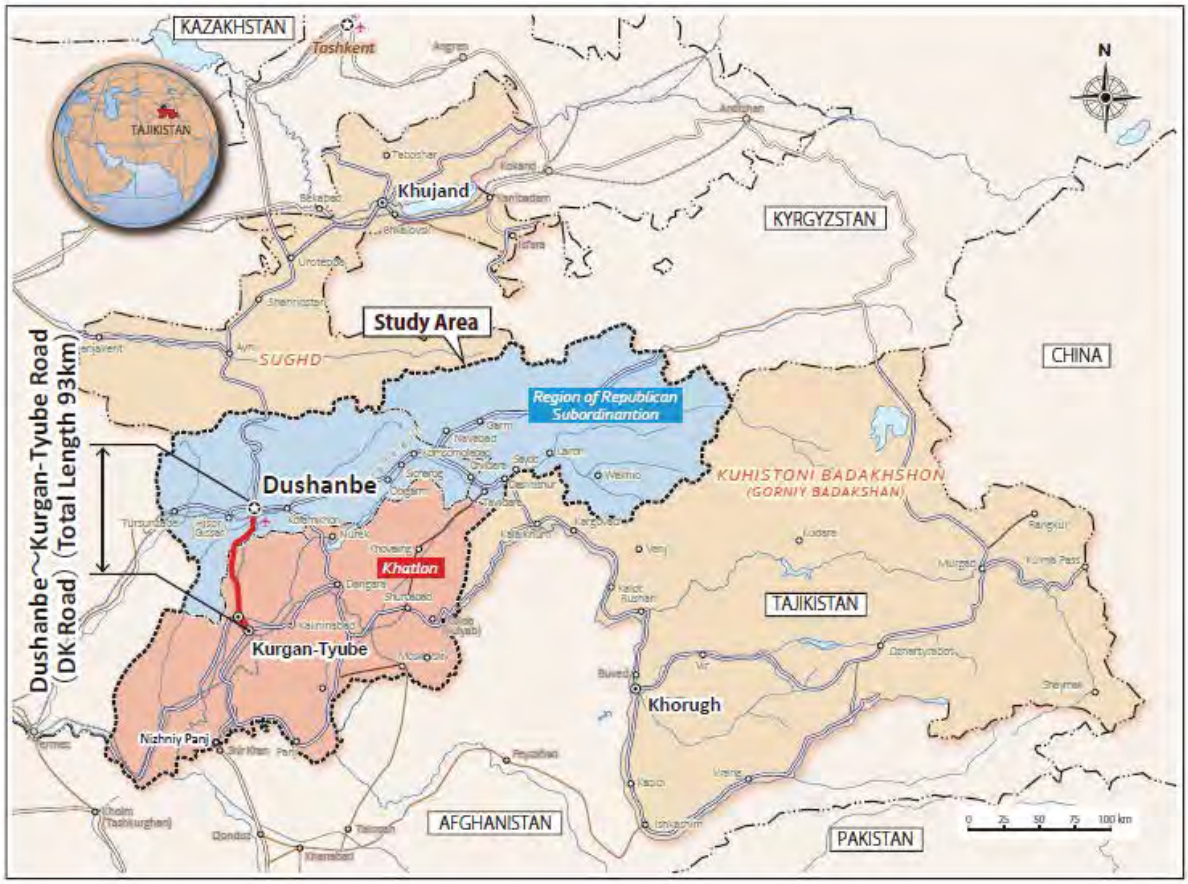
Favorable/ Adverse Effect	Description of Effects
Favorable Effect	1) Many people will be benefited by the project
	2) Reduction of road users' travel/travel time
	3) Reduction of travel cost
	4) Reduction of traffic accidents
	5) Reduction of poverty level of Khatlon Region
	6) Contribution to national/regional economic development
	7) Contribution to smoother commodity transport
Minor Adverse Effect	8) National environment will be slightly affected at mountainous section due to slope cutting, but effect is minor.
	9) Additional lands will be acquired. Mostly un-utilized mountain areas and agricultural lands.
	10) Some roadside vendors and fruits stands will be affected.

Source: JICA Study Team

10.3 Additional studies required

The additional studies including but not limited to the following items will be required for the realization of the Project.

- Topographic Survey
- Bridge Site Boring
- Existing Pavement Survey
- Material sources Survey
- Underground and Overhead Utilities Survey
- Irrigation Canal Survey
- Roadside Vendors and Fruit Stands Survey
- EIA and RAP
- Economic Evaluation



PROJECT LOCATION

Table of Contents

List of Figure and Table

Abbreviations

AASHTO	:	American Association of State Highway and Transportation Officials
ADB	:	Asian Development Bank
AH	:	Asian Highway
CBR	:	California Bearing Ratio
CEP	:	Committee of Environmental Protection
CIS	:	Commonwealth of Independent States
CLMG	:	State Committee of Land Management and Geodesy
DK Road	:	Dushanbe - Kurgan-Tyube Road
EBRD	:	European Bank for Reconstruction and Development
EIA	:	Environmental Impact Assessment
ESAL	:	Equivalent Single Axle Load
GBAR	:	Gorno-Badakhshan Autonomous Region
GDP	:	Growth Domestic Product
GOST	:	Gosudarstvennyy Standart (National Standard in Soviet Union)
HCM	:	Highway Capacity Manual
IDB	:	Islamic Development Bank
IMF	:	International Monetary Fund
IRI	:	International Roughness Index
IUCN	:	International Union for Conservation of Nature
JFPR	:	Japan Fund for Poverty Reduction
MDGs	:	Millennium Development Goals
MOT	:	Ministry of Transport
NATO	:	North Atlantic Treaty Organization
NDS 2015	:	National Development Strategy on the Republic of Tajikistan for the Period to 2015
NDS 2025	:	National Target Development Strategy for Transport Sector of the Republic of Tajikistan to the Year 2025
OD	:	Origin and Destination
OPEC	:	Organization of the Petroleum Exporting Countries
PC	:	Prestressed Concrete
PEE	:	Public Ecological Expertise
POPs	:	Persistent Organic Pollutants
PVC	:	Polyvinyl Chloride
RC	:	Reinforced Concrete
ROW	:	Right of Way
RRS	:	Regions of Republican Subordination
SEE	:	State Ecological Expertise
SEHM	:	State Enterprise of Highway Maintenance
SETM	:	State Enterprise of Transport Management
SNiP	:	Stroitelnye Normy i Pravila
USSR	:	Union of Soviet Socialist Republics

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Republic of Tajikistan (hereinafter referred to as "Tajikistan"), a landlocked country surrounded by China, the Kyrgyz Republic, Uzbekistan and Afghanistan, has about 30,000km of total road network. Of the total road network, the national road infrastructure in Tajikistan plays a very important role in the socio-economic activities of the country, with roughly 65% of freight transport and 99% of passenger transport depending on the road network.

The province of Khatlon, which borders with Afghanistan in the southern section of the country, is not only susceptible to the influence of the current conditions in Afghanistan but likewise has a high rate of poverty incidence of about 50% which has become a major concern in the country. In order to avoid destabilization in the neighboring areas due to the current conditions in Afghanistan and achieve both economic and social stability in the province of Khatlon, the improvement of the road network connection from the same province to the capital city of Dushanbe is an urgent issue that needs to be addressed. In particular, the Dushanbe-Nihzny Pyanj road section is one of the most important international road corridors in Tajikistan. To address the issue, JICA has undertaken through grant aid, the improvement of a section of this road from Kurgan-Tyube to Nihzny Pyanj.

The Dushanbe – Kurgan-Tyube road section (hereinafter referred to as the "DK road") of the Dushanbe-Nihzny Pyanj road, connects Dushanbe with Kurgan-Tyube (one of the largest city in Khatlon). However, the opening of the Nihzny Pyanj Bridge at the border with Afghanistan has led to a dramatic increase in the traffic volume in recent years which contributed much to the deterioration of the pavement condition of this road section. Due to insufficient information, majority of the road section was not considered in the previous maintenance projects, except for the road sections that were improved under ADB financing. Under such conditions, the Tajikistan government thus considers the improvement and widening of the existing DK road as an urgent priority.

This Study is undertaken to accumulate sufficient information that will be used to define the scope of work for the DK road improvement.

1.2 Objectives of the Study

The Study objectives are to:

- Investigate the current status of the road network development in the vicinity of the study area, the traffic demand and the necessary improvement works for the DK road,
- Review the development plans for the DK road that will contribute to a safe and smooth traffic flow in this area, and
- Propose to the Tajikistan government an effective and appropriate scope for the project feasibility.

The direction of Japan's possible aid for the project is proposed based on the above objectives.

1.3 Study Area

The Study area covers Khatlon province and the Regions of Republican Subordination (RRS), specifically the DK road section (approximately 93km of road length).

1.4 Scope of the Study

The scope of the Study includes:

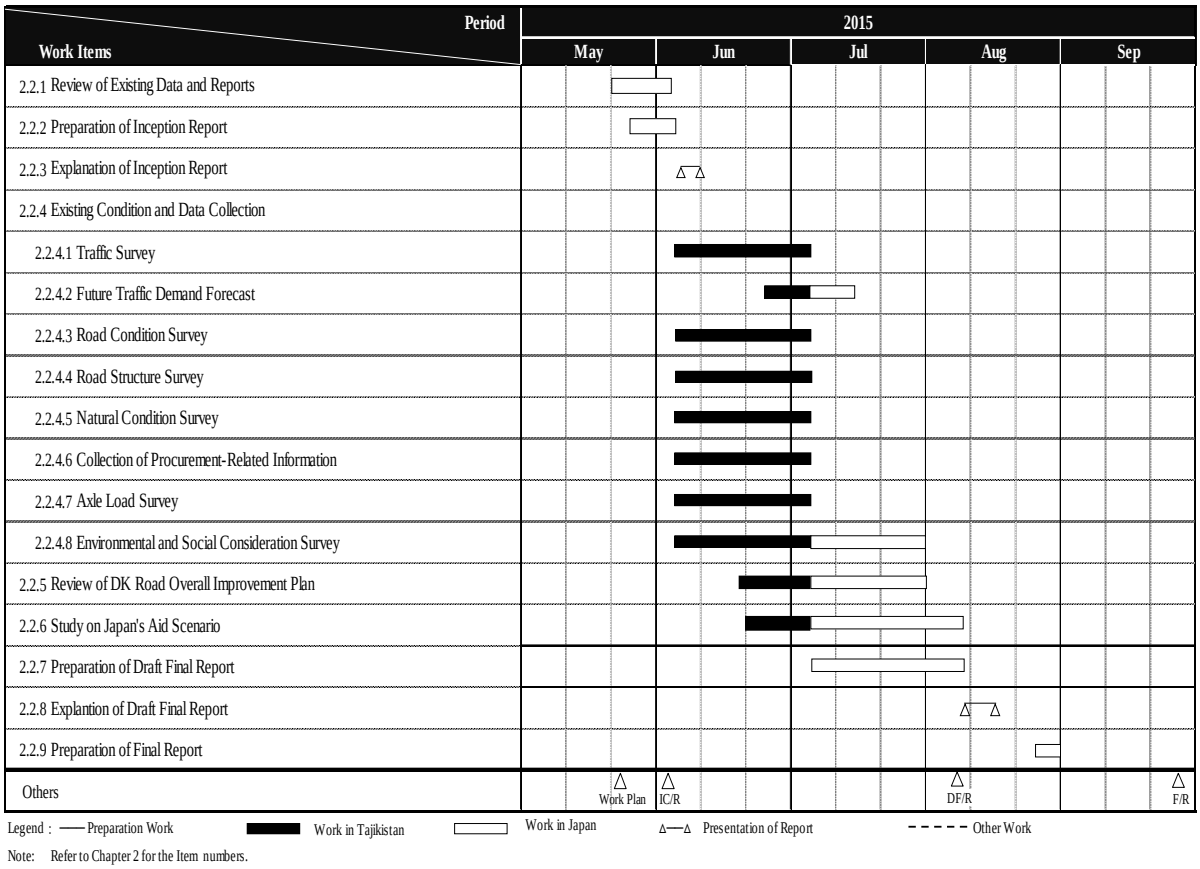
1) Review of Existing Data and Reports
2) Preparation of Inception Report
3) Explanation and Discussion of Inception Report
4) Traffic Survey

5) Future Traffic Demand Forecast
6) Road Condition Survey
7) Road Structure Survey
8) Natural Condition Survey
9) Collection of Procurement-Related Information
10) Axle Load Survey
11) Environmental and Social Consideration Survey
12) Review of DK Road Overall Development Plan
13) Study on Japan's Aid Scenario
14) Preparation of Draft Final Report
15) Explanation and Discussion of Draft Final Report
16) Preparation of Final Report

1.5 Study Schedule

The Study was undertaken from June 2015 to September 2015. **Table 1.5-1** presents the Study Implementation Schedule.

TABLE 1.5-1 STUDY IMPLEMENTATION SCHEDULE



Note: Refer to Chapter 2 for the Item numbers.

CHAPTER 2 NATIONAL DEVELOPMENT PLAN AND ROAD DEVELOPMENT PLAN

2.1 National Development Plan

Tajikistan has the "National Development Strategy on the Republic of Tajikistan for the Period to 2015 (herein after refer as NDS 2015" which is intended to provide an orderly long-term development process in accordance with the Millennium Development Goals (MDGs). The national development strategy for 2025 is under preparation.

Tajikistan faced serious economic difficulties in the early 1990s arising from the collapse of the USSR and the transitional period; end of budget subsides from the Soviet Union, aggravation of the socio-political situation and civil war, which cost the country's economy more than 7 billion USD. The NDS 2015 summarizes challenges of the development after collapse of USSR in 3 phases as shown below;

Initial Phase : Post-Soviet development 1992-1997	Creation of political stability and basic market mechanisms. GDP was shrunk, inflation rose to several thousand percent. The foundations were laid for development of the economy and in 1997 economic growth was achieved for the first time.
Second Phase : 1997-1999	After Post-Soviet development phase, strong economic growth indicators started in 2000, annual growth in GDP was 9.3%. Inflation fell to 6-7%, the country's poverty rate reduced from 81% in 1999 to 64% in 2003.
New Phase : after 1999	The economic development after 1999. Many of the problems of the transitional period were dealt with in the previous phases. The phase for market transformation.

Tajikistan's opportunities and advantage for economic developments are;

(1) hydropower resources and fresh water, (2) diverse mineral resources, (3) tourism development, (4) agricultural raw materials for industrial processing, (5) undeveloped land, (6) favorable conditions for cultivation of agricultural products, (7) advantageous strategic geographical position as a transit country, (8) inexpensive labor force,

Objective factors for economic development are;

(1) landlocked, (2) it is far away from developed world economic centers, (3) a shortage of accessibility to oil and gas deposit, (4) natural and geographical features, (5) small domestic market, (6) political instability in the surrounding region, (7) high transaction cost associated with natural disaster recovery efforts and combating drug trafficking and terrorism.

The structure of NDS is determined by the following 3 blocks by the contents of its sectoral sections.

a **Functional Block :** Public administration reform, macroeconomic development, investment climate, development of private sector, regional cooperation , integration into the global economy

b **Production Block** : food security, agro-industrial complex development, infrastructure, communications, energy, industry

c **Social Block :** health care system, education system, science, access to water supply, sanitation and housing, municipal services, social welfare, gender equality, environmental sustainability

In NDS 2015, (1) Reform of public administration, (2) Development of the private sector (3) Development of human potential are the national priorities. Infrastructure sector is classified in "Production Block" and put its priority on (1) Development as integrated system (2) More efficient use of available resources (3) Promotion of the most important investment projects, predominantly as part of private-sector initiatives. In the item (3), the NDS put a highway development to Afghanistan to gain access to Iran and Pakistan as a priority strategy.

2.2 Road Development Plan

Tajikistan has "National Target Development Strategy for Transport Sector of the Republic of Tajikistan to the Year 2025 (hereinafter referred as Transport NDS 2025)" to provide long-term development in the Transport Sector which includes a road development plan. The outline of the plan is described hereinafter;

2.2.1 Introduction

Tajikistan with the area of 143.1 thousand square km is situated in a mountainous area of Central Asia, at the cross road of the developed transport network of the north (Russia and Kazakhstan), to the south (large ports at the Indian Ocean coast), to the East (China) and to the West (European countries and Mediterranean region). Development of the transport infrastructure of the country commenced mainly in the 60-80s as an integral part of the USSR transport network, but it possessed features of a dead-end network and in the 90s, it rapidly degraded.

The transport sector of Tajikistan combines vehicular, railway and air transport modes. Due to specific physical and climatic condition of the country (93% of the territory is mountainous), the highway traffic has acquired higher strategic importance than other traffic modes especially for internal traffic and the coverage of the country regions.

2.2.2 The Program Objectives, Tasks and Principles

The NDS Transport 2025 is assuming a steady economic growth of 5% annually in a short-term and 4% annually in long-term period and sets following 2 objectives;

(1) Determination of measures for steady development of transport complex capable of meeting the population demand for an efficient and safe transportation services both for short- and long-term perspectives

(2) Building-up transport network infrastructure catering for economic and domestic needs of the population with due emphasis on the safety compliance.

The key direction of the development of each transportation mode is summarized in **Table 2.2-1**. In order to implement the plan, in short and medium-tem period, the rehabilitation program should be funded fully at the grants and soft loan of international financial institutions. In the long-term period, the resources for the reconstruction, construction and maintenance will be collected fully from the national road users.

TABLE 2.2-1 KEY DIRECTION OF EACH MODES IN NDS TRANSPORT 2025

Modes	Key Direction
Road transport	Private sector and local government potential will be used to replace the obsolete rolling stock Logistics centers (transport terminals) will be set up sponsored by easy terms loans and internal capital of the shipping entities;
Railway transport	Projects will be implemented by utilization of internal funds and attraction of private investment
Civil aviation transport	Air companies should be sustainable to purchase required equipment, aircrafts and helicopters at commercial interest rates Airports, terminals and air flight control units should be sustainable due to improvement of their services levels

2.2.3 Analysis of the Current Status of the Transport Sector

(1) General

Collapse of the Soviet Union had a negative impact on the basic economic indicators, thus from 1991 to 1996, the traffic volumes by all transport modes reduced 2.7 times, freight carriage went 3.7 times, passengers transport decreased 4.3 times. Since 1999, along with the economic growth, the traffic was increased. Especially due to constant growth of construction and industrial production, freight volume was increased. It is to note that almost 70% of the economic produce is transported by road. However, the effect of following problems is anxious to nullify positive economic trends of the last years;

- High deterioration (50-70%) of the assets. Rolling stock (trains, vehicles)
- Cost
- Non-completed construction projects and delay of commencement of operation
- Relatively low safety of the transport facility

Some key figures on traffic from 2008 to 2010.

Growth of freight transport: 2.5%～3.0%

Passenger transport: 4.5%～5.0%

(2) Vehicle Transport

More than 90% of internal freight and passenger carriage is by the vehicle transport. In 2010, the number of registered vehicles reached 297,272 units which is 111,588 units more than the number of registered vehicles in 2000. Amongst it, car is 80%, truck is 14% and bus is 6%.

(3) Railway Transport

In 1994, the “Tajik Railway” was set up under Dushanbe Department of Central Asian Railway with 679.9km of main lines, 61.5km are double-track. In 1999, Kurgan-Tyube - Kulyab（L=132 km） was commissioned. They have 3 railway networks but with no connection between them (they are connected through Uzbekistan and Turkmenistan). The freightage volume by railway in 2010 was 10,439.9 thousand tons including 4,927.1 thousand tons of transit carriage. Total passenger carriage is 593.8 thousand passengers of which 0.9％ was transit.

(4) Air Transport

4 international airports, 3 national air companies. 87% of international air flights go to the Russian Federation, 4.7% to China, 4.1% to Turkey. 705 of the international flights depart from Dushanbe airport, 28% from Khujand and 2% from Kurgan-Tyube.

(5) Motor Roads

The road network density is 187km/1000km2 which is considerably lower than the developed countries (600km/1000km2 in USA, 300km/1000km2 in Canada). Total length of public owned roads is 26,766km（2008）, of which 13,975km（52.2%） (5,291km of republican roads and 8684km of rural/feeder roads) is under MOT, 12,791km (47.8%) is under local government. According to the pavement type, 28% is paved roads, 45% is bituminous treated roads and 27% is gravel roads. Along Tajikistan border line, there are 25 border checkpoints (17 with Uzbekistan, 5 with the Kyrgyz Republic, 2 with Afghanistan and 1 with China).

2.2.4 Development Program

In the NDS Transport 2025, the development program is set by each transport sectors as below;

(1) Public Transportation

Investment program on logistic center, trolley bus depots related projects.

TABLE 2.2-2 DEVELOPMENT PROGRAMME FOR PUBLIC TRANSPORT

	2015	2020	2025	Total
Estimated cost (Million US$)	24.2	36.9	17.5	78.6

(2) Railway

- Restructuring plan of the State Unitary Enterprise "Tajik Railway" including to provide practical possibilities to attract private capital into various sphere of railway transport.
- Short Term
  Vahdat - Yavan, Dushanbe – Kurgan-Tyube, 150 Bridge Rehabilitation, Slope protection, locomotives
- Medium Term
  55 bridges reconstruction, Vhdat - Kramyk (to border of the Kyrgyz Republic), Kolhzabad - Nihzny Pyanj (to border of Afghanistan)
- Long Term
  North-South railway

TABLE 2.2-3 DEVELOPMENT PROGRAM ON RAILWAY

	2015	2020	2025	Total
Estimated cost (Million US$)	240.0	883.1	4,805.0	5,928.1

(3) Civil Aviation

- Short Term
  New terminal of Dushanbe International Airport
- Medium Term
  Privatization of airway companies, construction of the new air traffic control tower in Dushanbe, Reconstruction of runway in Kulyab airport, Extension of runway in Kurgan-Tyube airport and Reconstruction of Kurgan-Tyube international airport.
- Long Term
  Second runway of Dushanbe International Airport

TABLE 2.2-4 DEVELOPMENT PROGRAM ON CIVIL AVIATION

	2015	2020	2025	Total
Estimated Cost (Million US$)	130.0	67.5	45.5	243.0

(4) Road Network

Nearly 75% of republican roads have lost completely or partially their pavement and 60% to 80% of the road network cannot be maintained without expansive rehabilitation. At 48% of the road driving speed may not exceed 35km/h. **In the development program of road network, the section between Dushabe - Kurgan-Tyube particulary Dushanbe - Obikiik and Obikiik - Kyzilkala section is in the list of Long Term Program.**

- Short Term
  International Road (Vahdat-Dangara) including Chormagzak Tunnel, Obi Garm-Nurabad, Dushanbe Kulyab- Kalai Khumb, Dushanbe-Trusanzade
- Medium Term
  Rehabilitation of international and national roads of 734km Isfara-Kyrgyz Border, Isfara-Uzbekistan Border
- Long Term
  Rehabilitation of other roads and construction of road facilities

TABLE 2.2-5 DEVELOPMENT PROGRAM ON ROAD NETWORK

	2015	2020	2025	Total
Estimated Cost (Million US$)	501.7	680.0	1,152.2	2,333.9

CHAPTER 3 SOCIO-ECONOMIC AND PHYSICAL CONDITIONS OF THE PROJECT AREA

3.1 Socio-Economic Condition

Based on the statistical data issued by the Agency of Statistics under the President of the Tajikistan and the MOT, the socio-economic conditions are summarized by population, GDP, Import/Export (Domestic and National), Poverty and Number of Vehicles Registered.

3.1.1 Population

Number of population, growth rate and density is shown in **Table 3.1-1**. Characteristics of the population of the project area are as follows;

Republic of Tajikistan

- Population has reached at 8,161.0 thousand people in 2013.
- Population density is low at 57.2 persons/km^2.
- Highest population growth was recorded at 2.7% in 2010, then in a trend of decreasing and recorded at 2.2% in 2013.

Dushanbe City

- Population has reached at 775.8 thousand people in 2013, at 9.5% share of the whole Tajikistan.
- Population density is quite high at 7,758.0 persons/km^2.
- Highest population growth rate recorded in 2008 and 2010 at 2.8%, then in a trend of decreasing growth rate, 2.2% in 2012 and 1.5% in 2013.

Khoroson District

- Population has reached at 100.9 thousand persons in 2013, and shared 1.2% of the whole Tajikistan.
- Population growth rate from 2012 to 2013 was 3.2%, much higher than that of Dushanbe City.

Bokhtar District

- Population has reached at 214.8 thousand persons in 2013 and shared 2.6% of the Tajikistan.
- Population growth rate from 2012 to 2013 –recorded negative 7.2%.

Kurgan-Tyube City

- Population has reached at 101.6 thousand persons in 2013, a 1.2% share of the whole Tajikistan. Share of population is the same as that of Khoroson District.
- Population growth rate from 2012 to 2013 was quite high at 31.9%.

TABLE 3.1-1 NUMBER OF POPULATION IN THE REPUBLIC OF TAJIKISTAN (YEAR 2000 – YEAR 2013)

		Area (1,000 km2)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Population (1,000 persons)	Republic of Tajikistan	142.6	6,264.6	6,371.2	6,487.1	6,598.8	6,718.9	6,842.2	6,965.5	7,096.9	7,250.8	7,417.4	7,621.2	7,807.2	7,987.4	8,161.1
	GBAR	64.1	207.4	208.3	208.8	209.5	206.8	206.4	206.3	203.1	203.7	204.8	206.5	208.5	210.2	212.1
	Sogd Region	25.2	1,901.8	1,928.1	1,954.6	1,983.3	2,015.8	2,047.9	2,079.5	2,113.8	2,153.4	2,197.9	2,247.6	2,298.8	2,349.0	2,400.6
	Khatlon Region	24.6	2,198.4	2,236.2	2,280.7	2,323.0	2,368.4	2,413.2	2,457.6	2,504.6	2,559.3	2,618.3	2,698.6	2,765.8	2,831.7	2,898.6
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	97.8	100.9
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	231.4	214.8
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	77.0	101.6
	RRS	28.6	1,377.6	1,407.0	1,438.0	1,466.1	1,497.9	1,530.4	1,564.1	1,601.2	1,641.2	1,685.2	1,737.4	1,786.1	1,832.2	1,874.0
	Dushanbe City	0.1	579.4	591.6	605.0	616.9	630.0	644.3	658.0	674.2	693.2	711.2	731.1	748.0	764.3	775.8
Growth Rate (%)	Republic of Tajikistan	-	-	1.7%	1.8%	1.7%	1.8%	1.8%	1.8%	1.9%	2.2%	2.3%	2.7%	2.4%	2.3%	2.2%
	GBAR	-	-	0.4%	0.2%	0.3%	-1.3%	-0.2%	0.0%	-1.6%	0.3%	0.5%	0.8%	1.0%	0.8%	0.9%
	Sogd Region	-	-	1.4%	1.4%	1.5%	1.6%	1.6%	1.5%	1.6%	1.9%	2.1%	2.3%	2.3%	2.2%	2.2%
	Khatlon Region	-	-	1.7%	2.0%	1.9%	2.0%	1.9%	1.8%	1.9%	2.2%	2.3%	3.1%	2.5%	2.4%	2.4%
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2%
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-7.2%
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.9%
	RRS	-	-	2.1%	2.2%	2.0%	2.2%	2.2%	2.2%	2.4%	2.5%	2.7%	3.1%	2.8%	2.6%	2.3%
	Dushanbe City	-	-	2.1%	2.3%	2.0%	2.1%	2.3%	2.1%	2.5%	2.8%	2.6%	2.8%	2.3%	2.2%	1.5%
Density (persons/km^2)	Republic of Tajikistan	142.6	43.9	44.7	45.5	46.3	47.1	48.0	48.8	49.8	50.8	52.0	53.4	54.7	56.0	57.2
	GBAR	64.1	3.2	3.2	3.3	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3
	Sogd Region	25.2	75.5	76.5	77.6	78.7	80.0	81.3	82.5	83.9	85.5	87.2	89.2	91.2	93.2	95.3
	Khatlon Region	24.6	89.4	90.9	92.7	94.4	96.3	98.1	99.9	101.8	104.0	106.4	109.7	112.4	115.1	117.8
	Khoroson District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bokhtar District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kurgan-Tyube City	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	RRS	28.6	48.2	49.2	50.3	51.3	52.4	53.5	54.7	56.0	57.4	58.9	60.7	62.5	64.1	65.5
	Dushanbe City	0.1	5,794.0	5,916.0	6,050.0	6,169.0	6,300.0	6,443.0	6,580.0	6,742.0	6,932.0	7,112.0	7,311.0	7,480.0	7,643.0	7,758.0

Source: Agency on Statistics under President of the Republic of Tajikistan

3.1.2 Economic Development (GDP)

Gross Domestic Product (herein after GDP) in Tajikistan is shown in **Table 3.1-2**. Characteristics of the GDP of Tajikistan are as follows;

- GDP at constant price reached at 199.0 Million Somoni in 2013.
- GDP growth rate was quite high at 8.3% to 10.6% between 2000 and 2004. It reduced from 7.9% to 6.7% between the 2005 and 2008, though economic growth level is still high.
- Although GDP growth rate was reduced to 3.9% in the year 2009, it has bounced back to 6.5% to 7.4% between 2010 and 2013.
- Sectoral shares for the 2013 were as follows: 21.1% for the primary sector, 23.2% for the secondary sector and 55.7% for the tertiary sector.

TABLE 3.1-2 GDP IN TAJIKISTAN FROM 2000 TO 2013

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GDP (Constant Price at Million Somoni)		75.0	82.0	90.0	99.0	109.0	117.0	125.0	134.0	145.0	151.0	161.0	172.0	185.0	199.0
Growth Rate (%)		8.3%	10.2%	9.1%	10.2%	10.6%	6.7%	7.0%	7.8%	7.9%	3.9%	6.5%	7.4%	7.5%	7.4%
Sectoral Economic Output	Primary	-	-	-	-	-	-	-	-	28.7	28.1	31.6	40.9	43.1	42.0
	Secondary	-	-	-	-	-	-	-	-	35.5	37.0	40.1	38.7	40.9	46.2
	Tertiary	-	-	-	-	-	-	-	-	80.8	85.9	89.4	92.4	101.0	110.8
Growth Rate (%)	Primary	-	-	-	-	-	-	-	-	-	-2.2%	12.4%	29.7%	5.3%	-2.6%
	Secondary	-	-	-	-	-	-	-	-	-	4.1%	8.4%	-3.5%	5.6%	12.9%
	Tertiary	-	-	-	-	-	-	-	-	-	6.4%	4.0%	3.4%	9.4%	9.7%

Source: IMF and Agency on Statistics under President of the Republic of Tajikistan

3.1.3 Import and Export

Import and export volume in Tajikistan-related counties and major import and export countries are shown in **Table 3.1-3**, **Table 3.1-4** and **Figure 3.1-1**.

Major import countries of Tajikistan are The Kyrgyz Republic at 132,491 thousand tons, China at 119,217 thousand tons and Turkey at 84,243 thousand tons. Major export country is Turkey at 76,613 thousand tons.

TABLE 3.1-3 IMPORT VOLUME FROM OTHER RELATED COUNTRIES

Unit: 1,000 Ton

Name of countries	2011	2012	2013	2014
China	896,509	108,326	1,407,196	119,217
The Kyrgyz Republic	1,506,945	917	282,632	132,491
Uzbekistan	87,970	20,866	40,817	6,228
Russia	179,985	22,215	217,957	26,947
Other CIS Countries	222,586	148,191	238,593	36,182
Europe	17,039	32,016	31,215	11,676
Turkey	519,308	72,978	831,745	84,243
Afghanistan	4,082	2,207	6,861	36,221
Middle East Asia	222,586	148,191	238,593	36,182

CIS: Commonwealth of Independent States (The Kyrgyz Republic, Kazakhstan, Uzbekistan, Turkmenistan, Russia, Ukraine, Belorussia, Moldova, Armenia, Azerbaijan)

Source: MOT

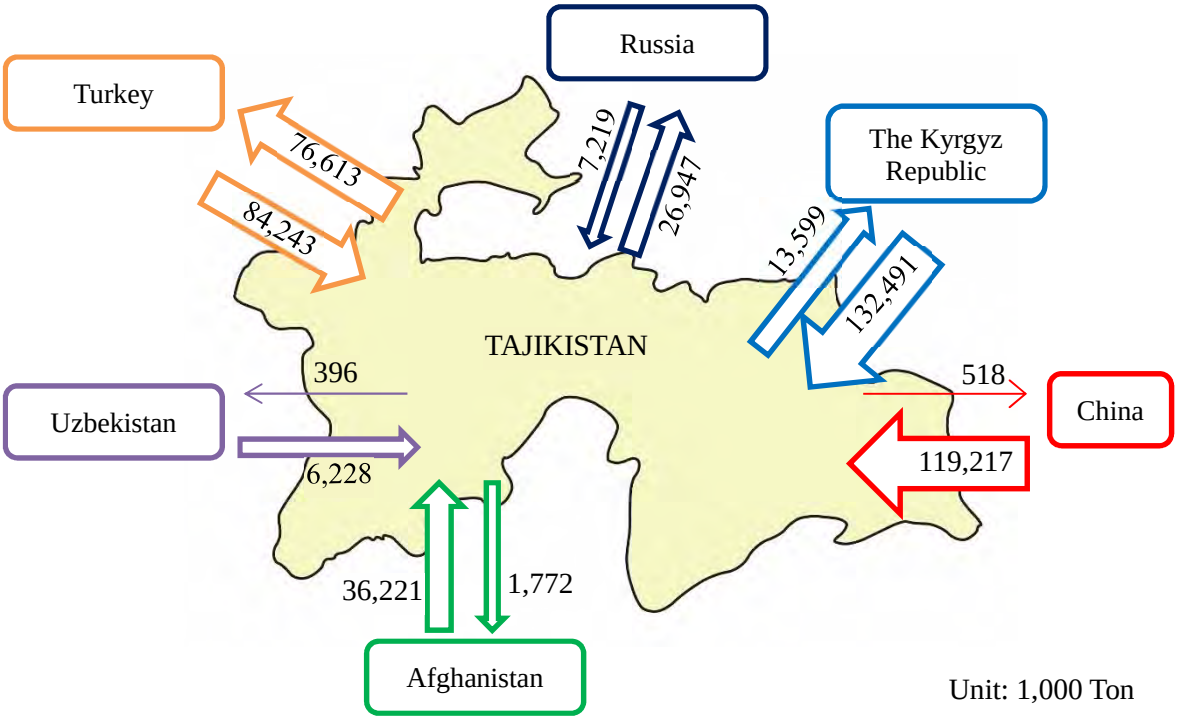
TABLE 3.1-4 INDICATOR OF EXPORT VOLUME TO OTHER RELATED COUNTRIES

Unit: 1,000 Ton

Name of countries	2011	2012	2013	2014
China	288	883	182	518
The Kyrgyz Republic	30,841	7,119	153,928	13,599
Uzbekistan	3,246	1,562	9,213	396
Russia	6,883	2,351	9,992	7,219
Other CIS Countries	33,281	20,780	234,241	7,627
Europe	556	5,529	4,171	769
Turkey	210,342	81,480	103,398	76,613
Afghanistan	572	696	1,296	1,772
Middle East Asia	33,281	20,780	234,241	7,627

CIS: Commonwealth of Independent States (The Kyrgyz Republic, Kazakhstan, Uzbekistan, Turkmenistan, Russia, Ukraine, Belorussia, Moldova, Armenia, Azerbaijan)

Source: MOT



Source: MOT

FIGURE 3.1-1 MAJOR IMPORT AND EXPORT COUNTRIES

3.1.4 Import and Export at Tajikistan/Afghanistan Boarder

Import and export made through Tajikistan/Afghanistan border is shown in **Table 3.1-5.** Number of transport and volume of commodities had decreased in 2013 and 2014. The reason of decrease in the number of vehicle and volume of commodities maybe as follows;

Import

- Until 2014 Tajikistan was importing cement in a huge amount from Pakistan through Afghanistan because domestic production of cement was not enough for the country. In 2014, a big cement plant started operation in Yavan District (Kurgan-Tyube zone). With the operation of this big cement plant, import of cement from Pakistan through Afghanistan decreased.

- Tajikistan was importing potatoes, onions and other vegetables through this border, but with the increased of production of domestic agricultural foods in Tajikistan, the import of vegetables decreased.

Export

- Tajikistan has been exporting cotton, however, due to the reduction of cotton field in the Country export volume reduced.

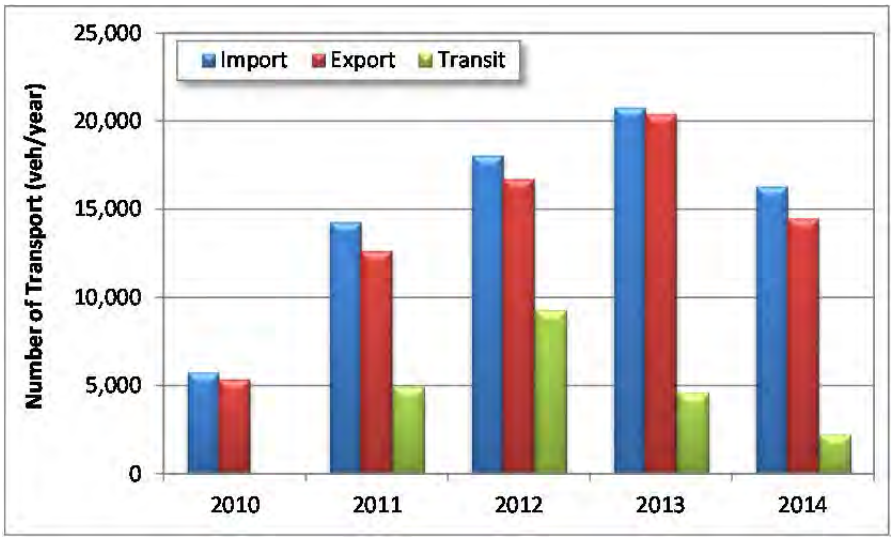
Transit

- Commodities needed by NATO Force stationed in Afghanistan have been transported through Tajikistan. Transit commodities started to decrease with the reduction of NATO Force in Afghanistan.

TABLE 3.1-5 IMPORT, EXPORT AND TRANSIT CROSSING THROUGH AFGHANISTAN BORDER

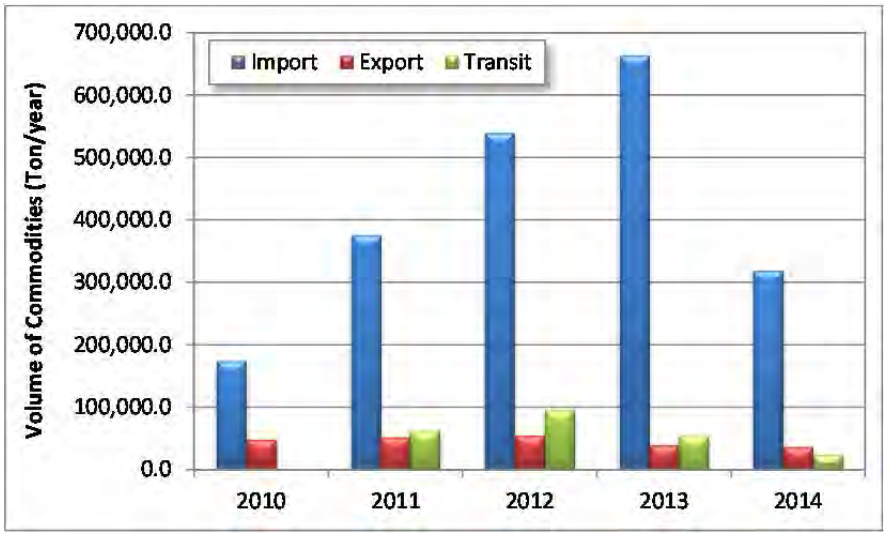
Year		Import			Export			Transit		
		Number of transport (veh)	Volume of Commodities (ton)	Number of Passengers (persons)	Number of transport (veh)	Volume of Commodities (ton)	Number of Passengers (persons)	Number of transport (veh)	Volume of Commodities (ton)	Number of Passengers (persons)
Volume	2010	5,743	173,845.6	-	5,337	48,075.2	-	-	-	-
	2011	14,289	375,578.8	14,110	12,641	51,873.0	13,703	4,934	62,452.1	-
	2012	18,053	539,469.3	16,399	16,723	54,804.0	16,865	9,276	95,911.9	-
	2013	20,777	663,837.6	8,178	20,410	39,157.9	8,241	4,593	53,758.0	-
	2014	16,291	318,774.0	9,614	14,483	36,685.2	8,703	2,212	23,588.0	-
Growth Rate (%)	2011-2010	148.8%	116.0%	-	136.9%	7.9%	-	-	-	-
	2012-2011	26.3%	43.6%	16.2%	32.3%	5.7%	23.1%	88.0%	53.6%	-
	2013-2012	15.1%	23.1%	-50.1%	22.0%	-28.5%	-51.1%	-50.5%	-44.0%	-
	2014-2013	-21.6%	-52.0%	17.6%	-29.0%	-6.3%	5.6%	-51.8%	-56.1%	-

Source: MOT



Source: MOT

FIGURE 3.1-2 NUMBER OF VEHICLES CROSSING TAJIKISTAN / AFGHANISTAN BORDER (2010 – 2014)



Source: MOT

FIGURE 3.1-3 VOLUME OF COMMODITIES CROSSING TAJIKISTAN / AFGHANISTAN BORDER (2010 – 2014)

3.1.5 Poverty Level

Poverty level in 2003 is shown in **Table 3.1-6**. The poverty rate of 78% in Khatlon Region where the DK Road is located is higher than Tajikistan's poverty rate of 64%. On the other hand, the poverty rate of 49% in Dushanbe City is much lower than that of Tajikistan. Poverty rate of residents along the DK Road especially in the Khatlon Region is quite high.

TABLE 3.1-6 SUMMARY OF POVERTY LEVEL

Region	Population, 2003 (1,000 persons)	Poverty Population, 2003 (1,000 persons)	Overall poverty rate	Poverty reduction rate, 1999-2003
GBAR	197	165	84%	-13%
Sogd Region	2,123	1,359	64%	-15%
Khatlon Region	2,169	1,692	78%	-13%
RRS	1,553	699	45%	-26%
Region Total	6,042	3,915	65%	-20%
Dushanbe City	630	309	49%	-12%
Total	6,672	4,270	64%	-18%

Source: Agency on Statistics under President of the Republic of Tajikistan

3.1.6 Number of Vehicles Registered

Number of vehicles registered in year 2010 to 2014 is shown in **Table 3.1-7** Characteristics of the vehicles registered in the project area are as follows;

Dushanbe City

- Number of vehicles registered in 2014 was composed of 55,799 passenger cars and 4,059 trucks.
- Growth rate of the number of passenger cars and trucks between 2010 and 2014 is 7.2% and 0.3%, respectively.
- Vehicle was registered at 15.4 persons per vehicle in 2013.

Khatlon Region

- Number of vehicles registered in 2014 was composed of 84,386 passenger cars and 6,934 trucks.
- Growth rate of the number of passenger cars and trucks between 2010 and 2014 is 3.4% and -3.9%, respectively. It is lower than that of Dushanbe City.
- Vehicle was registered at 36.4 persons per vehicle in 2013. The number of vehicle owner is lower than other city.

Kurgan-Tyube City

- Number of vehicles registered in 2014 was composed of 60,518 passenger cars and 4,059 trucks. This is much higher than that of Dushanbe City.
- Growth rate of passenger cars and trucks between year 2010 and 2014 is 3.9% and -1.5%, respectively.
- Vehicle was registered 1.8 persons per vehicle in 2013. The number of vehicle owner is higher than Dushanbe City.

TABLE 3.1-7 NUMBER OF VEHICLES REGISTERED IN YEARS 2010 TO 2014

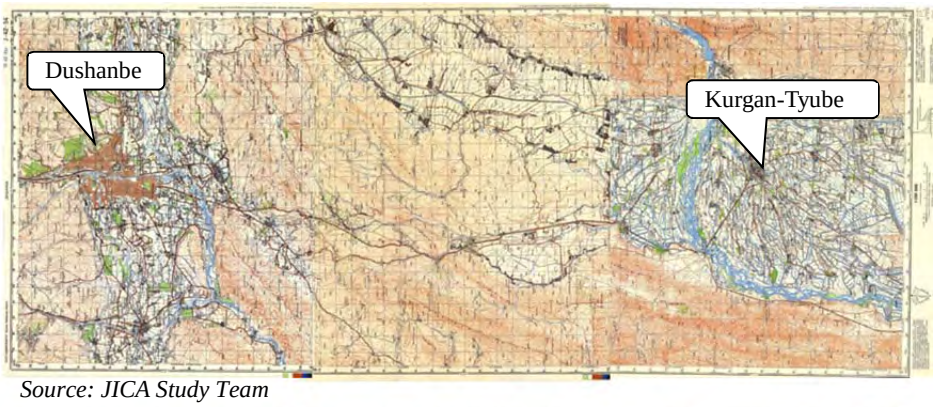
Area	Type of Vehicle	Number of Vehicle Registered (veh)					Growth Rate (%)
		2010	2011	2012	2013	2014	2014 - 2010
RRS	Passenger Car	293,676	310,554	329,016	350,353	367,189	5.7%
	Truck	37,395	35,424	36,346	36,942	39,345	1.3%
	Total	331,071	345,978	365,362	387,295	406,534	5.3%
	Persons/veh	-	-	5.6	5.3	-	-
Dushanbe City	Passenger Car	42,303	43,982	49,542	50,303	55,799	7.2%
	Truck	4,309	3,826	3,587	3,452	4,358	0.3%
	Total	46,612	47,808	53,129	53,755	60,157	6.6%
	Persons/veh	-	-	15.4	15.4	-	-
Khatlon Region	Passenger Car	73,735	73,563	74,958	79,728	84,386	3.4%
	Truck	8,131	6,735	7,307	6,868	6,934	-3.9%
	Total	81,866	80,298	82,265	86,596	91,320	2.8%
	Persons/veh	-	-	37.8	36.4	-	-
Kurgan-Tyube City	Passenger Car	51,990	51,493	52,888	57,146	60,518	3.9%
	Truck	4,307	4,715	5,287	3,272	4,059	-1.5%
	Total	56,297	56,208	58,175	60,418	64,577	3.5%
	Persons/veh	-	-	1.5	1.8	-	-

Source: MOT

3.2 Physical Consideration

3.2.1 Topography

The study area is located on a hilly terrain with an altitude ranging from 400m to 1,400m including of a rolling area (15km in total), a mountainous area (13km in total) and a flat area. The topographic map and photos of the typical case of topography found in the study area are shown below.



Source: JICA Study Team

Source: Google Earth

FIGURE 3.2-1 TOPOGRAPHIC CONDITION OF THE STUDY AREA

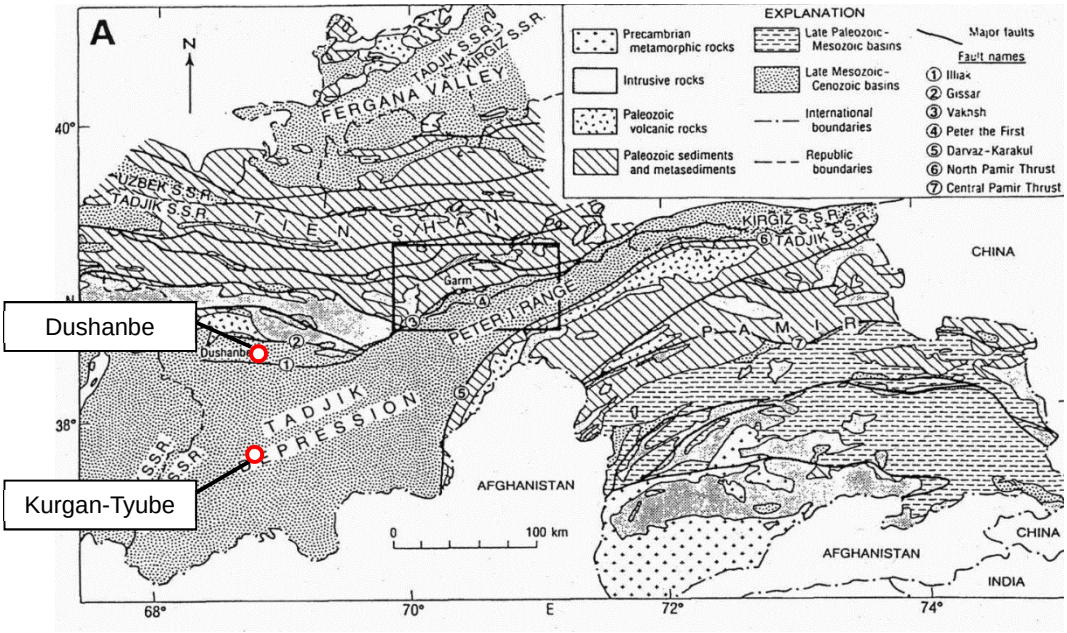
PHOTO 3.2-1 MOUNTAINOUS AREA

PHOTO 3.2-2 ROLLING AREA

PHOTO 3.2-3 FLAT AREA

3.2.2 Geology

Complex geological structure consists of rocks and deposits of various geological times in Tajikistan. The Study area belongs to Tajik Depression Zone and the alluvial fan is formed by Vakhsh River and other rivers. Deposits of Late Mesozoic Era and Cenozoic Era spread over the Tajik Depression Zone and mainly soft rock accumulates on the zone. Geological map in Tajikistan and geological condition of the study area are shown below.



Source: JICA Study Team

FIGURE 3.2-2 GEOLOGICAL MAP IN TAJIKISTAN

PHOTO 3.2-4 GEOLOGICAL CONDITION OF THE STUDY AREA

3.2.3 Climate Condition

The average monthly temperature in the major cities of Dushanbe, Obikiik and Kurgan-Tyube, from 1901 to 2012 is shown in **Table 3.2-1** and **Figure 3.2-3** and the average monthly rainfall in **Table 3.2-2** and **Figure 3.2-4**. The highest in the average monthly temperature in those cities happened in July and lowest in January. At winter season, Dushanbe is a little colder than the other two cities and the temperature is below the freezing point. There is little rain throughout the year and the largest amount is from about 80 mm to 100 mm in March. It hardly ever rains from July to September in those cities.

TABLE 3.2-1 AVERAGE MONTHLY TEMPERATURE (1901-2012)

Unit: ℃

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dushanbe	-5.84	-4.18	0.75	7.09	11.55	16.52	19.53	18.74	13.87	7.79	1.83	-3.07
Obikiik	1.44	3.6	8.42	14.59	19.22	23.97	26.12	24.62	19.74	14.18	8.65	3.86
Kurgan-Tyube	-0.04	2.14	7.28	13.57	18.21	22.94	25.36	23.99	19.25	13.51	7.76	2.47

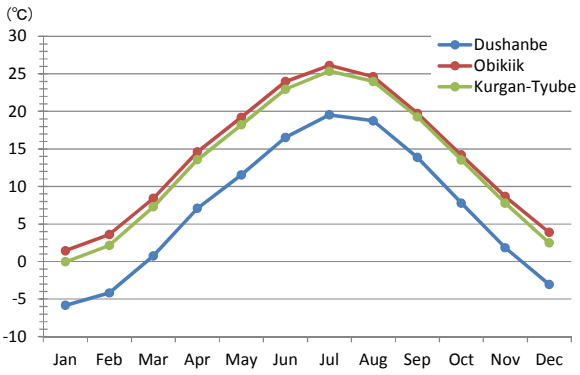
Source: Climate Change Knowledge Portal

TABLE 3.2-2 AVERAGE MONTHLY RAINFALL (1901-2012)

Unit: mm

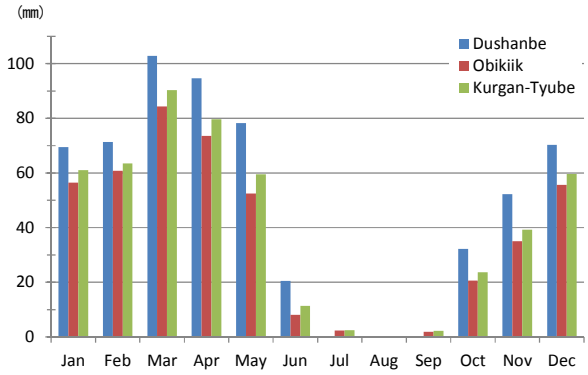
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dushanbe	69.47	71.27	102.8	94.62	78.22	20.51	0.13	0.24	0.08	32.29	52.22	70.31
Obikiik	56.48	60.87	84.36	73.61	52.46	8.11	2.36	0.17	1.93	20.69	35	55.67
Kurgan-Tyube	61.02	63.54	90.34	79.64	59.54	11.35	2.5	0.12	2.18	23.72	39.29	59.67

Source: Climate Change Knowledge Portal



Source: Climate Change Knowledge Portal

FIGURE 3.2-3 AVERAGE MONTHLY TEMPERATURE (1901-2012)



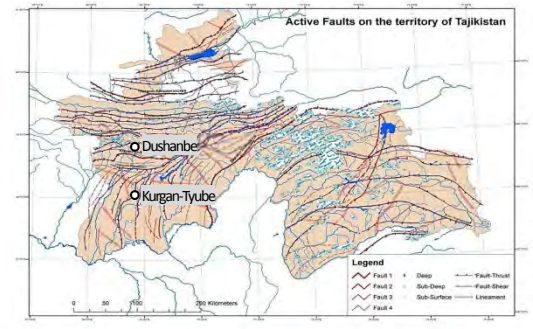
Source: Climate Change Knowledge Portal

FIGURE 3.2-4 AVERAGE MONTHLY RAINFALL (1901-2012)

3.2.4 Earthquake

There are many active faults in Tajikistan and large scale earthquakes have occurred five times in the past, large one has not occurred after 1998. The study area is set on the zone of Mmax=5.5 or Mmax=6.5 in the seismic zones map and extends across sections of seven, eight and nine degree of shaking intensity (MSK-64 scale) in the seismic hazard map.

The active faults map, the earthquake history, the seismic zones map and the seismic hazard map are shown below.



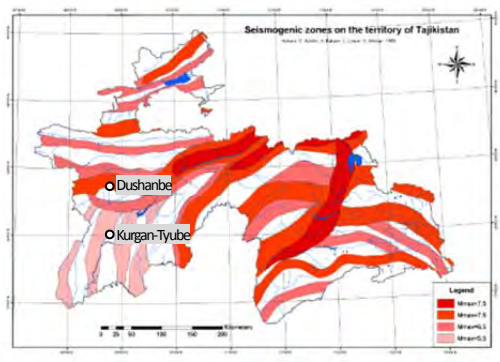
Source: JICA Study Team

FIGURE 3.2-5 ACTIVE FAULTS MAP

TABLE 3.2-3 EARTHQUAKE HISTORY

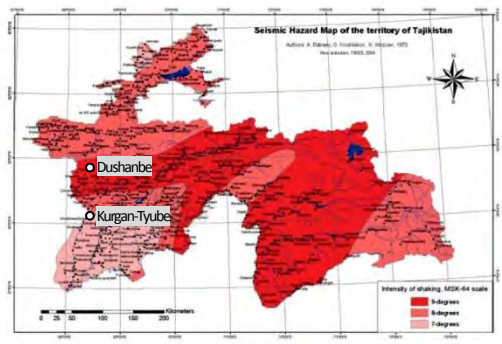
Year	Place	Magnitude	No. of Fatalities
1907	Qaratog	M 8.0	12,000
1911	Sarez	M 7.4	90
1949	Khait	M 7.5	12,000
1998	Afghanistan-Tajikistan Border Region	M 5.9	2,323
1998	Afghanistan-Tajikistan Border Region	M 6.6	4,000

Source: United States Geological Survey



Source: JICA Study Team

FIGURE 3.2-6 SEISMIC ZONES MAP



Source: JICA Study Team

FIGURE 3.2-7 SEISMIC HAZARD MAP

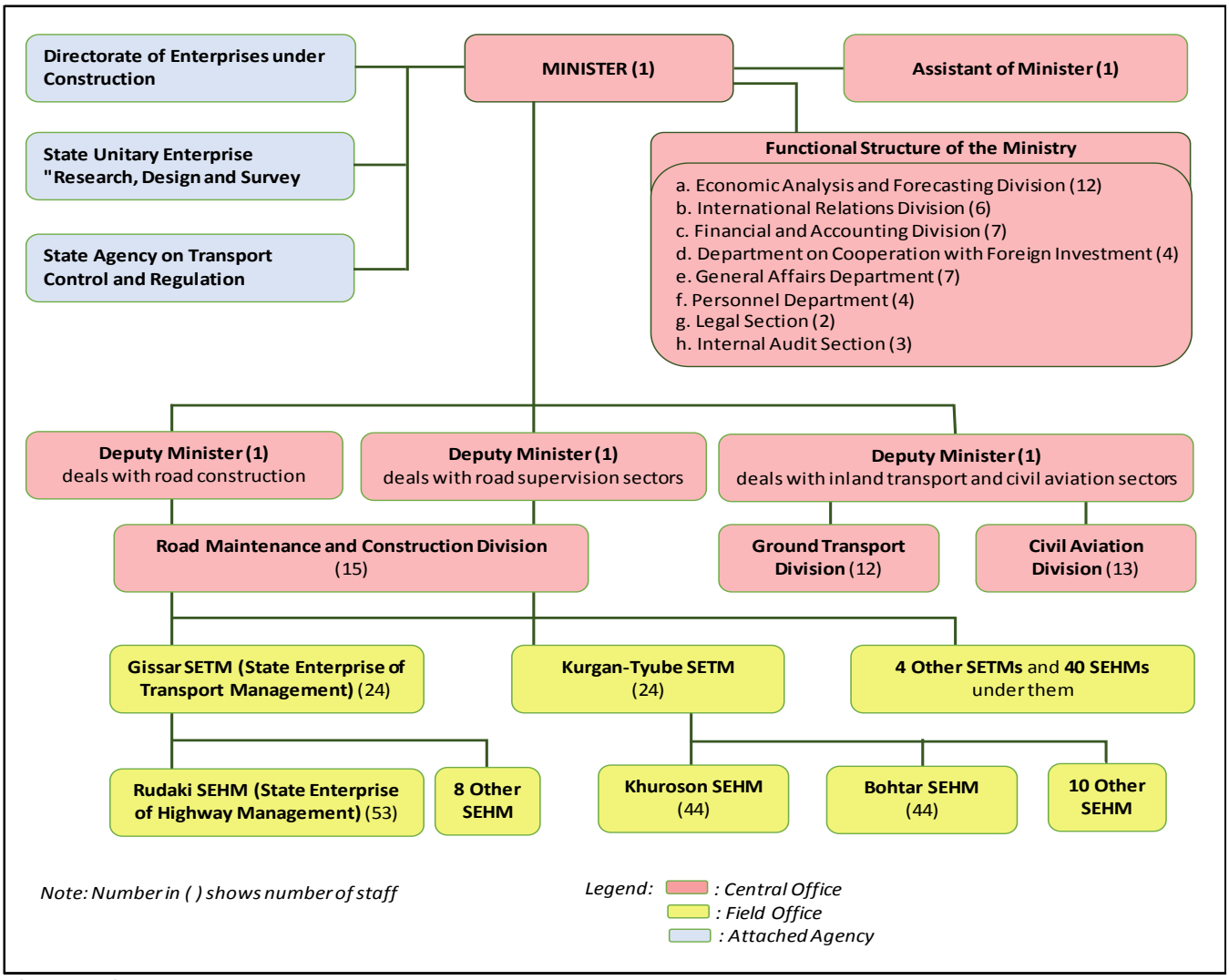
CHAPTER 4 TRANSPORT SECTOR OVERVIEW

4.1 Organization of the Ministry of Transport

The Ministry of Transport (MOT) is responsible for road, rail and air transport. The organization of MOT is shown in **Figure 4.1-1**. The central office has 90 staffs. Field offices comprise of 6State Enterprise of Transport Management (SETM) and 61 State Enterprise of Highway Maintenance (SEHM). Field offices which are in-charge of Dushanbe-Kurgan-Tyube Road are as follows;

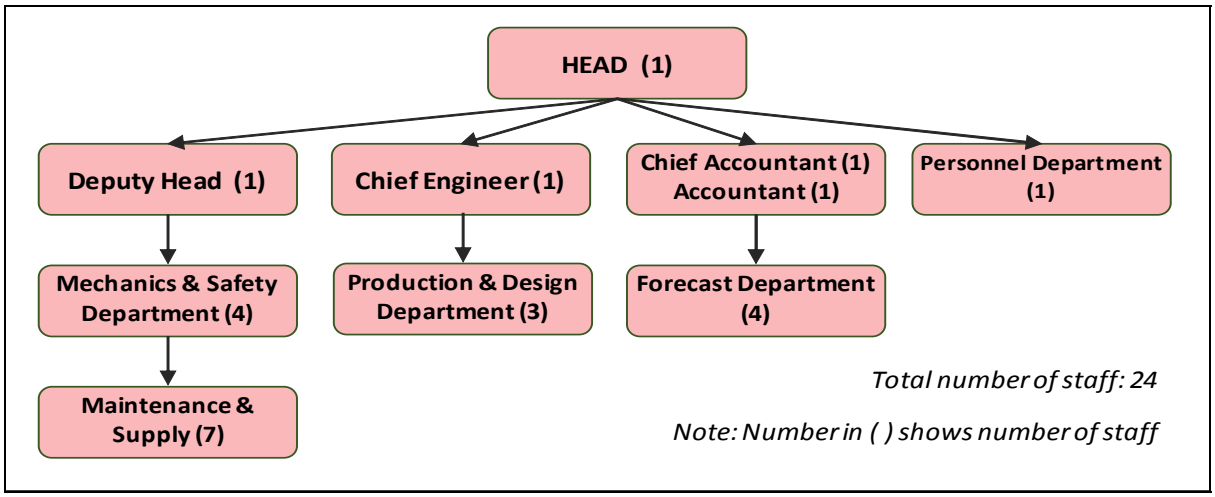
Gissar SETM → Rudaki SEHM
Kurgan-Tyube SETM → Khuroson SEHM
Bohtar SEHM

There are 3 attached agencies. Organization chart of Gissar SETM and Rudaki SEHM is shown in **Figure 4.1-2** and **Figure 4.1-3**, respectively.



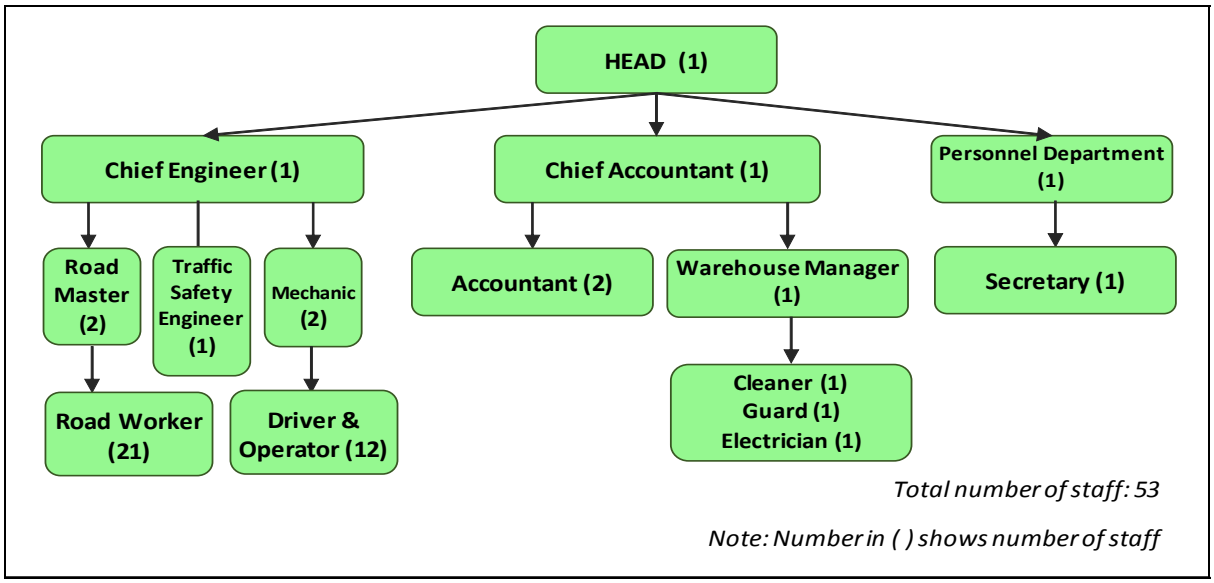
Source: MOT

FIGURE 4.1-1 ORGANIZATION CHART OF MOT



Source: MOT

FIGURE 4.1-2 ORGANIZATION CHART OF GISSAR SETM



Source: MOT

FIGURE 4.1-3 ORGANIZATION CHART OF RUDAKI SEHM

4.2 Road Sector

4.2.1 Roads under the Responsibility of MOT

MOT is responsible for the 3 kinds of roads, namely (1) International Road, (2) National Road and (3) Local Road. Road length by type of pavement is shown in **Table 4.2-1.** Bridge length is shown in **Table 4.2-2.**

TABLE 4.2-1 ROAD LENGTH BY ROAD CLASSIFICATION AND TYPE OF PAVEMENT

Road Classification	Total Length (km)	Road Length by Type of Pavement (km)			
		Asphalt Concrete	Aggregate & Bitumen	Gravel	Earth
International Road	3,335.6	1,685.2	1,294.2	356.2	0
National Road	2,087.7	954.2	668.0	443.8	21.5
Local Road	8,717.9	1,854.0	3,830.9	2,021.0	1,012.0
Total	14,141.0	4,493.4	5,793.1	2,821.0	1,033.5

Source: MOT

TABLE 4.2-2 BRIDGE LENGTH BY ROAD CLASSIFICATION AND BRIDGE TYPE

Road Classification	Number and Total Length (m)	Bridge Number and Length by Bridge Type (m)		
		Concrete	Steel	Wooden
International Road	516 (14,589 m)	464 (12,106 m)	49 (2,474 m)	3 (9 m)
National Road	313 (7,095 m)	231 (4,961 m)	70 (1,566 m)	12 (568 m)
Local Road	1,387 (19,757 m)	1,243 (16,164 m)	128 (2,793 m)	16 (800 m)
Total	2,216 (41,441 m)	1,938 (33,231 m)	247 (6,833 m)	31 (1,377 m)

Source: MOT

Roads/bridges under the responsibility of Gissar SETM and Kurgan-Tyube are shown in **Table 4.2-3.**

TABLE 4.2-3 ROADS / BRIDGES UNDER THE RESPONSIBILITY OF GISSAR AND KURGAN-TYUBE SETM

		GISSAR SETM	KURGAN-TYUBE SETM
Road	International Road	287.3	427.7
	National Road	410.1	321.2
	Local Road	1,213.4	1,991.6
	Total	1,910.8	2,740.5
Bridge (No. and Bridge Length)	International Road	75 (2,771.2 m)	57 (1,846.0 m)
	National Road	65 (1,413.6 m)	68 (1,569.0 m)
	Local Road	232 (4,312.0 m)	488 (5,940.0 m)
	Total	372 (8,496.8 m)	613 (9,355.0 m)

Source: MOT

4.2.2 Road Budget

National budget, MOT budget and road maintenance budget for the past 5 years are shown in **Table 4.2-4.** About 8.6% to 11.1% of national budget was allocated to MOT. MOT allocated 4.2% to 5.4% of its budget to road maintenance.

TABLE 4.2-4 NATIONAL AND MOT BUDGET

Unit: Million Somoni

	2010	2011	2012	2013	2014
National Budget	6,537	8,292	10,860	12,057	13,901
MOT Budget	638 (9.8%)	919 (11.1%)	936 (8.6%)	1,033 (8.6%)	1,308 (9.4%)
MOT Road Maintenance Budget	34 ((5.3%))	39 ((4.2%))	47 ((5.0%))	56 ((5.4%))	57 ((4.4%))

Note: Number in ( ) shows MOT Budget share to National Budget. Number in (( )) shows Road Maintenance Budget to MOT Budget

Source: MOT

Road maintenance budget allocation to Gissar and Kurgan-Tyube SETMs is shown in **Table 4.2-5**. In 2014, average maintenance budget per km of road was 3,140 Somoni in Gissar SETM and 2,890 Somoni in Kurgan-Tyube SETM.

TABLE 4.2-5 ROAD MAINTENANCE BUDGET ALLOCATION TO GISSAR AND KURGAN-TYUBE SETMS

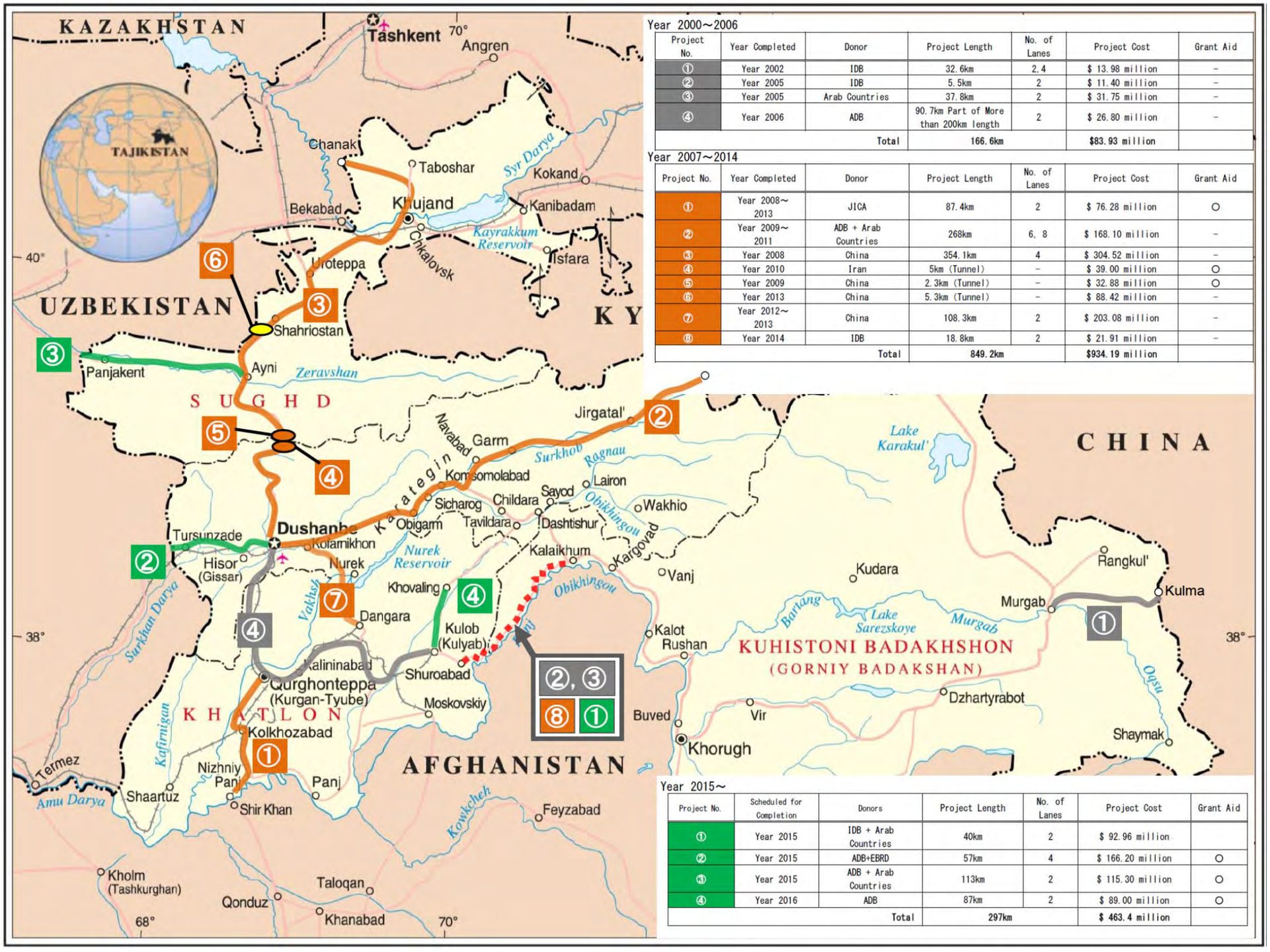
Unit: Million Somoni

SETM	Road Length (km)	2010	2011	2012	2013	2014
Gissar	1,910.8	4,005.4 (2.10)	4,005.4 (2.10)	4,772.8 (2.50)	5,277.8 (2.76)	5,993.2 (3.14)
Kurgan-Tyube	2,740.5	4,847.2 (1.77)	4,847.2 (1.77)	6,003.9 (2.19)	6,909.8 (2.52)	7,909.1 (2.89)

Note: Number in ( ) shows average maintenance budget per km of road
Source: MOT

4.2.3 Past and Present Foreign-assisted Road Project

Past and present foreign-assisted road projects are shown in **Figure 4.2-1**. ADB financed rural roads improvement projects are shown in **Figure 4.2-2** and **Figure 4.2-3**, respectively.



Year 2000～2006

Project No.	Year Completed	Donor	Project Length	No. of Lanes	Project Cost	Grant Aid
①	Year 2002	IDB	32.6km	2,4	$ 13.98 million	-
②	Year 2005	IDB	5.5km	2	$ 11.40 million	-
③	Year 2005	Arab Countries	37.8km	2	$ 31.75 million	-
④	Year 2006	ADB	90.7km Part of More than 200km length	2	$ 26.80 million	-
		Total	166.6km		$83.93 million	

Year 2007～2014

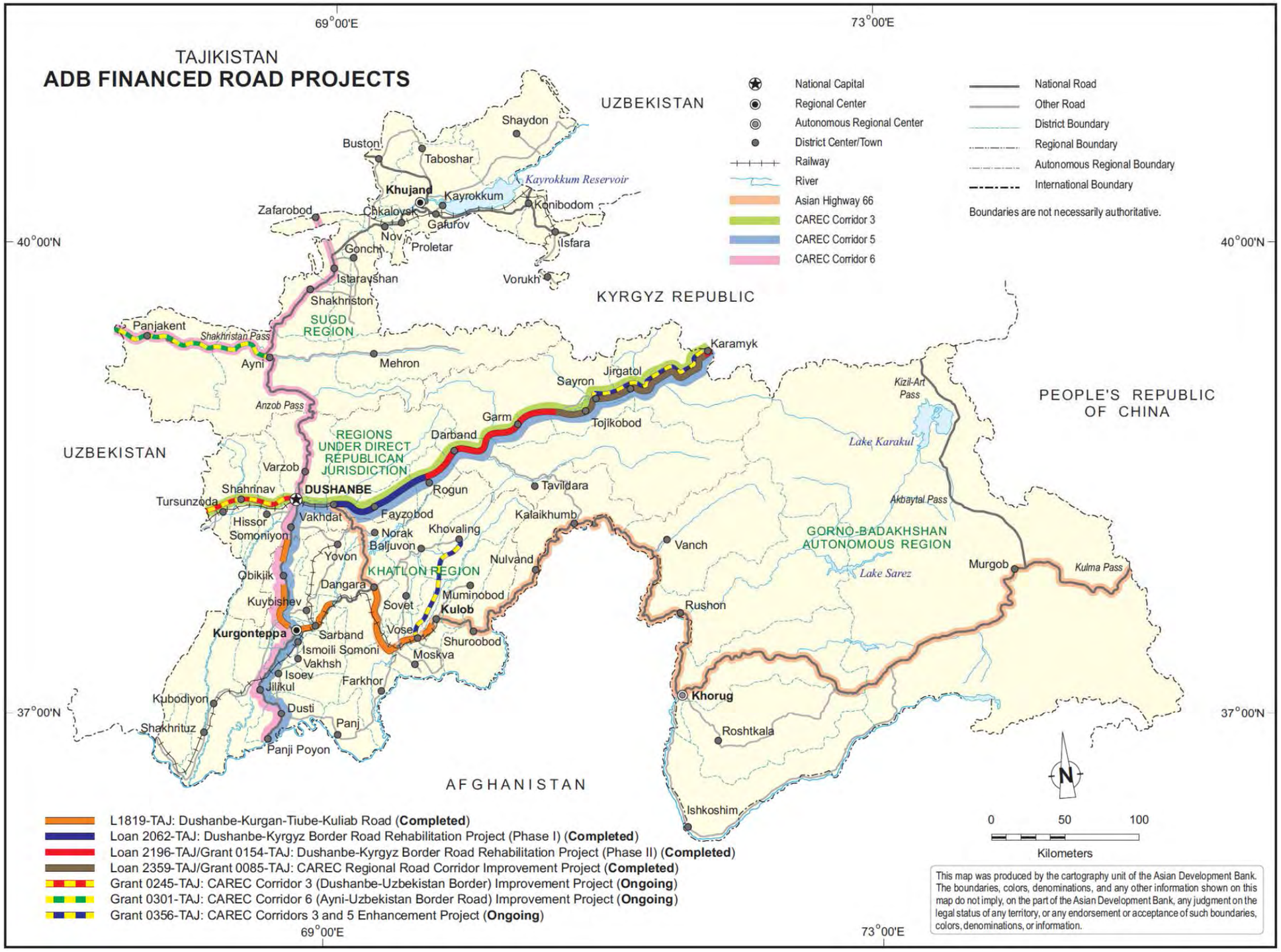
Project No.	Year Completed	Donor	Project Length	No. of Lanes	Project Cost	Grant Aid
①	Year 2008～2013	JICA	87.4km	2	$ 76.28 million	○
②	Year 2009～2011	ADB + Arab Countries	268km	6, 8	$ 168.10 million	-
③	Year 2008	China	354.1km	4	$ 304.52 million	-
④	Year 2010	Iran	5km (Tunnel)	-	$ 39.00 million	○
⑤	Year 2009	China	2.3km (Tunnel)	-	$ 32.88 million	○
⑥	Year 2013	China	5.3km (Tunnel)	-	$ 88.42 million	-
⑦	Year 2012～2013	China	108.3km	2	$ 203.08 million	-
⑧	Year 2014	IDB	18.8km	2	$ 21.91 million	-
		Total	849.2km		$934.19 million	

Year 2015～

Project No.	Scheduled for Completion	Donors	Project Length	No. of Lanes	Project Cost	Grant Aid
①	Year 2015	IDB + Arab Countries	40km	2	$ 92.96 million	
②	Year 2015	ADB+EBRD	57km	4	$ 166.20 million	○
③	Year 2015	ADB + Arab Countries	113km	2	$ 115.30 million	○
④	Year 2016	ADB	87km	2	$ 89.00 million	○
		Total	297km		$ 463.4 million	

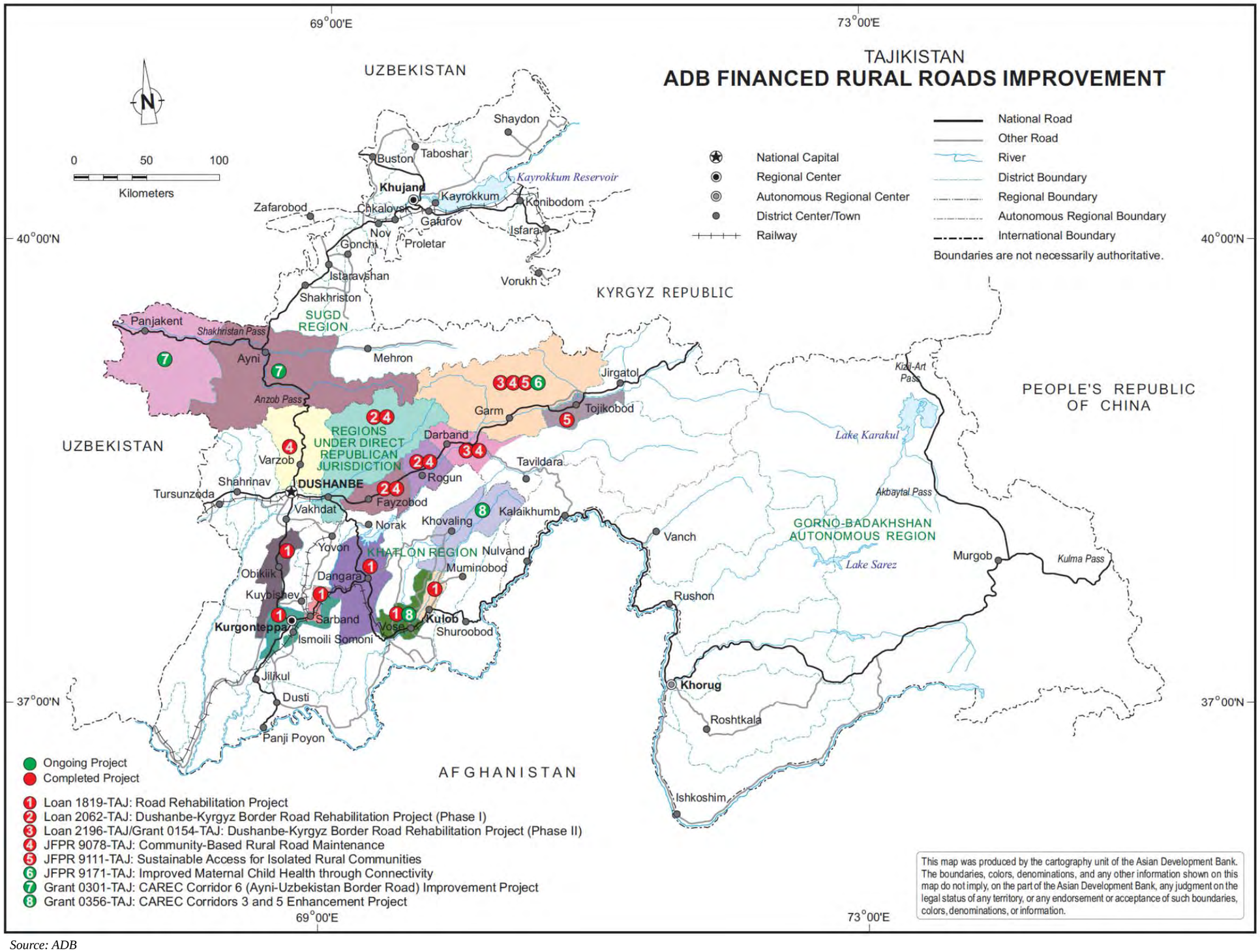
Source: MOT

FIGURE 4.2-1 PAST AND PRESENT FOREIGN – ASSISTED ROAD PROJECTS



Source: ADB

FIGURE 4.2-2 ADB FINANCED ROAD PROJECTS



Source: ADB

FIGURE 4.2-3 ADB FINANCED RURAL ROAD IMPROVEMENT PROJECTS

4.2.4 Proposed Major Road Projects

Table 4.2-6 shows major on-going and proposed road projects.

TABLE 4.2-6 MAJOR ON-GOING AND PROPOSED ROAD PROJECTS

Name of Project	Cost in Thousand US$	Funding Source (Thousand US$)		Period		Length
				Beginning	Completion	
Construction of Shagon-Zigar road Phase II	15900	13770	Loan of IDB	2007	2010	9.75 km
		2130	Government of Tajikistan portion			
Rehabilitation of Dushanbe- Kyrgyz border, Phase 3	76500	40900	Loan of ADB	2007	2011	114 km
		12500	Grant of ADB			
		23100	Government of Tajikistan portion			
Rehabilitation of Kurgan-Tyube -Dusty, Phase I	35000 (3,432,000,000 JPY)	Grant of Japan		2009	2011	42 km
Construction of Istiklol tunnel on Dushanbe-Khujand road (additional works)	6000	3000	Grant of Iran	2011	2015	N/A
		3000	Government of Tajikistan portion			
Construction of Shahriston tunnel in the frame of Dushanbe-Chanak (Uzbek border)	88424	Lax loan of China		2006	2013	5,253 km
Rehabilitation of Dushanbe-Kulma road, Dushanbe-Dangara section, Phase I	51578	49000	Loan of China EXIMBANK	2009	2012	57.8 km
		2578	Government of Tajikistan portion			
Rehabilitation of Dushanbe-Kulma road, Dushanbe-Dangara section, Phase II * Including Construction of Chormagzak tunnel	151500	143925	Loan of China EXIMBANK	2009	2013	50.5 km
		7575	Government of Tajikistan portion			
	64000	Loan of China EXIMBANK		2010	2013	4.43 km
Construction of Shagon-Zigar road Phase III	21907	18572	Loan of IDB	2011	2014	1.75 km
		3335	Government of Tajikistan portion			
Construction of Kulyab-Kalaihumb road (Shurabad-Shagon section)	92900	20000	Loan of IDB	2011	2015	40 km
		20000	Loan of Saudi Fund for Development			
		17000	Loan of Kuwait Fund for Arab Economic Development			
		15000	Loan of Abu Dhabi Fund			
		13000	Loan of OPEC Fund			
		7900	Government of Tajikistan portion			
Rehabilitation of Kurgan-Tyube - Dusty, Phase I	23300 (1,889,000,000 JPY)	Grant of Japan		2012	2013	18 km

Name of Project	Cost in Thousand US$	Funding Source (Thousand US$)		Period		Length
				Beginning	Completion	
Construction of New terminal at the Dushanbe International Airport	51593.1	26458	Loan of France	2012	2014	N/A
		25135.1	Government of Tajikistan portion			
Rehabilitation of Dushanbe-Tursunzade road (Uzbek border)	166200	120000	Grant of ADB	2011	2015	57 km
		35000	Loan of EBRD			
		11200	Government of Tajikistan portion			
Construction of bridge through Pyanj river in Shurabad region	3500	Grant of Agha Khan Fund		2011	2013	200 m
Preparation of feasibility study and preliminary design for construction of Labi-Jar-Kalaihumb road	1000	Technical assistance of Kuwait Fund for Arab Economic Development		2013	2015	135 km
Study of economic development for conducting of feasibility study on construction of standard railway (1435mm) inside Tajikistan	1000	Technical assistance of Iran		2011	2015	
Preparation of the feasibility study of the road section from Sino monument till Western Gate of Dushanbe City	2890	Technical assistance of EBRD		2014	2015	4.6km
Preparation of the feasibility study for rehabilitation of Ayni-Panjakent road	900	800	Technical assistance of ADB	2012		113 km
		100	Government of Tajikistan portion			
Rehabilitation of Ayni-Panjakent road	115300	100000	Grant of ADB	2012	2015	113 km
		14000	Loan of Opec Fund			
		1300	Government of Tajikistan portion			
Construction of bridge Yangolik	2369.9	2000	Technical assistance of JFPR	2007	2010	226.8 km
		245.6	Government of Tajikistan portion			
		124.3	Social Fund			
Construction of 6 bridges through Pyandzh and Vahon rivers in Gorno-Badakhshan Autonomous Area	4289.5	Grant of Agha Kgan Fund		202	201	585 m
Construction of bridge via Surkhob river and repair of 9 km of Road in Rasht region	2933	2500	Technical assistance of JFPR	2013	2014	9 km
		433	Government of Tajikistan portion			
The project for Improvement of equipment for road maintenance in Khatlon Region and Districts of Republican subordination	13155 (1,344,000,000 JPY)	Grant of Japan		2013	2015	

Name of Project	Cost in Thousand US$	Funding Source (Thousand US$)		Period		Length
				Beginning	Completion	
The project for development of 3 and 5 CAREC corridors (Vose-Khovaling road rehabilitation and second layer of asphalt on Sairon-Karamik section)	89000	70000	Grant of ADB	2014	2016	
		19000	Government of Tajikistan portion			
The project for technical Improvement of Khujand Airport	3000	Grant of EBRD				

Source: MOT

4.3 Railway Sector

Railway network of Tajikistan is shown in **Figure 4.3-1**. Railway between Yangi and Yavan is under construction. Operation of Bazaar Railway between Tajikistan and Uzbekistan in the south is currently suspended.

Source: MOT

FIGURE 4.3-1 RAILWAY NETWORK

4.4 Air Transport Sector

There are 4 international airports and 6 regional airports as shown in **Table 4.4-1** and **Figure 4.4-1**.

TABLE 4.4-1 INTERNATIONAL AND REGIONAL NETWORKS

International Airport	Regional Airport
• Dushanbe • Khujand • Kulyab • Kurgan-Tyube	• Gissar • Isfana • Khorog • Moskovskiy Pyandzh • Murgab • Parkhar

Source: MOT

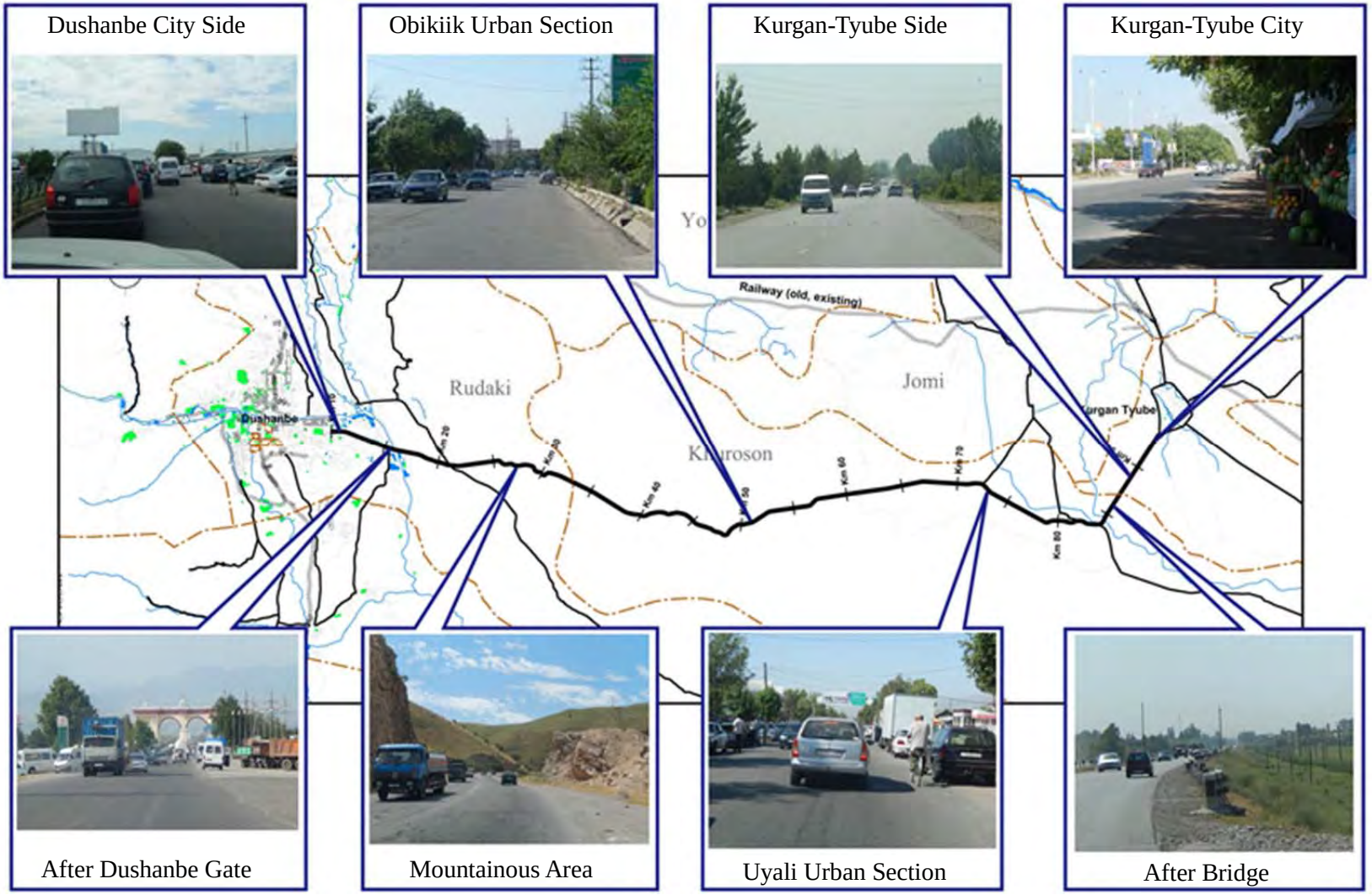
Source: MOT

FIGURE 4.4-1 INTERNATIONAL AND REGIONAL AIRPORTS

CHAPTER 5 TRAFFIC STUDY

5.1 Existing Traffic Condition

Traffic condition of DK Road is shown in **Figure 5.1-1.** Heavy traffic is observed within Dushanbe City and Kurgan-Tyube City. High traffic volume is also observed at suburbs of Dushanbe City, urban sections at Obikiik, Uyali and Kizil-kala. Inter-urban section south of Uyali has relatively heavy traffic. Most cars are driving at very high speed with over 100km/h throughout the road which causes high risk of traffic accidents.



Source: JICA Study Team

FIGURE 5.1-1 EXISTING TRAFFIC CONDITION OF DK ROAD

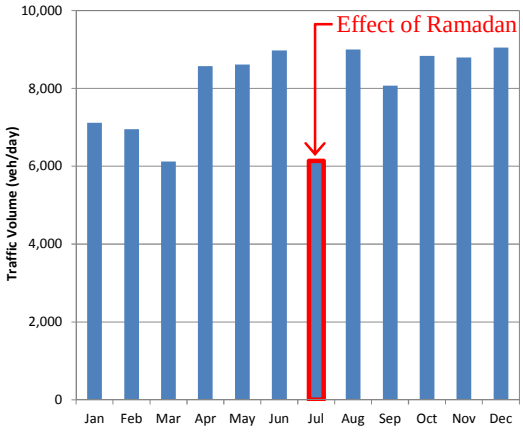
5.2 Existing Traffic Data

MOT has a periodic traffic count survey stations at 4 locations along the DK Road. This periodic traffic count is conducted for 4 days (Thursday, Friday, Saturday and Sunday) every month at each stations and the survey period is 6 hours per day. The SEHM (State Enterprise on Highway Management) Rudaki is operating a survey station at Km.15 and Km.32, SEHM Khuroson and SEHM Bokhtar are operating at Km. 51 and Km. 91, respectively.

Table 5.2-1 shows the monthly traffic volume in 2014 at the MOT traffic survey station (Km.51), the traffic volume was approximately 6,000 to 9,000 veh/day. High traffic volume was observed in June, August and December. July has a significantly low volume due to the Ramadan which started from the end of June until the end of July.

TABLE 5.2-1 MONTHLY TRAFFIC VOLUME AT SEHM KHUROSON TRAFFIC SURVEY STATION KM. 51 IN 2014

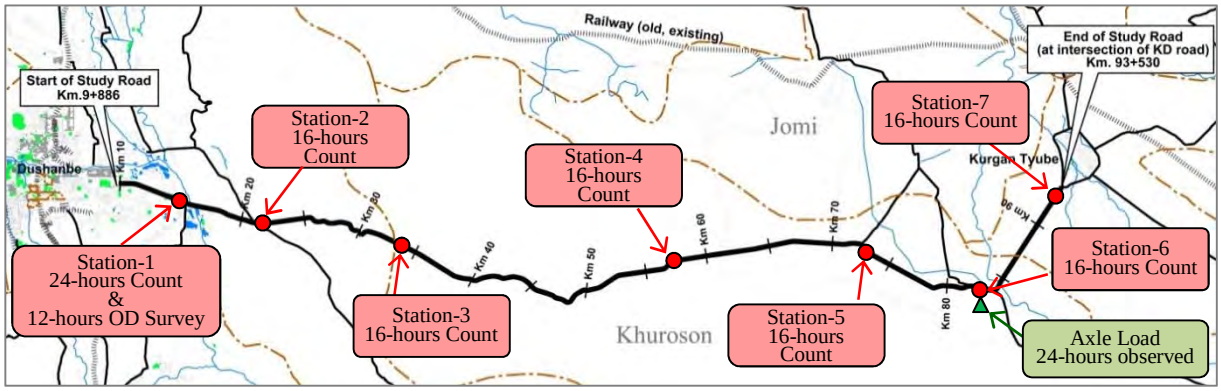
	Passenger Car	Bus	Truck	Tractor	Total
Jan	4,462	18	2,575	57	7,112
Feb	4,388	9	2,466	58	6,921
Mar	4,693	5	1,779	17	6,494
Apr	6,468	19	2,056	30	8,573
May	6,428	10	2,150	24	8,612
Jun	6,665	10	2,276	24	8,975
Jul	4,693	5	1,420	17	6,135
Aug	6,682	10	2,289	24	9,005
Sep	6,338	12	1,696	23	8,069
Oct	6,370	6	2,435	27	8,838
Nov	6,693	19	2,056	30	8,798
Dec	6,745	10	2,271	24	9,050



Note: Ramadan in 2014 was started from end of June until end of July
Source: MOT

5.3 Traffic Surveys Undertaken

The JICA Study Team has carried out the following traffic surveys: 1) Traffic Count Survey, 2) Roadside OD Interview Survey, 3) Axle Load Survey and 4) Travel Speed Survey under this project.



Source: JICA Study Team

FIGURE 5.3-1 TRAFFIC SURVEY STATION UNDER JICA STUDY

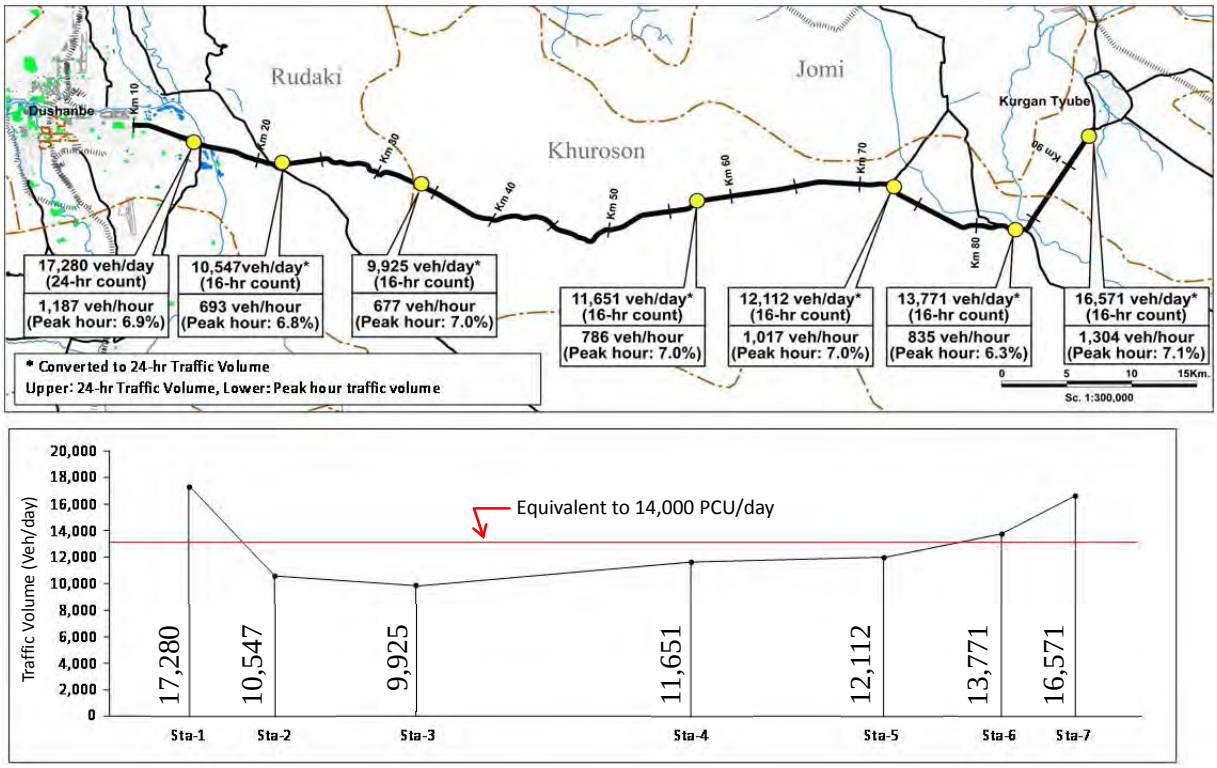
TABLE 5.3-1 OUTLINE OF TRAFFIC SURVEY

Survey	Objective	Contents	Remarks
Traffic Count Survey (at 7 Traffic Count Stations)	・To review MOT traffic survey results ・To understand the local traffic within urban area ・To understand the changes in traffic volume between urban areas	・Traffic volume by vehicle type, direction, and time zone ・7 locations along DK Road ・Survey periods are 16-hr for 6 traffic count stations and 24-hr at Roadside OD interview Survey Stations ・7 vehicle types for inter-city, 9 vehicle types for urban area (including motorbike and pedestrian)	・16 to 24-hr traffic count by vehicle type ・Traffic volume by direction ・Peak hour ratio ・Large vehicle ratio
Roadside OD Interview Survey (at Traffic Count Station-1)	・To understand road usage (trip purpose, occupancy, cargo) ・To understand the between Tajikistan and interdependence Afghanistan	・1-location, 12-hr survey at the outskirts of Dushanbe City ・Trip origin and destination ・Trip purpose ・Occupancy ・Cargo type	・OD table by vehicle type ・Trip purpose ratio ・Average occupancy rate ・Cargo type and its OD
Axle Load Survey (at 1 Axle Load Station)	・To clarify the required pavement design axle load	・Survey at MOT-operated weighing bridge station (1-direction per day, total 2 days) ・24-hr survey ・Cargo OD survey	・Single-axle, tandem-axle, tridem-axle, axle load distribution and average axle load
Travel Speed Survey	・To understand truck's travel speed	・Utilize the drive recorder with GPS ・Following up the truck and observation of travel speed	・Travel speed ・Travel time

Source: JICA Study Team

5.4 Traffic Volume

The result of traffic volume observed by the JICA Study Team is shown in **Figure 5.4-1**. Traffic volume at Station-1 and Station-7 located in urban area is high at 17,280 veh/day and 16,571 veh/day, respectively. These traffic volume are already exceeded maximum target volume of a 2-lane road (SNiP standard defines maximum target traffic volume of a 2-lane is 14,000 PCU/day which is equivalent to approximately 13,000 veh/day). Traffic volume at the mountainous and inter-urban areas was observed between 9,000 veh/day and 12,000 veh/day.

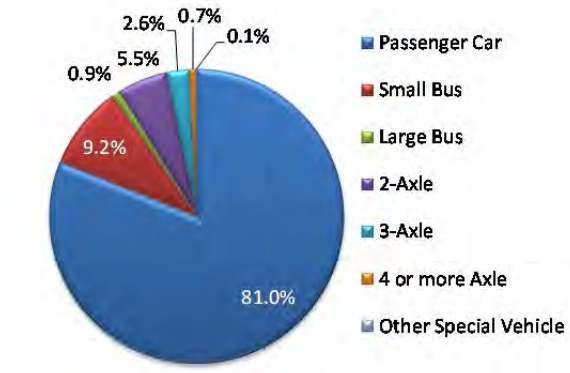


Source: JICA Study Team

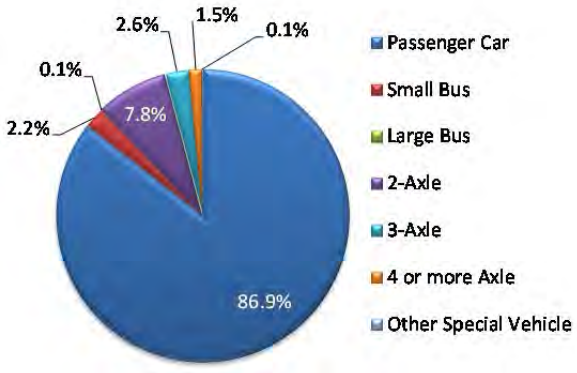
FIGURE 5.4-1 TRAFFIC VOLUME AT TRAFFIC SURVEY STATIONS

5.4.1 Vehicle Composition

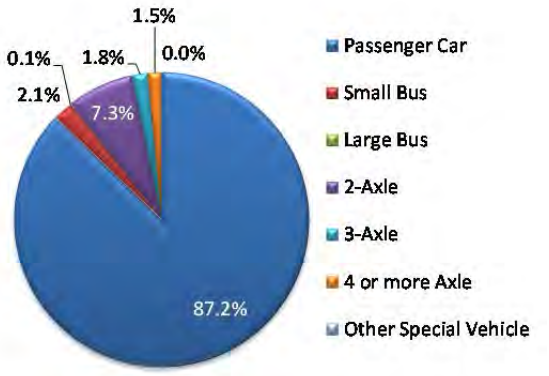
The vehicle composition at the 7 stations is shown in **Figure 5.4-2**. The share of passenger car at each station is predominant ranging from 81.0% to 88.4%. The share of truck on DK Road is approximately 10%. On the other hand, the share of bus is still low, thus passenger cars are used for people transportations.



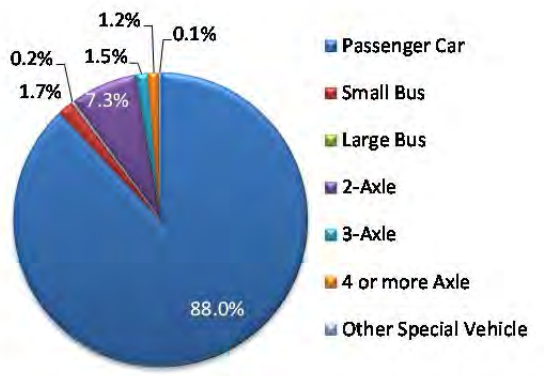
Survey Station-1 (Km. 15)



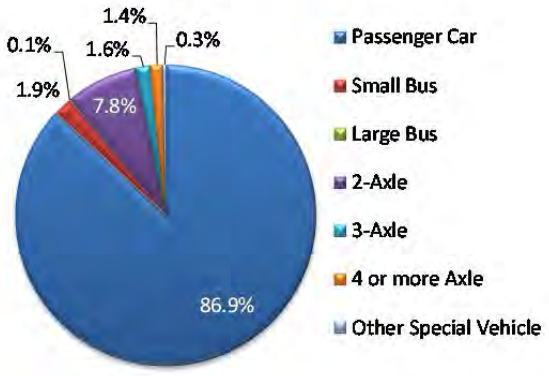
Survey Station-2 (Km. 22)



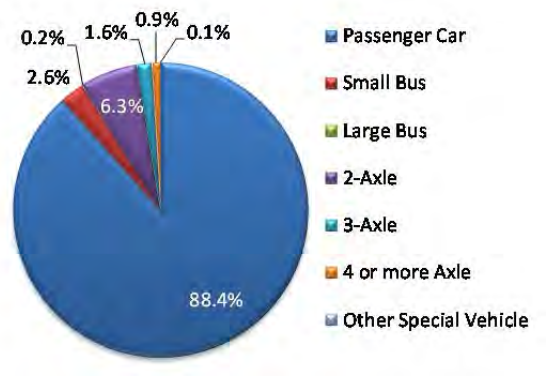
Survey Station-3 (Km. 32)



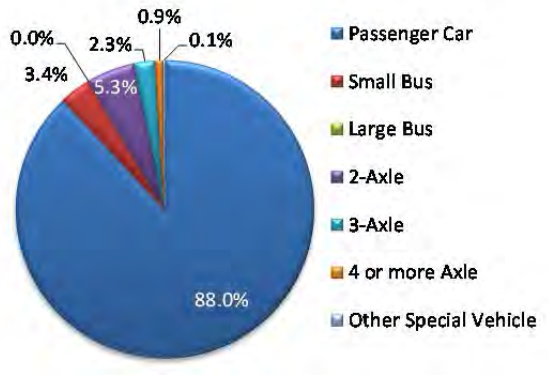
Survey Station-4 (Km. 57)



Survey Station-5 (Km. 73)



Survey Station-6 (Km. 84)



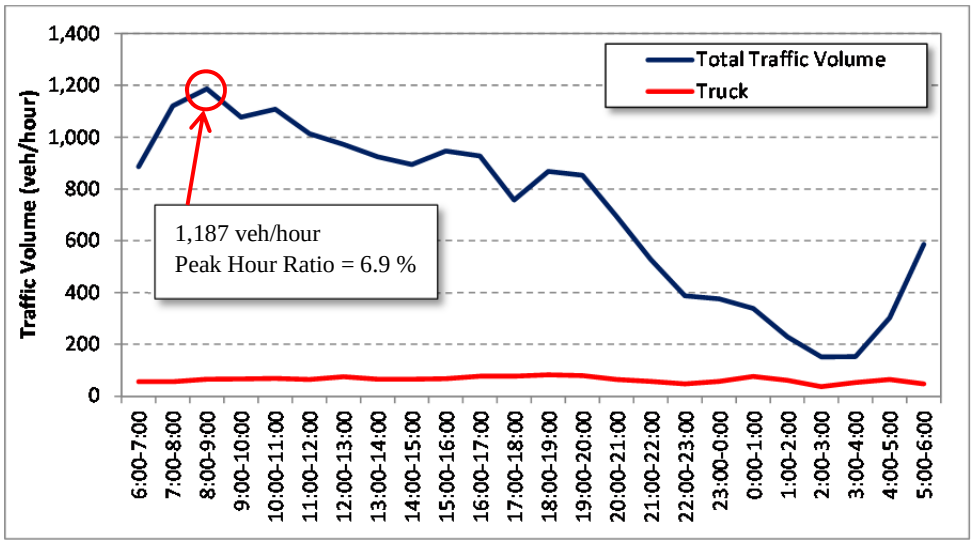
Survey Station-7 (Km. 93)

Source: JICA Study Team

FIGURE 5.4-2 VEHICLE COMPOSITION AT SEVEN (7) STATIONS

5.4.2 Hourly Variation and Peak Hour Ratio

Figure 5.4-3 shows hourly variation and peak hour ratio at observed traffic count station-1. Peak hour was observed between 8:00 AM and 9:00 AM at 1,187 veh/hour and peak hour ratio is 6.9%. Hourly variation of truck was observed rather constant throughout a day. Truck is not allowed to pass through DK Road during a day time in the summer season according by the department order of traffic regulation. Therefore, heavy truck is passing through the DK Road during night-time.



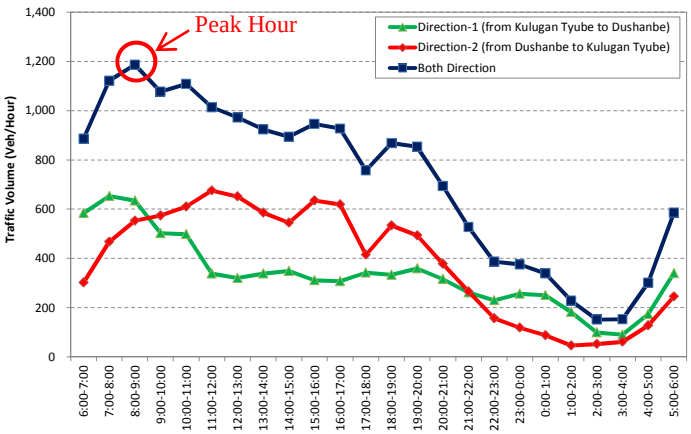
Source: JICA Study Team

FIGURE 5.4-3 HOURLY VARIATION AND PEAK HOUR RATIO AT STATION-1 (KM. 15)

5.4.3 Directional Traffic Difference

Directional traffic difference is shown in **Figure 5.4-4**. Traffic volume of direction-1 (from Kurgan-Tyube to Dushanbe) and direction-2 (from Dushanbe to Kurgan-Tyube) are 9,203 veh/day and 8,074 veh/day, respectively. Directional split in peak hour is almost half split at direction-1 and direction-2 (53:47).

Direction-1 during morning time is higher than direction-2 due to work trips at Dushanbe City. After morning time, traffic volume of direction-2 increases. This may be understood that some passengers and trucks visited to a bazaar in Dushanbe City and go to Kurgan-Tyube side carrying some commodities (commercial goods, food, etc.) and go back from 10:00 AM.



Station-1 (Km. 15)

<Directional Traffic Difference>

- Direction-1 (Kurgan-Tyube - Dushanbe) : 8,074 veh/day
- Direction-2 (Dushanbe - Kurgan-Tyube) : 9,203 veh/day
- Both Direction : 17,280 veh/day
- Directional Split at Peak Hour (Direction 1 : Direction 2) : 53 : 47

Source: JICA Study Team

FIGURE 5.4-4 DIRECTIONAL TRAFFIC DIFFERENCE AT STATION-1 (KM. 15)

5.5 OD Survey Results

OD pattern, trip purpose and commodities transported were summarized based on the result of the roadside OD interview survey observed at the Traffic Count Station-1.

5.5.1 OD Pattern (MAP)

Zoning map is shown in **Figure 5.5-1** and zoning table is shown in **Table 5.5-1**. OD pattern of passenger car, bus, truck and all vehicles is shown in **Figure 5.5-2** to **Figure 5.5-5**.

Passenger Car OD Pattern

- Passenger car trips between Dushanbe City and Kurgan-Tyube and South of Kurgan-Tyube are predominant and share about 80% of all passenger car trips.
- Most of the passenger car trips start or end at Dushanbe City.

Bus OD Pattern

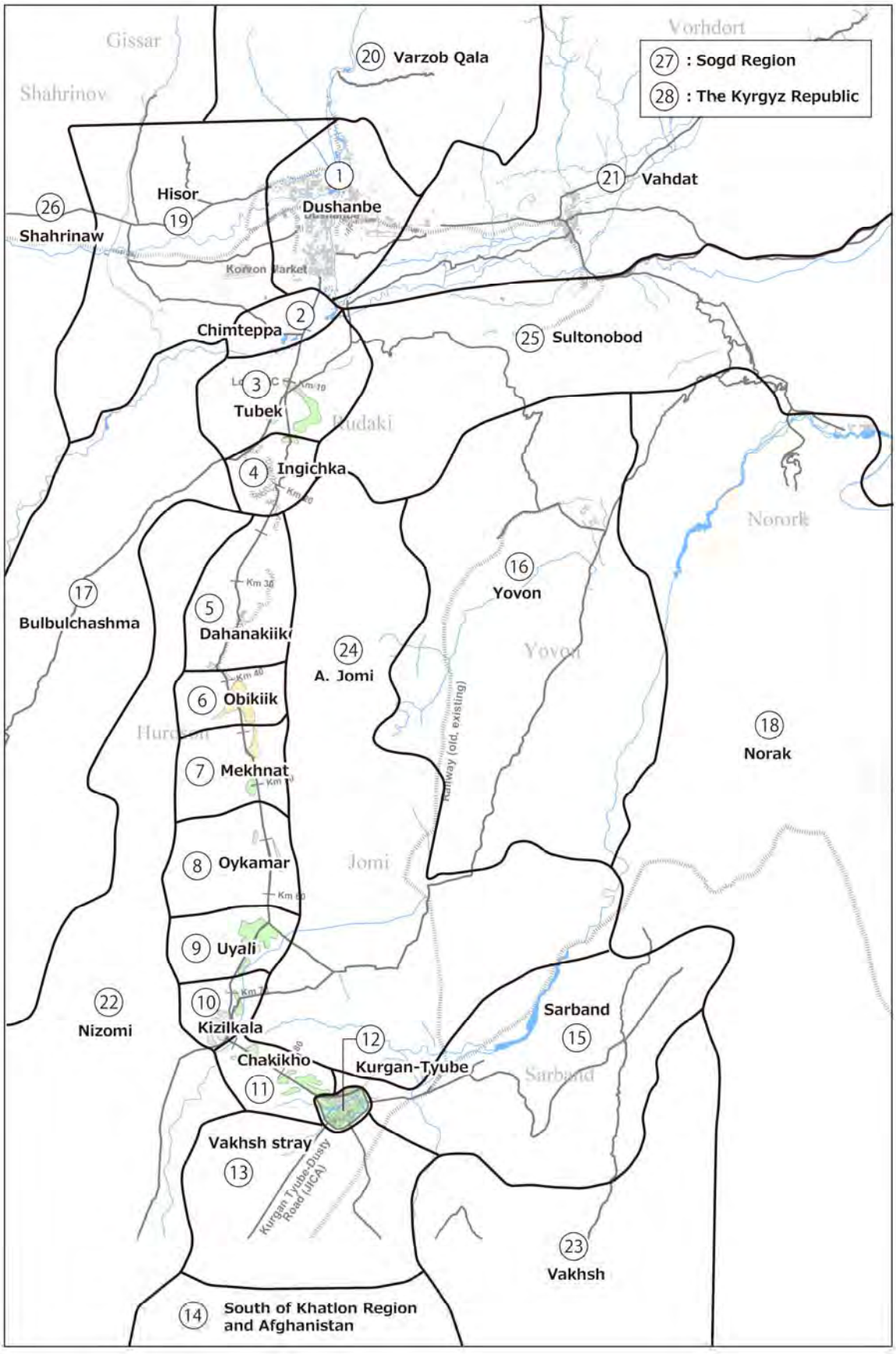
- About 50% of bus trips are between Dushanbe City and Kurgan-Tyube and South of Kurgan-Tyube.
- About 24% of but the traffic are between Dushanbe City and Tubek. Small buses are used for this trip.

Truck OD Pattern

- About 70% of truck trips are between Dushanbe City and Kurgan-Tyube and South of Kurgan-Tyube.

All Vehicles OD Pattern

- About 75% of all the vehicles are passing between Dushanbe City and Kurgan-Tyube/South of Kurgan-Tyube.



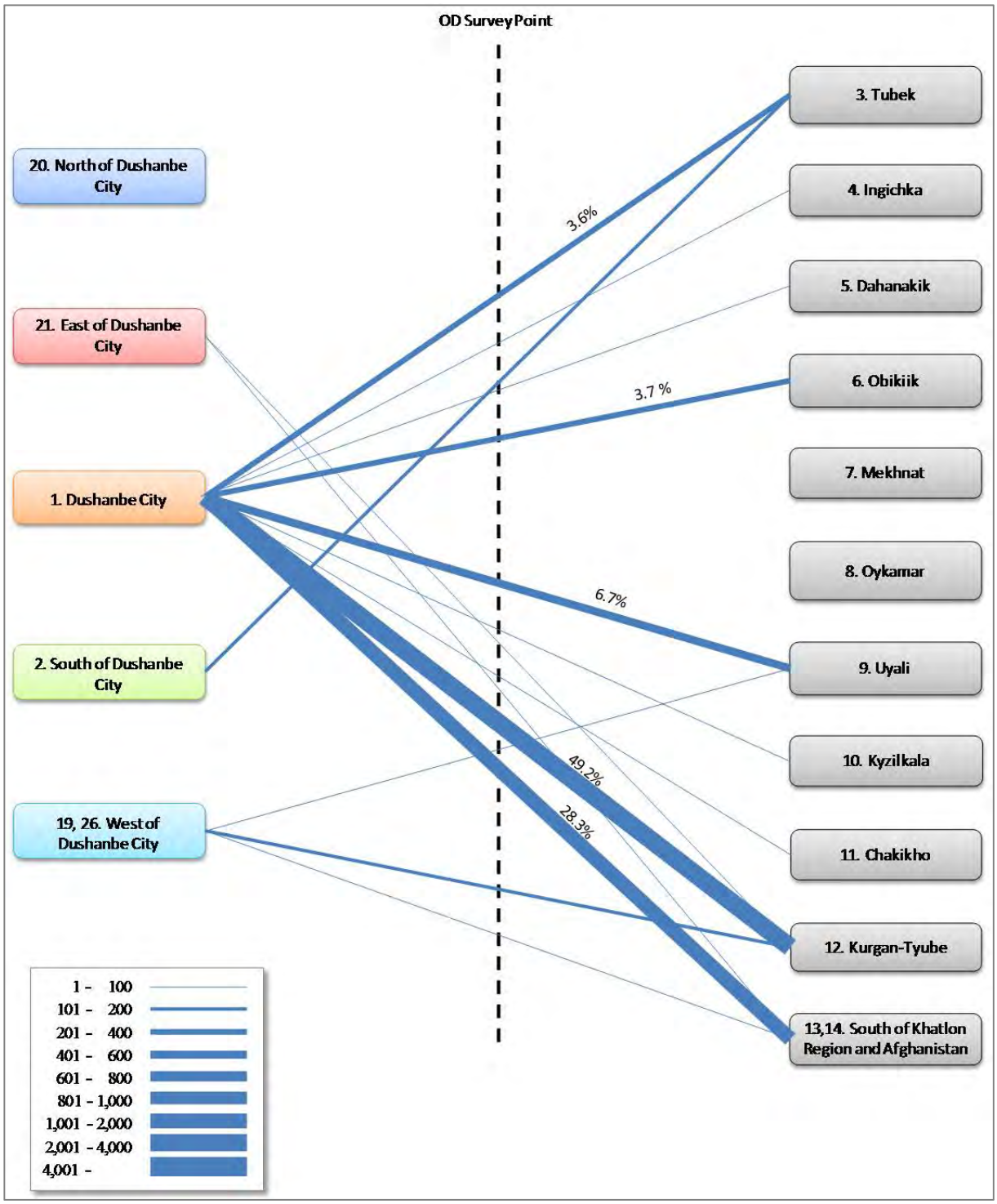
Source: JICA Study Team

FIGURE 5.5-1 ZONING MAP

TABLE 5.5-1 ZONING NUMBER TABLE

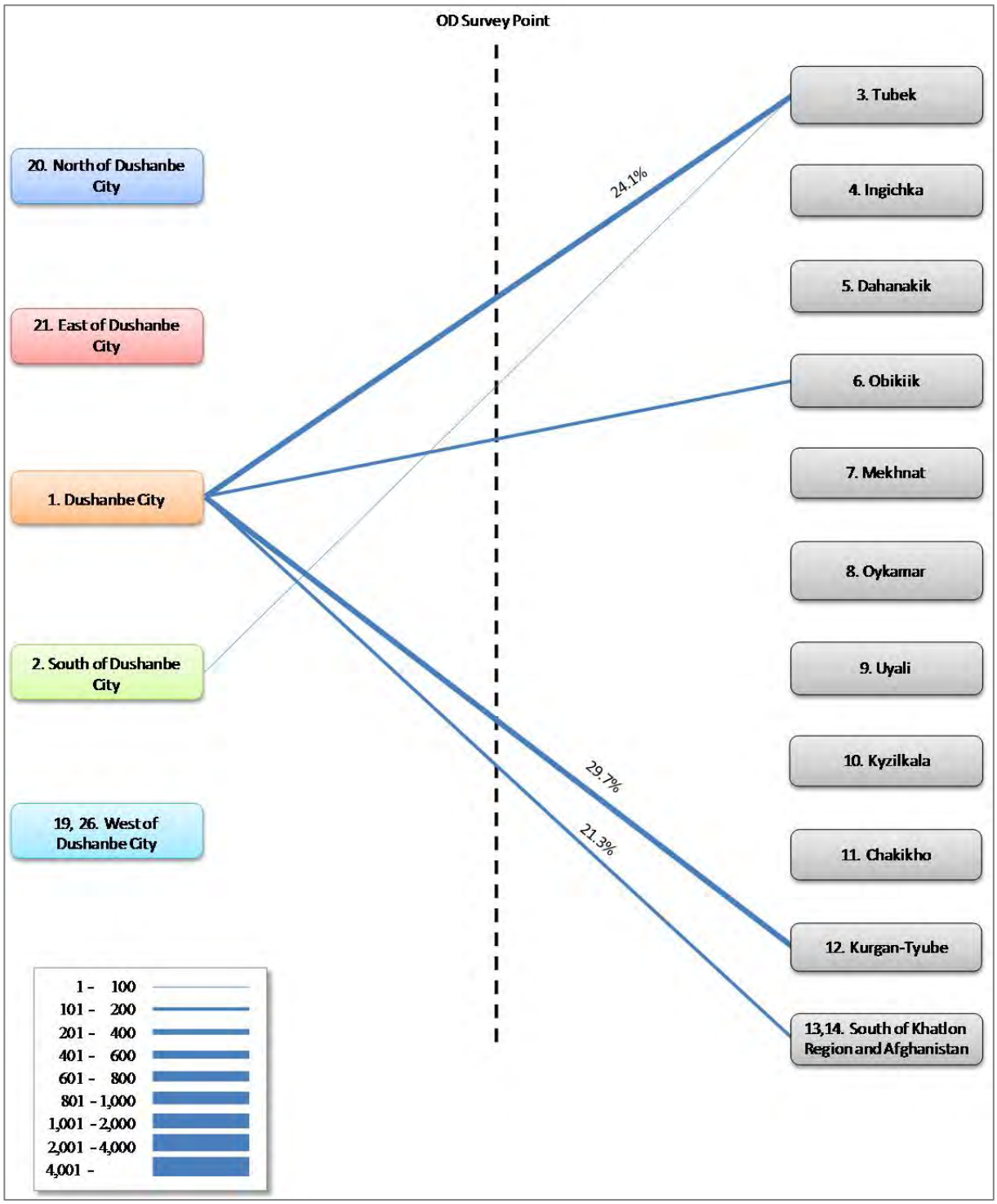
Zone Number	Town/Village Name	District/City	Province
1	Dushanbe	Dushanbe	RRS
2	Somon, Chimteppa, Obi Shifo, Navbunyod, Bahoriston,	Rudaki	RRS
3	Somoniyon, Tubek, Zarkamar, Lohur, Qosimobod, Orzu	Rudaki	RRS
4	Ingichka, Fakhrobod, Qaromandi, Urazboy, Yangihayot	Rudaki	RRS
5	Dahanakiik, Station Dahanakiik, Urozboy, Qaramandi, Gozimalik	Khuroson	Khatlon
6	Obikiik, Qushlich, Ismoili Somoni, A. Sohinnazarov, Oriyon, T. Dovidov, Galaobod, Saadi Quraev, J. Huseinov, A. Toshmuhammedov, Kh. Murodov, Musoev	Khuroson	Khatlon
7	Kiikmazor, Mekhnat, Hiloli, Lolazor, Jomi	Khuroson	Khatlon
8	Oykamar, Gulrez, Iftikhor, Hiloli	Khuroson	Khatlon
9	Uyali, Chorbogh, Vakhsh, Khuroson, Istiqlol, Nawzamin, Javoni, 18 portsesi bolo, Halqajar, Guliston,	Khuroson	Khatlon
10	Kizilkala, Buirobofon, Sarband	Khuroson	Khatlon
11	Chakikho, Borbad, Navobod, Ortod, Makhsumobod, Bibikhuram, Malik Giyoev, Qahramon, Hayoti Naw, Oq Oltun	Bokhtar	Khatlon
12	Kurgan-Tyube	Kurgan-Tyube	Khatlon
13	Vakhshstroy, Ismoili Somoni, Zargar, Bainalmilal, Yakkatut, Kalininobod, Havaskor, Guli surkh	Bokhtar	Khatlon
14	South of Khatlon Region (Uzun, Chapaev, S. Isoev, Varashilovobod, Kommunizm, Dusti, Zamini Nav, Rissovkhoz, Qaradum, Garouti), Afghanistan	Rumi, Qumsangir, Pyanj, Jilikul	Khatlon
15	Sarband, Bustonqala, Botrobod, Ergash	Sarband, Vose, Muminabad, Kulob, Khovaling,Farkhar	Khatlon
16	Yovon, Hasani, Urtaqainar, Garav, Dahana, Navkoram, Chorgul, Dashtobod, Zafarobod, Hayoti Nav, Firdavsi, Parchaso, Dastgirak, Furqat, Shota Rustaveli	Yovon	Khatlon
17	Bulbulchashma, Umbar, Beshbuloq, Shumul, Khojakulustu	Rudaki	DRS
18	Norak, Navdeha, Dahana, Shar-Shar, Shamoldara, Safedsang, Tojmahal, Khushdilon, Osmondara, Nurbakhsh	Norak	Khatlon
19	Hisor, Juyibodom, Navobod, Shurobi, Sharora, Oktyabr, Choryakkoron, Hisaor, Mahamdsoi Bolo, Bulbulchashma,Sharora	Hisor	DRS
20	Durmanbuloq, Chorbogh, Guzgarf, Sarynay, Darai Yaghnob, Kharangon, Bakavul, Varzob Qala, Luchob, Yakachughz, Shaftimizhgon,	Varzob	DRS
21	Guliston, Mehrobod, Khusnobod, Gulobod, Mehnatobod, Buston, Gulrez, Simiganj, Rohati, Noinkaj, Orjenikizobod	Vahdat	DRS
22	Nizomi, Pakhtaobod	Khuroson,Kobodiyon,Shahrituz	Khatlon
23	Vakhsh, Kirov, Doniyorqul, Komintern, Havaskor, Mashal, Angurbogh, Toshrobod	Vakhsh	Khatlon
24	A. Jomi, Buston, Rohi Socializm, Aral, Navobod, Aral, May 1st, Yakkatut, Chimbuloq, Oktyabr	Jomi	Khatlon
25	Lolazor, Komsomol, Sultonobod, Ghulakandoz, Pistamazor, Vahdatobod, Kuloni Bolo, Chormaghzak, Shakhtakiyon	Rudaki, Vahdat, Norak, Garm. Fayzobod, Rogun	DRS
26	Shahrinaw, Qaratogh, Tuda, Selbur, Sabo, Tojikiston, Katta, Chuqurdolon, Umbar, Karakuz, Tursunzoda, Nalbek, Levako, Toshobod, Chirtak, May 1st, Chapaev, Pakhtaobod, Rabot, A. Surkh, Pashmikuhna, Beshbuloq, Seshanbe, Yakhshiobod	Shahrinaw, Tursunzoda	DRS
27	Khujand, Istarafshan, Ayni, Isfara, Konibodom, Ura-Teppa, J.Rasulov, Penjikent	Khujand, Istarafshan, Ayni, Isfara, Konibodom, Ura-Teppa, J.Rasulov, Penjikent	Sogd
28	The Kyrgyz Republic	The Kyrgyz Republic	The Kyrgyz Republic

Source: JICA Study Team



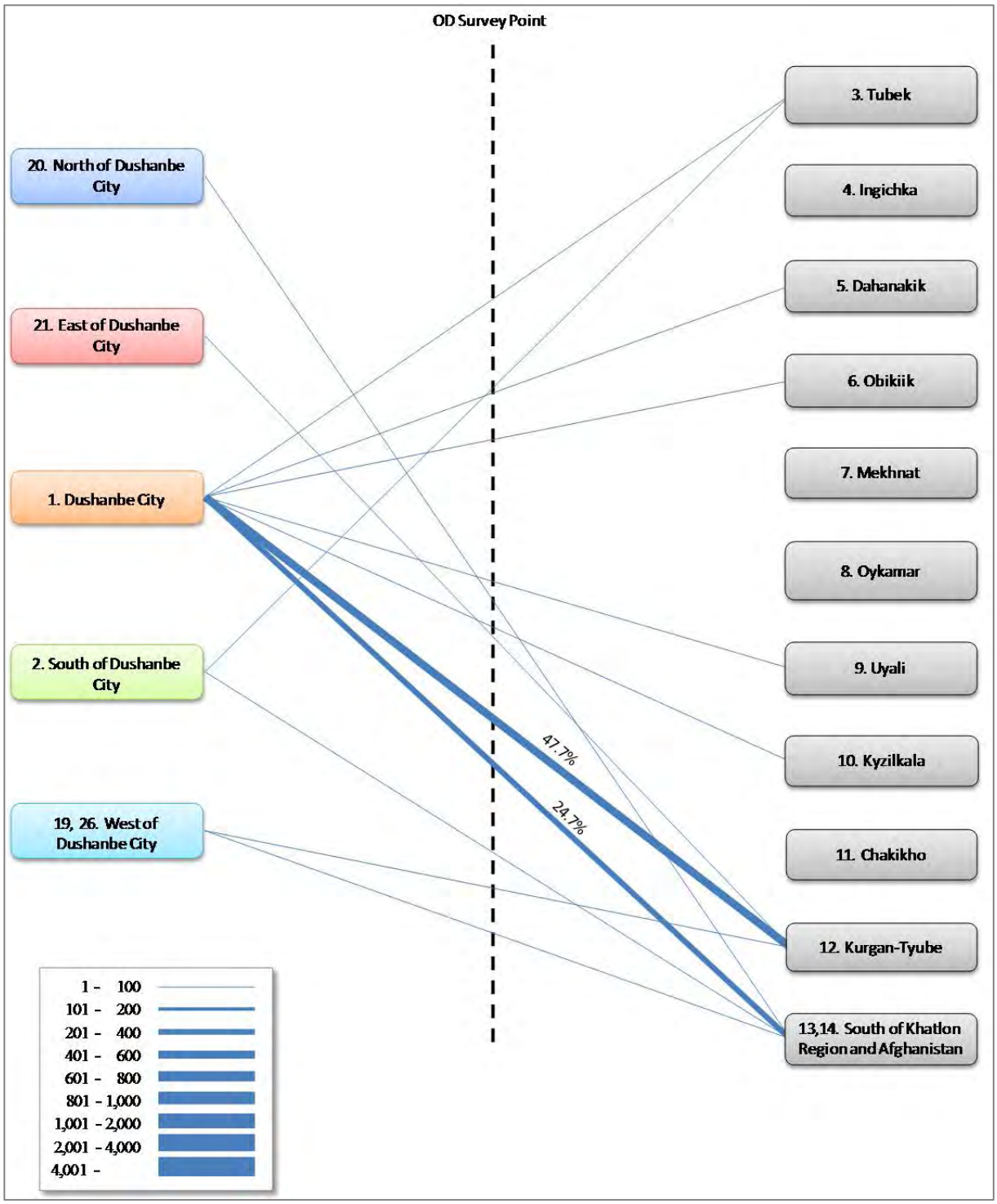
Source: JICA Study Team

FIGURE 5.5-2 PASSENGER CAR OD PATTERN



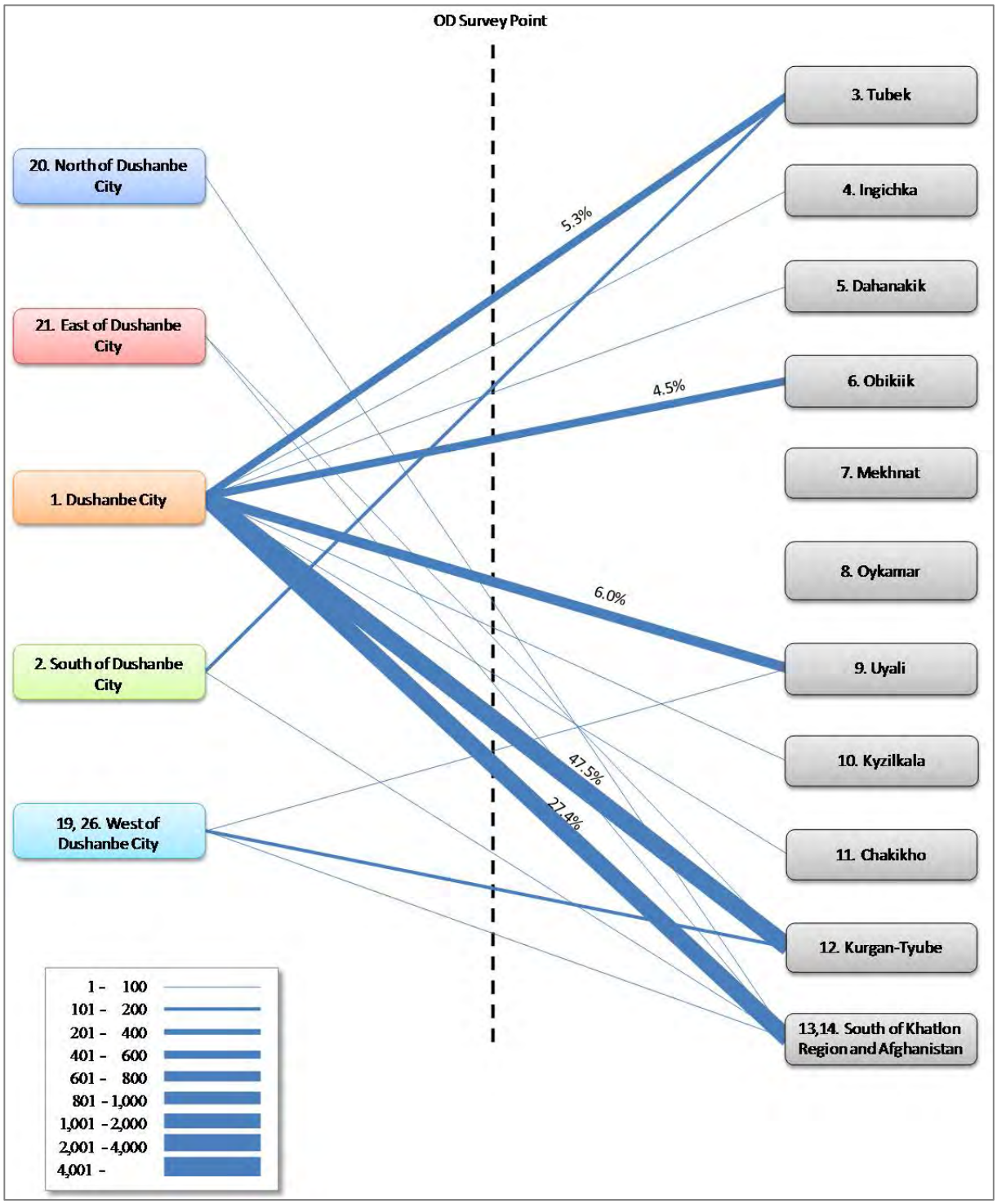
Source: JICA Study Team

FIGURE 5.5-3 BUS OD PATTERN



Source: JICA Study Team

FIGURE 5.5-4 TRUCK OD PATTERN

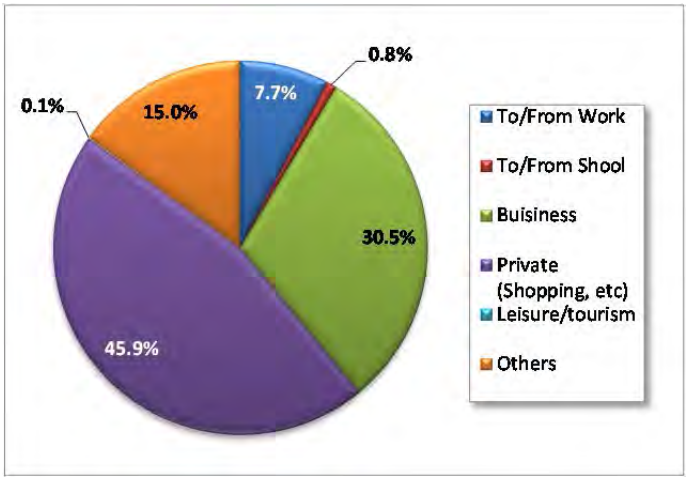


Source: JICA Study Team

FIGURE 5.5-5 ALL VEHICLE OD PATTERN

5.5.2 Trip Purposes

Share of trip purpose of passenger car passing DK Road is shown in **Figure 5.5-6**. Trip purpose of business and work shares 38.2% of total and private (Shopping, etc.) has highest share at 45.9%.



Source: JICA Study Team

FIGURE 5.5-6 SHARE OF PASSENGER CAR TRIP PURPOSE

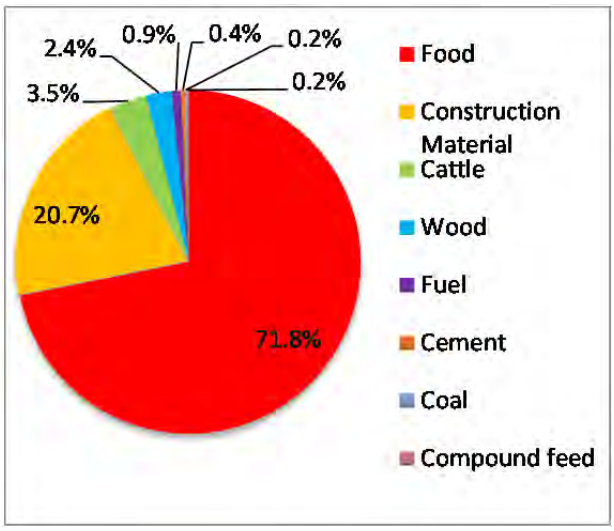
5.5.3 Commodities Transported

Commodities transported and share of commodities are shown in **Table 5.5-2**, **Figure 5.5-7** and **Figure 5.5-8**. Many food and construction material are transported on DK Road, shared at 80% to 90% respectively. Others like fuel, cattle, cement, clothes, wood and coal are also transported.

TABLE 5.5-2 COMMODITIES BY DIRECTION

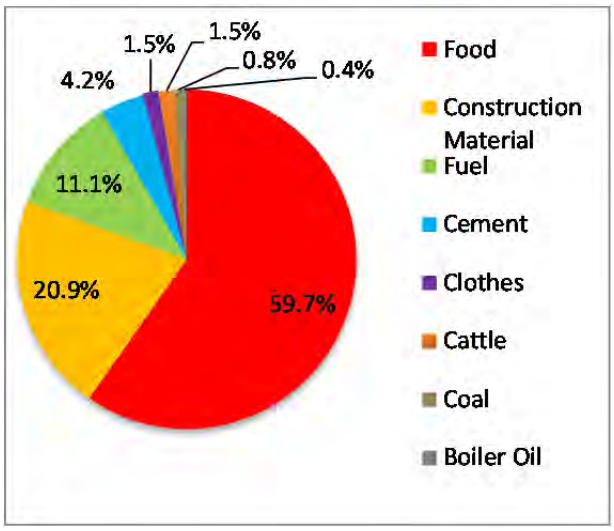
Direction	Commodities	Truck Total	%
From Dushanbe to Kurgan-Tyube	Food	158	59.8%
	Construction Material	55	20.8%
	Fuel	29	11.0%
	Cement	11	4.2%
	Clothes	4	1.5%
	Cattle	4	1.5%
	Coal	2	0.8%
	Boiler Oil	1	0.4%
From Kurgan-Tyube to Dushanbe	Food	401	72.0%
	Construction Material	115	20.6%
	Cattle	19	3.4%
	Wood	13	2.3%
	Fuel	5	0.9%
	Cement	2	0.4%
	Coal	1	0.2%
	Compound feed	1	0.2%

Source: JICA Study Team



Source: JICA Study Team

FIGURE 5.5-7 SHARE OF COMMODITIES FROM DUSHANBE TO KURGAN-TYUBE



Source: JICA Study Team

FIGURE 5.5-8 SHARE OF COMMODITIES FROM KURGAN-TYUBE TO DUSHANBE

5.6 Travel Time and Speed

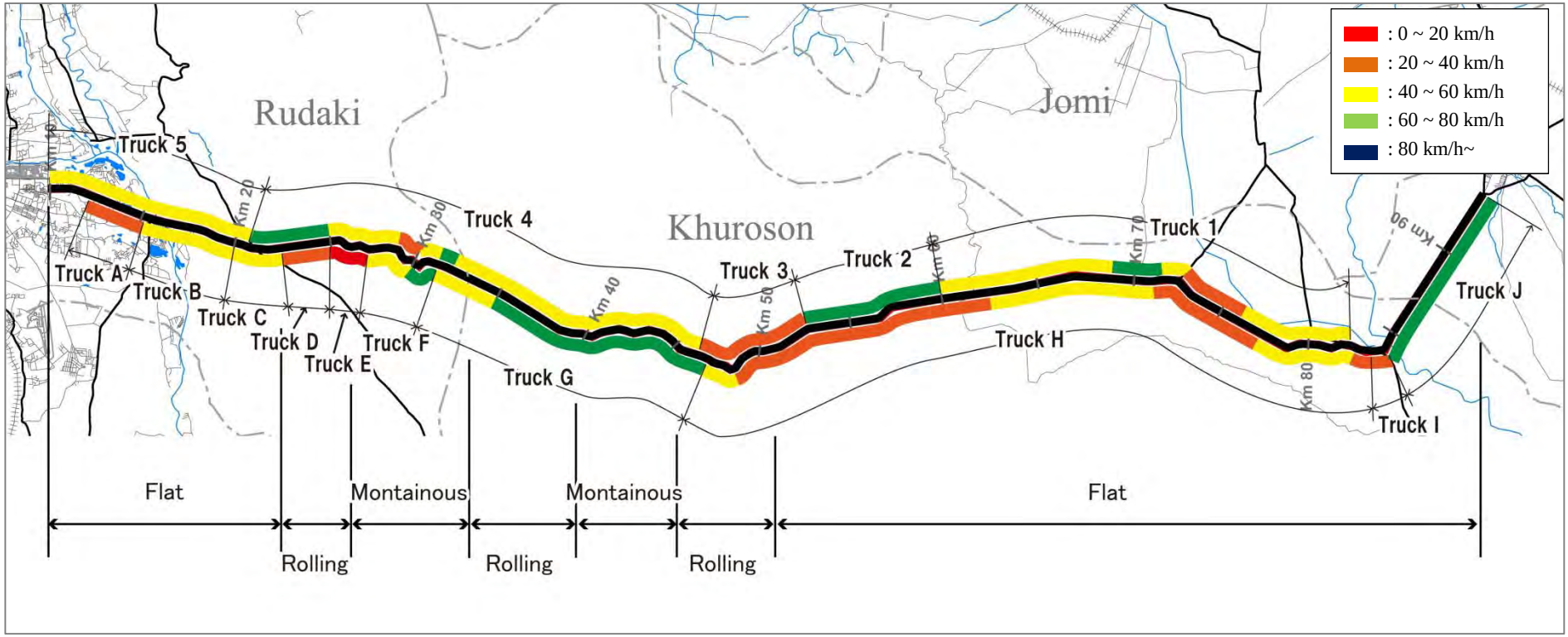
It was observed that passenger cars are traveling at very high speed of 100km/h or more. On the other hand, trucks, particularly heavily loaded trucks travel at low speed. Passenger cars try to overtake trucks utilizing opposite direction lane which is quite risky and cause of traffic accidents.

Based on above observation, it was decided that travel speed survey of passenger cars is not necessary, thus travel speed survey was focused on track travel time.

Travel speed survey method adopted was that a model vehicle follows a truck to estimate travel speed of the truck. Sometimes, a truck ends its trip at a certain point of DK Road. In that case, a model vehicle followed another truck.

Travel speed survey results are summarized in **Figure 5.6-1**. Characteristics of truck travel speed are as follows;

- Travel speed of loaded trucks is 20 to 40 km/h even at flat terrain.
- At mountainous terrain, travel speed of loaded truck is low at 20 km/h or less.
- A truck with no cargo can still travel at high speed of 60 to 80 km/h.
- Passenger cars try to overtake a loaded truck using opposite direction lane. Such overtaking will definitely increase as traffic volume increase and risks of traffic accidents increase accordingly.
- In near future, trucks will affect travel speed of passenger cars and traffic flow will be seriously disturbed.



Note: Truck A ~ J passed from Dushanbe to Kurgan-Tyube. Truck 1 ~ 5 passed from Kurgan-Tyube to Dushanbe
Source: JICA Study Team

FIGURE 5.6-1 TRAVEL SPEED OF TRUCKS AT DK ROAD

5.7 Axle Load Survey Results

5.7.1 Legal Framework of Axle Load in Tajikistan

Gross weight and axle load limit by the resolution No. 779 is specified as follows;

1) Gross Weight : 40 ton
2) Axle Load
   - Single axle : 10 ton
   - Tandem axle
     - Distance between axles more than 1.8m : 18 ton
   - Tridem axle
     - Distance between axles more than 1.8m : 22.5ton

Source: Resolution No. 779, Dec. 29, 2009

5.7.2 Number of Samples, Maximum Axle Load Observed and Equivalent Single Axle Load

Results of the axle load survey are summarized in **Table 5.7-1.**

TABLE 5.7-1 SUMMARY OF AXLE LOAD SURVEY (LOADED TRUCKS / TRAILERS ONLY)

Direction	Item	2-axle Truck	3-axle Truck	4 or more Axle Truck/Trailer
To Kurgan-Tyube (South-bound direction)	No. of Vehicles Weighed (Sampled)	5	22	27
	Max. Axle Load of observed (Ton)	7.6	24.0	26.2
	Max. Gross Weight Observed (Ton)	13.4	34.0	53.5
	Average Standard ESAL per Vehicle	0.5372	3.4836	5.6291
To Dushanbe (North-bound direction)	No. of Vehicles Weighed (Sampled)	25	26	11
	Max. Axle Load of observed (Ton)	12.1	21.4	22.1
	Max. Gross Weight Observed (Ton)	19.6	29.4	39.5
	Average Standard ESAL per Vehicle	1.2706	1.4891	3.8340
Both Direction	No. of Vehicles Weighed (Sampled)	30	48	38
	Max. Axle Load of observed (Ton)	12.1	24.0	26.2
	Max. Gross Weight Observed (Ton)	19.6	34.0	53.5
	Average Standard ESAL per Vehicle	1.1484	2.4864	5.1095

Source: JICA Study Team
Note: ESAL – Equivalent Single Axle Load
[ ] – Exceeded Legal Limit

Axle loads of the south bound direction from Dushanbe to Kurgan-Tyube are heavier than the other direction except 2-axle truck. Number of samples of 2-axle trucks of the south-bound direction was only 5 and does not represent overall axle load, and an average of both direction is judged to represent the axle load.

5.7.3 ESAL for Pavement Design

Based on the axle load survey results, ESAL per trucks/trailer for pavement design is recommended to be as follows;

Table 5.7-2 ESAL PER TRUCK/TRAILER FOR PAVEMENT DESIGN

Type of Truck/Trailer	ESAL per Truck/Trailer
2-axle Truck	1.148
3-axle Truck	3.484
4-axle or more Truck/Trailer	5.629

Source: JICA Study Team

5.7.4 Ratio of Empty (or Without Cargo) Trucks/Trailers

During the OD Survey (12-hour Survey), trucks/trailers were asked if it is loaded of cargoes or not (empty/unloaded). Results were as follows;

Direction	Un-loaded Trucks/Trailers Ratio (from 6:00 AM to 6:00 PM)
From Dushanbe to Kurgan-Tyube	34.6%
From Kurgan-Tyube to Dushanbe	34.3%
Both Direction	34.5%

Source: JICA Study Team

Trucks/trailers are running even at night time from 7:00PM to 6:00AM and these trucks/trailers are mostly carrying cargoes. It can be assumed that 100% of trucks/trailers running during night time carry cargoes (or loaded). On this basis, empty or unloaded trucks/trailers ratio becomes as shown below;

Direction	Un-loaded Trucks/Trailers Ratio (from 6:00 AM to 6:00 PM)
From Dushanbe to Kurgan-Tyube	22.6%
From Kurgan-Tyube to Dushanbe	13.9%
Both Direction	18.2%

Source: JICA Study Team

Unloaded trucks/trailers ratio can be assumed to be **20%** of the truck/trailer traffic for the pavement design.

5.8 Average Number of Passenger

Average number of passenger by vehicle is shown in **Table 5.8-1**. Average number of passenger of car is high at 3.16 persons/veh. Because, many owner-driven taxis are passing DK Road, car occupancy is higher than private passenger car by site observation. Average number of passenger of small bus and large bus is 6.41 persons/veh and 49.33 persons/veh, respectively.

TABLE 5.8-1 AVERAGE NUMBER OF PASSENGER BY VEHICLE

Vehicle Type	Average Number of Passenger (persons/veh)
Car	3.16
Small Bus	6.41
Large Bus	49.33

Source: JICA Study Team

5.9 Traffic Characteristics of DK Road

Based on traffic survey and site observations, traffic characteristics of DK road are as follows;

- Over 85% traffic passing through the DK Road is a passenger car, the share of a bus and a truck is still low at 5% and 10%, respectively.
- Travel speed of passenger car passing through the DK Road is extremely high at approximately 100 km/h or more.
- Traffic volume in the urban area of Dushanbe City and Kurgan-Tyube City is high at over 13,000 veh/day.
- Traffic volume along the DK Road is rapidly increasing. However, traffic congestion has not yet observed along DK Road. The reason is that bottleneck points such as major intersections do not exist along DK Road. However, judging from traffic volume, DK Road is approaching to un-stable flow of traffic. When traffic increases some more (say additional 4,000 to 5,000 veh/day more), delay in travel time will occur.

5.10 Traffic Demand Forecast

5.10.1 Methodology

Traffic demand forecast of DK Road was undertaken in the following steps;

Step-1: Traffic projection is made based on the past traffic growth rates of DK Road

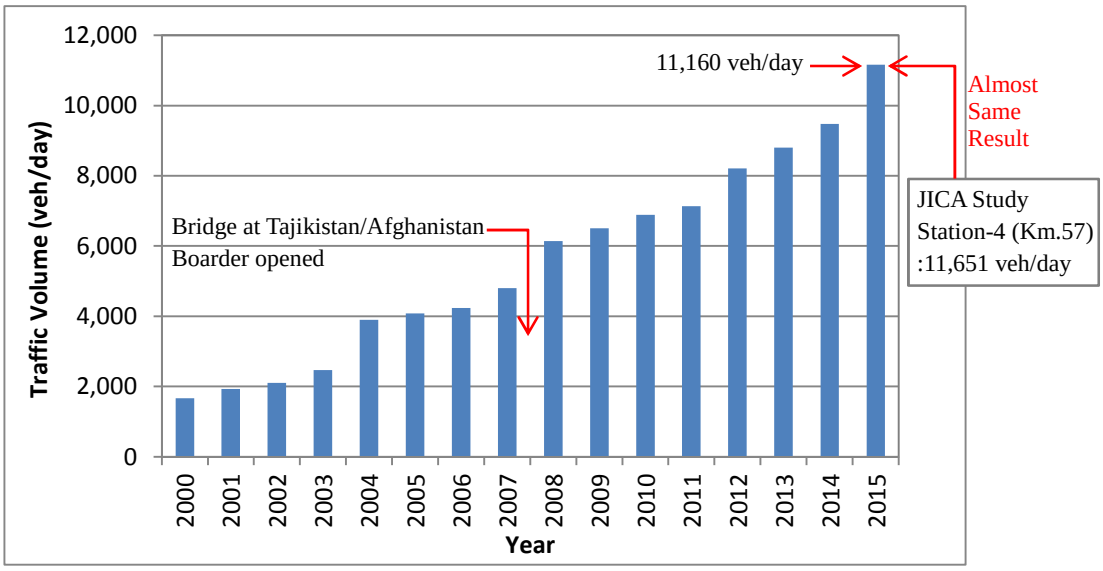
Step-2: traffic projection is made based on the co-relation between socio-economic growth pattern and traffic growth rate. Future socio-economic indicators are applied to co-relation between socio-economic indicators and traffic growth to estimate future traffic demand.

Step-3: Variety above traffic projection based on the formula of "Traffic Growth Rate Estimation".

Step-4: Determine future traffic growth rates and estimate future traffic volume.

Step-1: Traffic Projection Based on the Past Traffic Growth

Traffic count results at Km. 51 from 2000 to 2015 are shown in **Figure 5.10-1**. Past traffic growth in % per annum is summarized in **Table 5.10-1**.



Source: MOT

FIGURE 5.10-1 PAST TREND OF TRAFFIC VOLUME BY MOT TRAFFIC COUNT AT KM. 51

TABLE 5.10-1 PAST TRAFFIC GROWTH OF DK ROAD

Period	Average Traffic Growth Rate (% per annum)
2000 – 2014 (14 years average)	13.2%
2004 – 2014 (10 years average)	9.3%
2008 – 2014 (6 years average)	7.5%
2010 – 2014 (4 years average)	8.3%
2012 – 2014 (2 years average)	7.5%
2000 – 2013 (13 years average)	13.6%
2004 – 2013 (9 years average)	9.5%
2008 – 2013 (5 years average)	7.5%
2010 – 2013 (3 years average)	8.5%

Source: Developed by JICA Study Team Based on MOT Data

As shown above, traffic growth of DK Road is quite high. Traffic growth rate of 7.5% may be realistic growth rate.

Step-2: Co-relation between Socio-Economic Growth and Traffic Growth

Socio-economic indicators which may closely related to traffic growth are i) GDP, ii) population and iii) vehicle registration.

Co-relation between traffic growth and GDP growth are shown in **Table 5.10-2**.

TABLE 5.10-2 TRAFFIC GROWTH AND GDP GROWTH

Period	(A) Traffic Growth Rate	(B) GDP Growth Rate	A-B	Remarks
2000 – 2014	13.2%	7.7%	5.5%	Traffic growth rate is higher by 0.7% to 1.3% than GDP growth rate in recent years.
2004 – 2014	9.3%	6.8%	2.5%	
2008 – 2014	7.5%	6.5%	1.0%	
2010 – 2014	8.3%	7.0%	1.3%	
2012 – 2014	7.5%	6.8%	0.7%	
2000 – 2013	13.6%	7.8%	5.8%	Traffic growth rate is higher by 1.0 to 1.2% than GDP growth rate in recent years.
2004 – 2013	9.5%	6.9%	2.6%	
2008 – 2013	7.5%	6.5%	1.0%	
2010 – 2013	8.5%	7.3%	1.2%	

Source: JICA Study Team

In recent years (or after 2008), traffic growth rate of DK Road is higher by 0.7% to 1.3% than GDP growth rate.

For future traffic projection, traffic growth rate may be assumed to be higher by 1.0% than GDP growth rate.

Future GDP growth rate estimated by IMF is 5.75% from 2015 to 2019, thus traffic growth rate could be 6.75% per annum

Step-3: Based on "Traffic Growth Rate Estimation"

The following formula is commonly used internationally to estimate future traffic growth rate of a certain road;

$$\text{TGR (in \%)} = \left[\left(\frac{I \times E}{100} + 1\right) \times CP - 1\right] \times 100$$

Where;

TGR = Traffic growth rate per annum

E = Transport demand-income elasticity

= 1.2

I = Growth rate in percent for per capita income in constant price

= 4.1 (since data on per capita income was not available, thus per capita GDP growth rate was applied.)

CP = Compound population growth rate per annum

= 2.0% (Dushanbe City)

Based on the above assumption, traffic growth rate was computed as 7.0% per annum.

TABLE 5.10-3 POPULATION GROWTH RATE TREND

	Dushanbe	Khatlon
2000 – 2013	2.3%	2.1%
2004 – 2013	2.3%	2.3%
2008 – 2013	2.3%	2.5%
2010 - 2013	2.0%	2.4%

Source: MOT

Step-4: Determine Future Traffic Growth Rate Results of Step-1 to Step-3 are summarized as follows;

Estimated Traffic Growth Rate (%)			
Step-1	Ranges from 7.5% to 13.6%	⇨	Recent growth rate is 7.5%
Step-2	6.75%		
Step-3	7.0%		

Source: JICA Study Team

Judging from above results, 7.0% will be the most realistic traffic growth rate. However, traffic growth rate will be influenced by the economic growth and population increase rate. There is probability of higher of lower economic and population growth rate than assumed. Estimated traffic growth of 7.0% per annum was assumed and 10% and 5% was assumed to be High Assumption and Low Assumption, respectively.

Moreover, as the increase of traffic volume, growth rate is usually decreased. It was assumed that traffic growth rate will decrease by 0.5% at every 5 years for medium and low assumptions (growth rate of High Assumption will decrease by 1.0% at every 5 years). Annual traffic growth rate was assumed as shown in **Table 5.10-4**.

TABLE 5.10-4 ANNUAL AVERAGE TRAFFIC GROWTH RATE FOR FUTURE TRAFFIC VOLUME OF DK ROAD

Period	Annual Average Traffic Growth Rate (% per Annum)		
	High Assumption	Medium Assumption	Low Assumption
2016 – 2020	10.0%	7.0%	5.0%
2021 – 2025	9.0%	6.5%	4.5%
2026 – 2030	8.0%	6.0%	4.0%

Source: JICA Study Team

5.10.2 Future Traffic Volume

Future traffic volume of DK Road based on defined annual average growth rate (see **Table 5.10-4**) was estimated and shown in **Figure 5.11-1** to **Figure 5.11-7** in the next section.

5.11 Level of Service of Traffic and Estimated Timing of Widening to a 4-lane Road

Some of DK Road sections are carrying more than 10,000 veh/day and past traffic growth rate is quite high ranging 7.5% to 10.0% per annum. It is assumed that traffic will grow at 7.0% per annum even in the future.

Current DK Road is a 2-lane road and widening to a 4-1ane road (2-lane for each direction) will be required in near future.

5.11.1 Maximum Target Traffic Volume of a 2-lane Road

Various standards suggest maximum target traffic volume of a 2-lane road or timing to be widened to a 4-lane road as shown in Table 5.11-1.

TABLE 5.11-1 MAX. TARGET TRAFFIC VOLUME OF A 2-LANE ROAD (TIMING OF WIDENING TO A 4-LANE ROAD)

Standards	Max. Target Traffic Volume of A 2-lane Road
SNiP	14,000 PCU/day (or 12,800 veh/day for DK Road)
AASHTO USA	Level of Service : C (Recommended to be "D" by the Study Team)
Japan's Standards	20,000 veh/day

Source: JICA Study Team

Note: A Policy on Geometric Design of Highways and Streets, 2004 (AASHTO) suggests the appropriate level of service for each functional class of road as follows;

Functional class	Appropriate level of service for specified combinations of area and terrain type			
	Rural: Level	Rural: Rolling	Rural: Mountainous	Urban and Suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

DK Road is classified as Arterial Road and target level of service is "B" for level as rolling terrain and "C" for mountainous terrain and urban/suburban.

The JICA Study Team believes that AASHTO's criteria are too much ideal and recommended to down-grade to "D" for all terrains.

Service traffic volume of DK Road by terrain computed based on Highway Capacity Manual (HCM), 2000 is shown in **Table 5.11-2**.

TABLE 5.11-2 DK ROAD SERVICE TRAFFIC VOLUME

Level of Service	Terrain	
	Level/Flat	Mountainous
A (Motorists area able to travel at their desired speed)	**180 veh/hr**	**30 veh/hr**
B (Traffic flow with speeds of 80 km/h or slightly higher on level terrain)	**360 veh/hr**	**120 veh/hr**
C (Noticeable increases in platoon formation, platoon size, and frequency of passing impediments)	**770 veh/hr**	**270 veh/hr**
D (Unstable traffic flow. The two opposing traffic streams begin to operate separately at higher volume levels, as passing becomes extremely difficult)	**1,440 veh/hr**	**560 veh/hr**
E (Passing is virtually impossible at LOS E, and Platooning becomes intense, as slower vehicles or other interruptions are encountered)	**2,490 veh/hr**	**1.310 veh/hr**
F (Heavily congested flow with traffic demand exceeding capacity)		

Note: Assumption: 9% truck and bus, free flow speed-80kmlh, No passing lane-70%

Table 5.11-3 shows future traffic volume and level of service at each traffic survey station.

TABLE 5.11-3 FUTURE TRAFFIC VOLUME AND LEVEL OF SERVICE AT EACH TRAFFIC STATION

Year	Station-1(Flat)				Staion-2 (Flat)				Station-3 (Mountainous)				Sation-4 (Flat)			
	veh/day	veh/hour	LOS	VCR	veh/day	veh/hour	LOS	VCR	veh/day	veh/hour	LOS	VCR	veh/day	veh/hour	LOS	VCR
2015	17,280	1,187	D	0.82	10,547	717	D	0.50	9,925	675	E	1.21	11,651	781	D	0.54
2016	18,490	1,270	D	0.88	11,285	767	D	0.53	10,620	722	E	1.29	12,467	835	D	0.58
2017	19,784	1,359	D	0.94	12,075	821	D	0.57	11,363	773	E	1.38	13,339	894	D	0.62
2018	21,169	1,454	E	1.01	12,921	879	D	0.61	12,159	827	E	1.48	14,273	956	D	0.66
2019	22,651	1,556	E	1.08	13,825	940	D	0.65	13,010	885	E	1.58	15,272	1,023	D	0.71
2020	24,236	1,665	E	1.16	14,793	1,006	D	0.70	13,920	947	E	1.69	16,341	1,095	D	0.76
2021	25,811	1,773	E	1.23	15,754	1,071	D	0.74	14,825	1,008	E	1.80	17,403	1,166	D	0.81
2022	27,489	1,888	E	1.31	16,778	1,141	D	0.79	15,789	1,074	E	1.92	18,535	1,242	D	0.86
2023	29,276	2,011	E	1.40	17,869	1,215	D	0.84	16,815	1,143	E	2.04	19,739	1,323	D	0.92
2024	31,179	2,142	E	1.49	19,030	1,294	D	0.90	17,908	1,218	E	2.17	21,022	1,408	D	0.98
2025	33,206	2,281	E	1.58	20,267	1,378	D	0.96	19,072	1,297	E	2.32	22,389	1,500	E	1.04
2026	35,198	2,418	E	1.68	21,483	1,461	E	1.01	20,216	1,375	E	2.45	23,732	1,590	E	1.10
2027	37,310	2,563	E	1.78	22,772	1,549	E	1.08	21,429	1,457	E	2.60	25,156	1,685	E	1.17
2028	39,548	2,717	E	1.89	24,139	1,641	E	1.14	22,715	1,545	F	2.76	26,665	1,787	E	1.24
2029	41,921	2,880	F	2.00	25,587	1,740	E	1.21	24,078	1,637	F	2.92	28,265	1,894	E	1.32
2030	44,437	3,052	F	2.12	27,122	1,844	E	1.28	25,523	1,736	F	3.10	29,961	2,007	E	1.39

Year	Station-5 (Flat)				Staion-6 (Flat)				Staion-7 (Flat)			
	veh/day	veh/hour	LOS	VCR	veh/day	veh/hour	LOS	VCR	veh/day	veh/hour	LOS	VCR
2015	12,112	799	D	0.56	13,771	909	D	0.63	16,571	1,127	D	0.78
2016	12,960	855	D	0.59	14,735	973	D	0.68	17,731	1,206	D	0.84
2017	13,867	915	D	0.64	15,766	1,041	D	0.72	18,972	1,290	D	0.90
2018	14,838	979	D	0.68	16,870	1,113	D	0.77	20,300	1,380	D	0.96
2019	15,876	1,048	D	0.73	18,051	1,191	D	0.83	21,721	1,477	E	1.03
2020	16,988	1,121	D	0.78	19,315	1,275	D	0.89	23,242	1,580	E	1.10
2021	18,092	1,194	D	0.83	20,570	1,358	D	0.94	24,752	1,683	E	1.17
2022	19,268	1,272	D	0.88	21,907	1,446	E	1.00	26,361	1,793	E	1.24
2023	20,520	1,354	D	0.94	23,331	1,540	E	1.07	28,075	1,909	E	1.33
2024	21,854	1,442	E	1.00	24,848	1,640	E	1.14	29,900	2,033	E	1.41
2025	23,275	1,536	E	1.07	26,463	1,747	E	1.21	31,843	2,165	E	1.50
2026	24,671	1,628	E	1.13	28,050	1,851	E	1.29	33,754	2,295	E	1.59
2027	26,151	1,726	E	1.20	29,733	1,962	E	1.36	35,779	2,433	E	1.69
2028	27,720	1,830	E	1.27	31,517	2,080	E	1.44	37,926	2,579	E	1.79
2029	29,384	1,939	E	1.35	33,408	2,205	E	1.53	40,201	2,734	E	1.90
2030	31,147	2,056	E	1.43	35,413	2,337	E	1.62	42,613	2,898	F	2.01

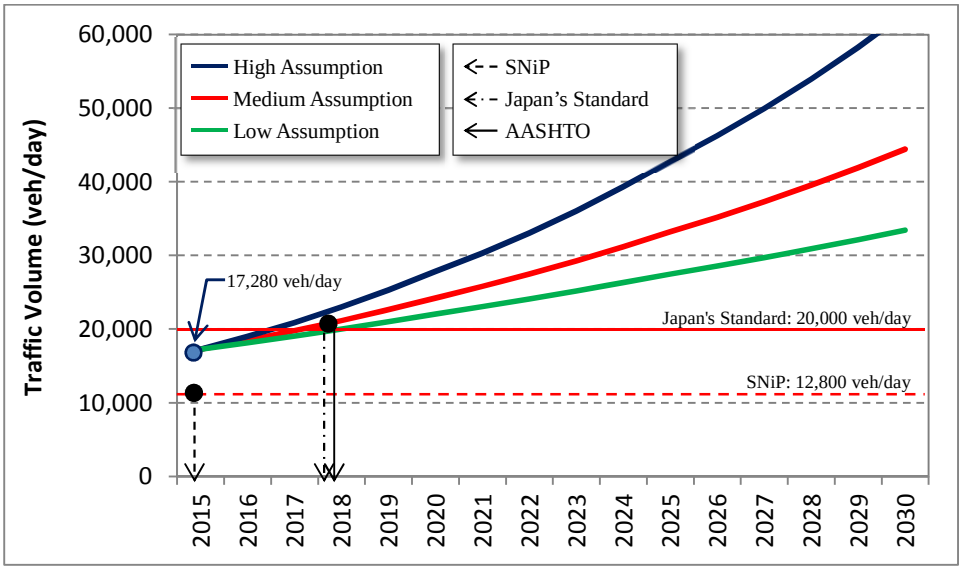
Source: Calculated by JICA Study Team based on HCM 2000

Future traffic demand and timing of widening to a 4-lane road at each traffic station is shown in **Figure 5.11-1** to **Figure 5.11-7**, and summarized in **Table 5.10-4**.

TABLE 5.11-4 TARGET YEAR WHEN WIDENING TO A 4-LANE TO BE COMPLETED

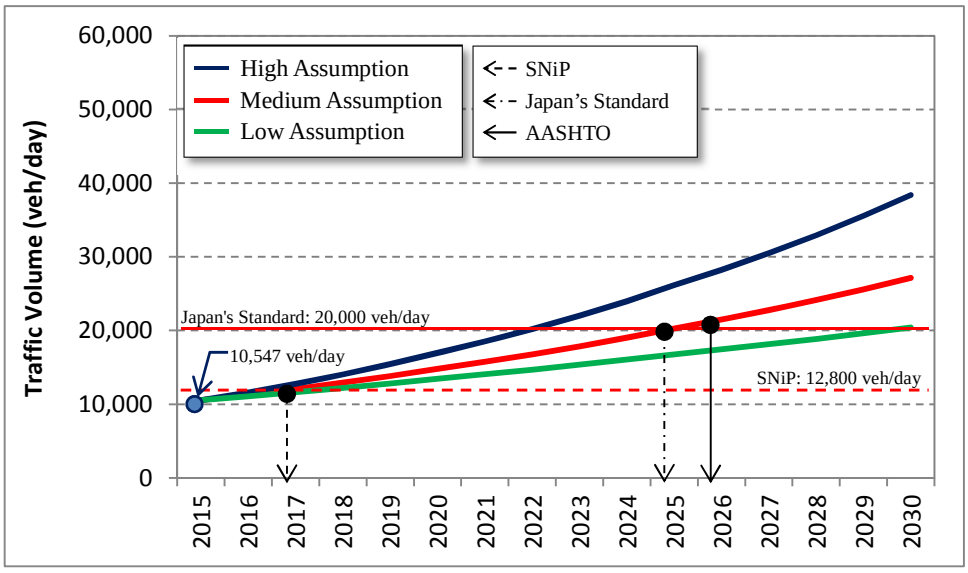
Traffic Station	Target Year when widening to a 4-1ane to be completed			
	SNiP	AASHTO	Japan's Standard	Recommendation (Note-1)
Traffic Survey Sta.- 1 (Km.15)	2015	2018	2018	2017
Traffic Survey Sta.- 2 (Km.22)	2017	2026	2025	2022
Traffic Survey Sta.- 3 (Km.32)	2018	2015	2026	2021
Traffic Survey Sta.- 4 (Km.57)	2016	2025	2024	2021
Traffic Survey Sta.- 5 (Km.73)	2016	2024	2023	2020
Traffic Survey Sta.- 6 (Km.84)	2015	2022	2021	2019
Traffic Survey Sta.- 7 (Km.93)	2015	2019	2018	2017

Note-1: Mid-year between the earliest and latest year is selected.
Source: JICA Study Team



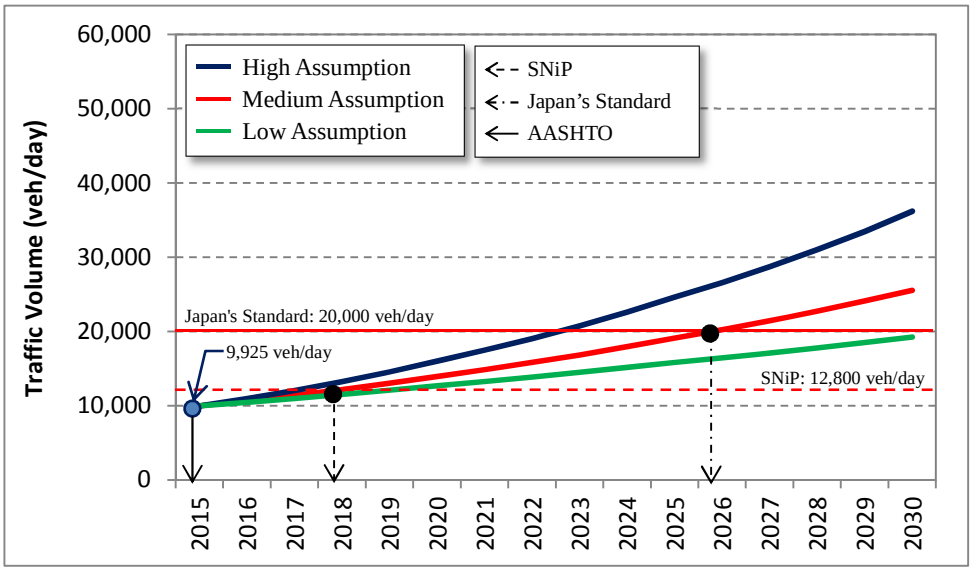
Source: JICA Study Team

FIGURE 5.11-1 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-1 (KM. 15)



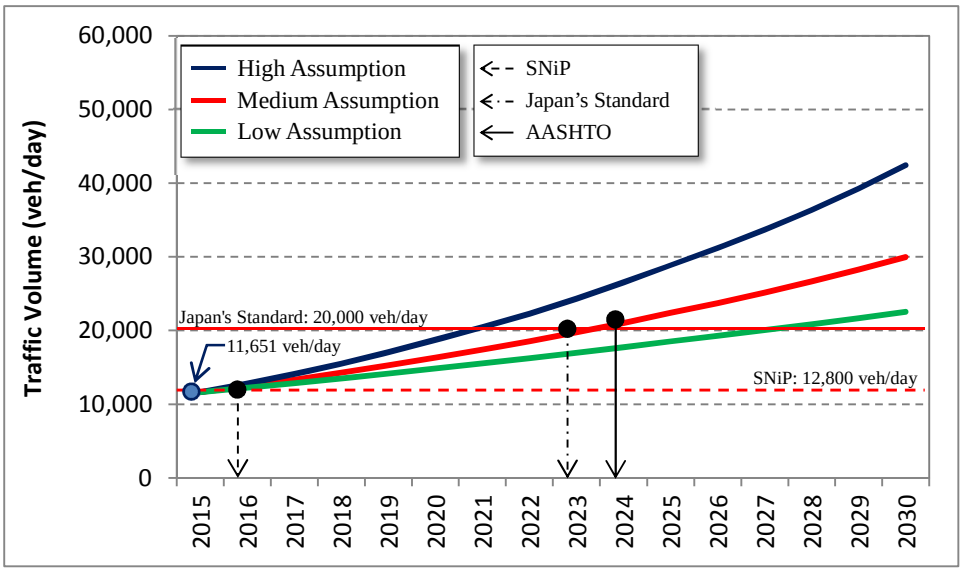
Source: JICA Study Team

FIGURE 5.11-2 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-2 (KM. 22)



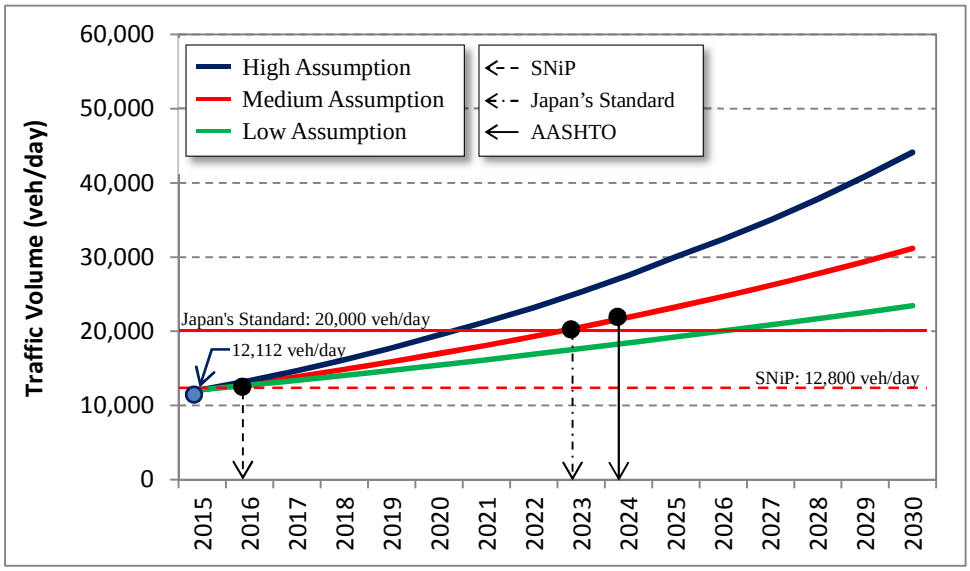
Source: JICA Study Team

FIGURE 5.11-3 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-3 (KM. 32)



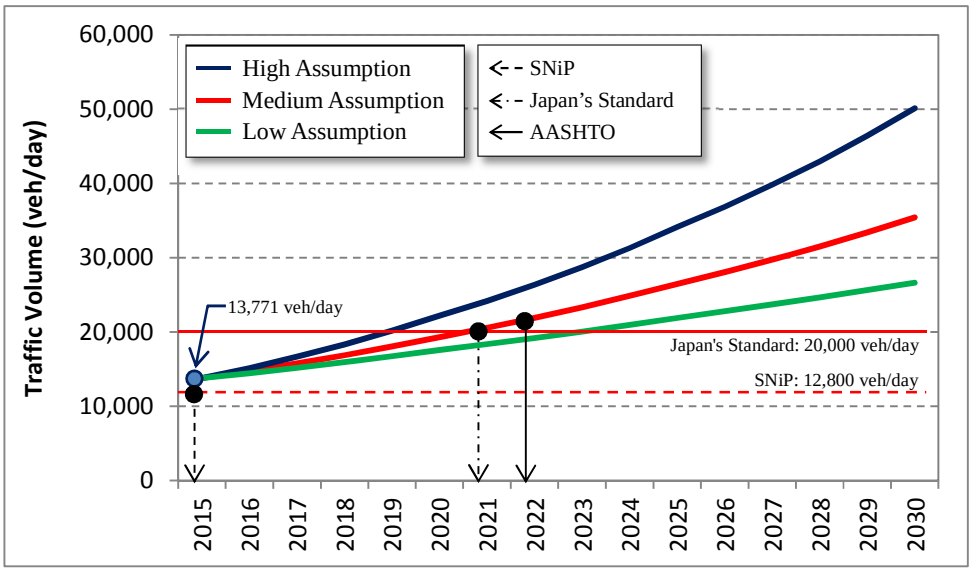
Source: JICA Study Team

FIGURE 5.11-4 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-4 (KM. 57)



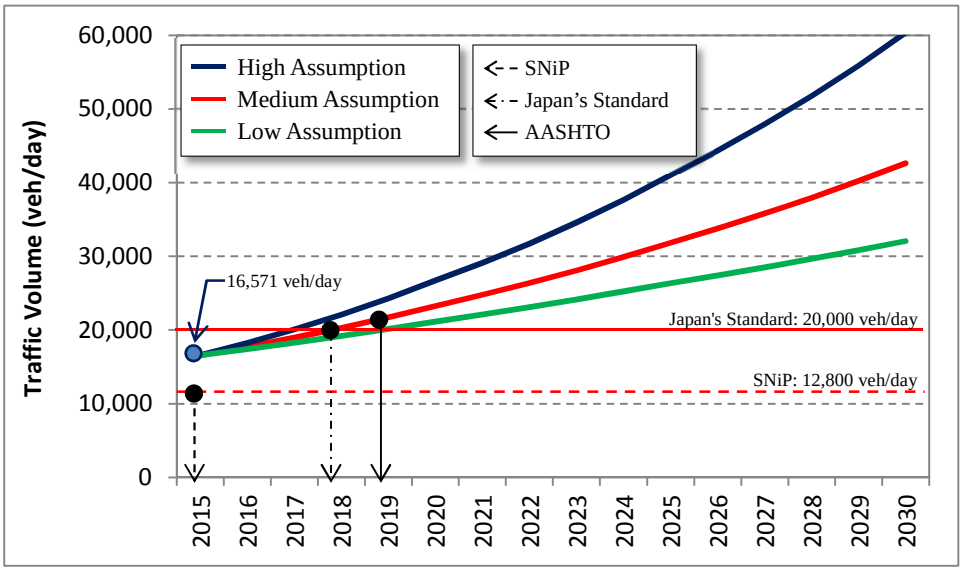
Source: JICA Study Team

FIGURE 5.11-5 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-5 (KM. 73)



Source: JICA Study Team

FIGURE 5.11-6 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-6 (KM. 84)



Source: JICA Study Team

FIGURE 5.11-7 TRAFFIC PROJECTION AT TRAFFIC SURVEY STATION-7 (KM. 93)

CHAPTER 6 EXISTING DK ROAD CONDITIONS AND PROBLEMS

6.1 Number of Lanes and Cross-section

6.1.1 Number of Lanes

The number of lanes of the existing DK Road is shown in the **Table 6.1-1**.

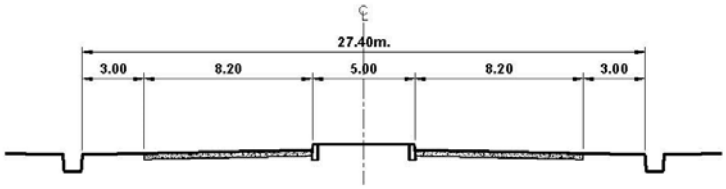
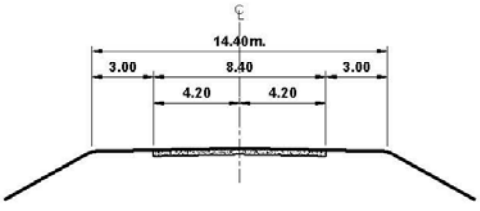
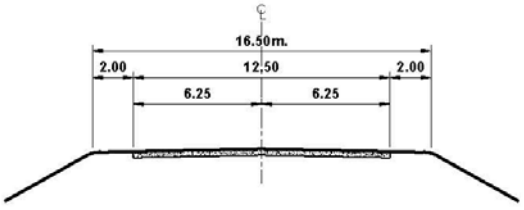
TABLE 6.1-1 LIST OF NUMBER OF LANES

Km	Number of Lanes	Length(Km)
Km.9+886(Start Point)～Km.15+030 (Within Dushanbe City)	4	5.14
Km.15+030～Km.93+530(End Point)	2	78.50
	Total	83.64

Source : JICA Study Team

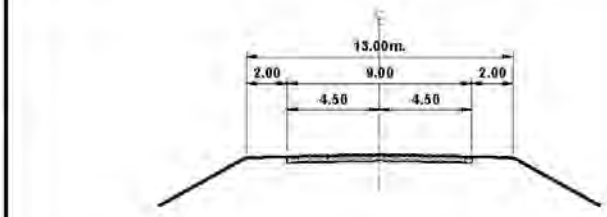
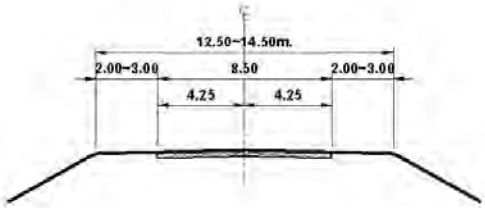
6.1.2 Existing Cross Sections

The existing cross sections of DK Road are shown in the **Figure 6.1-1** to **Figure 6.1-4.**

Section	Existing Cross-Section
Km. 9+886~Km. 15+018	
Km. 15+030~Km. 21+500	
Km. 21+500~Km. 37+000	

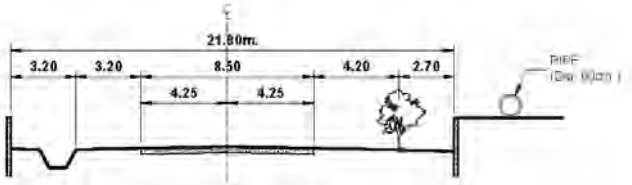
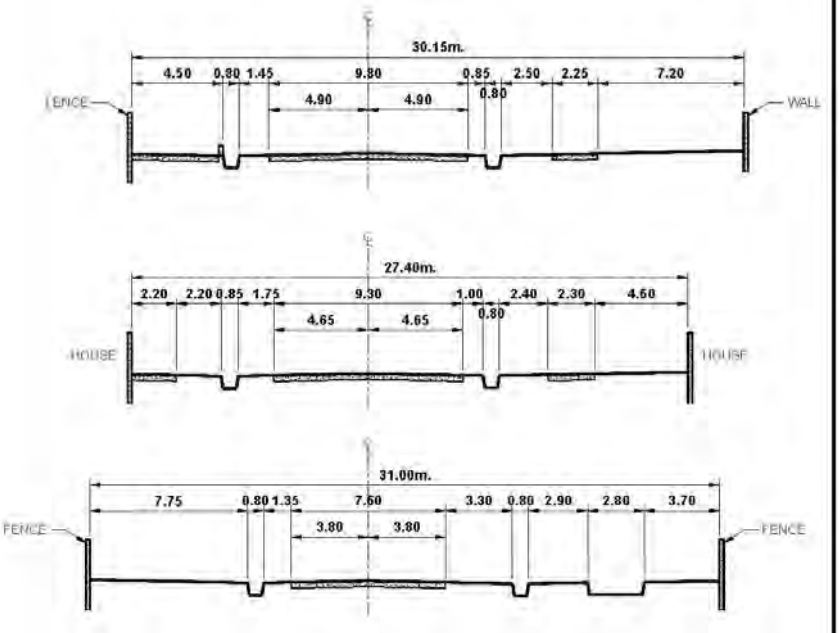
Source: JICA Study Team

FIGURE 6.1-1 CROSS SECTION OF RURAL SECTION (1/2)

Km. 38+000~Km. 51+000 Km. 54+000~Km. 72+000	
Km. 75+000~Km. 93+775	

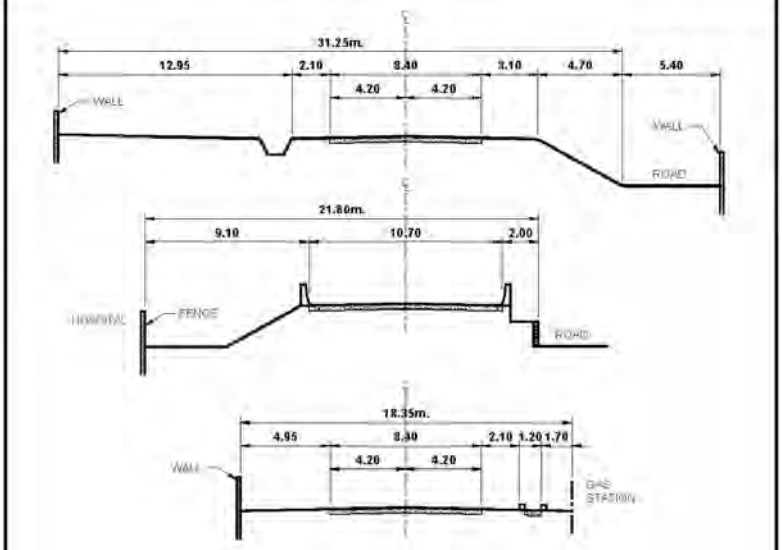
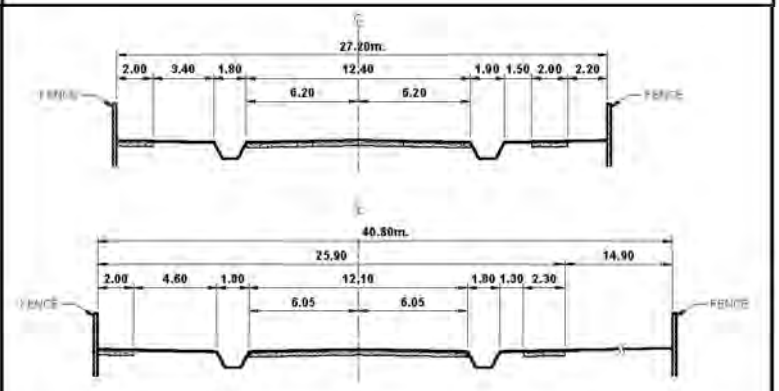
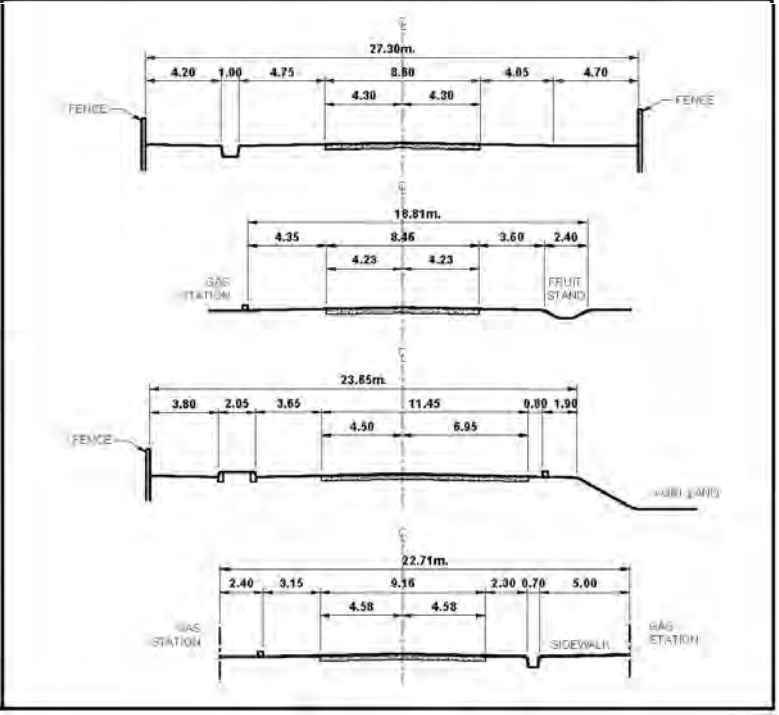
Source: JICA Study Team

FIGURE 6.1-2 CROSS SECTION OF RURAL SECTION (2/2)

Village / Town Name	Existing Cross-Section
Kief	
Uyali	

Source: JICA Study Team

FIGURE 6.1-3 CROSS SECTION OF URBAN SECTION (1/2)

Village / Town Name	Existing Cross-Section
Kyzilkala	
Obikik	
Kurgan Tyube	

Source: JICA Study Team

FIGURE 6.1-4 CROSS SECTION OF URBAN SECTION (2/2)

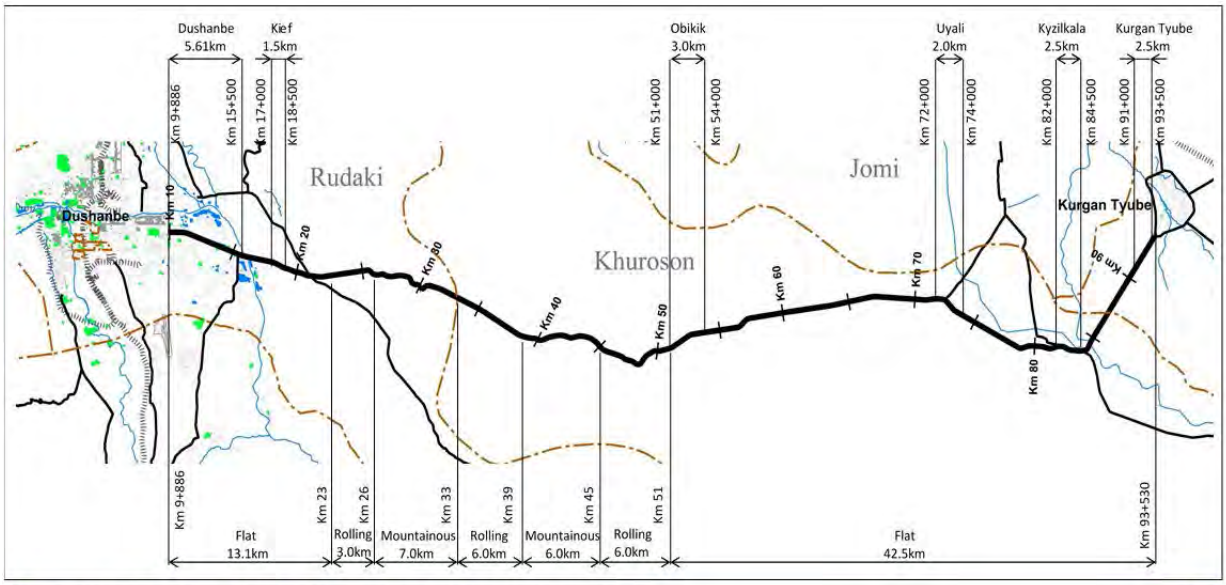
6.2 Horizontal Alignment

The elements of horizontal alignment of the existing DK road was reviewed and compared with the requirements of both the Asian Highway (AH) Standards and that of the SNiP for the different terrain/topography along the road alignment. A comparison of the design requirements for both the AH and SNiP Standards for flat, rolling and mountainous road sections is presented in **Table 6.2-1**.

TABLE 6.2-1 MINIMUM RADIUS FOR HORIZONTAL CURVES

Specification	Requirements	Flat	Rolling	Mountainous
Asian Highway (Class II)	Design Speed (km/hr)	100	80	50
	Min. Radius (m)	350	210	80
SNiP (Class III)	Design Speed (km/hr)	100	80	50
	Min. Radius (m)	600	300	100

The existing conditions of the DK road horizontal alignment curvature is summarized in **Figure 6.2-1** with reference to **Table 6.2-1** for flat, rolling and mountainous road sections along the alignment. As seen in the figure, if SNiP Class III is applied 15 sections of the road alignment need to be improved to comply with the minimum radius of curvature. However, when referring to the AH Class II road requirements, only 5 road sections will need to be improved.



Number of Horizontal Curves Along the Alignment Requiring Geometric Improvement									Total
AH Standard	R > 350	OK	-	-	-	-	-	2	5
	R > 210	-	OK	-	OK	-	3	-	
	R > 80	-	-	OK	-	OK	-	-	
SNiP Class III	R > 600	OK	-	-	-	-	-	11	16
	R > 300	-	OK	-	OK	-	3	-	
	R > 100	-	-	2	-	OK	-	-	

Profile: Length (km) of Road Section with Gradient Exceeding 5%, 6% or 7%								
Rolling	Over 5%	-	1.2	-	0.6	-	No Data	-
Mountainous	6%- 7%	-	-	1.5	-	1.2	No Data	-
	Over 7%	-	-	0.8	-	0.3	No Data	-
SNiP	Over 4%	-	1.7	6.6	1.5	3.1	No Data	-

FIGURE 6.2-1 EXISTING HORIZONTAL ALIGNMENT AND VERTICAL PROFILE ISSUES OF DK ROAD

6.3 Vertical Alignment

A profile survey was conducted from Km.23 to Km.45 of the existing DK road to determine the existing gradients along the rolling and mountainous terrains. The result of the survey is presented in **Figure 6.2-1**. As shown in the figure, at least 1.8 kms of the road section have gradients in excess of 5% for the rolling terrain and 3.8 kms of the road section have gradients in excess of 6% in the mountainous areas. Moreover, 3.2 kms of the road section in the rolling terrain and 9.7 kms in the

mountainous areas have gradients in excess of 4%. As indicated in **Table 6.3-1**, the existing DK road profile is closer to the AH Standards than the SNiP Standard which requires a more gentle grade.

TABLE 6.3-1 MAXIMUM VERTICAL GRADE FOR AH AND SNIP

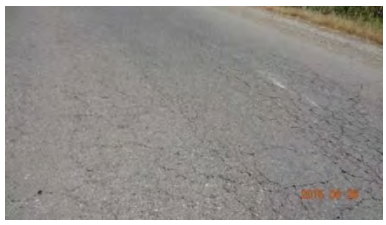
Specification	Maximum Vertical Grade (%)		
	Flat	Rolling	Mountainous
Asian Highway (Class II)	4	5	6~7
SNiP (Class III)	3.5	3.5	4

6.4 Pavement Condition

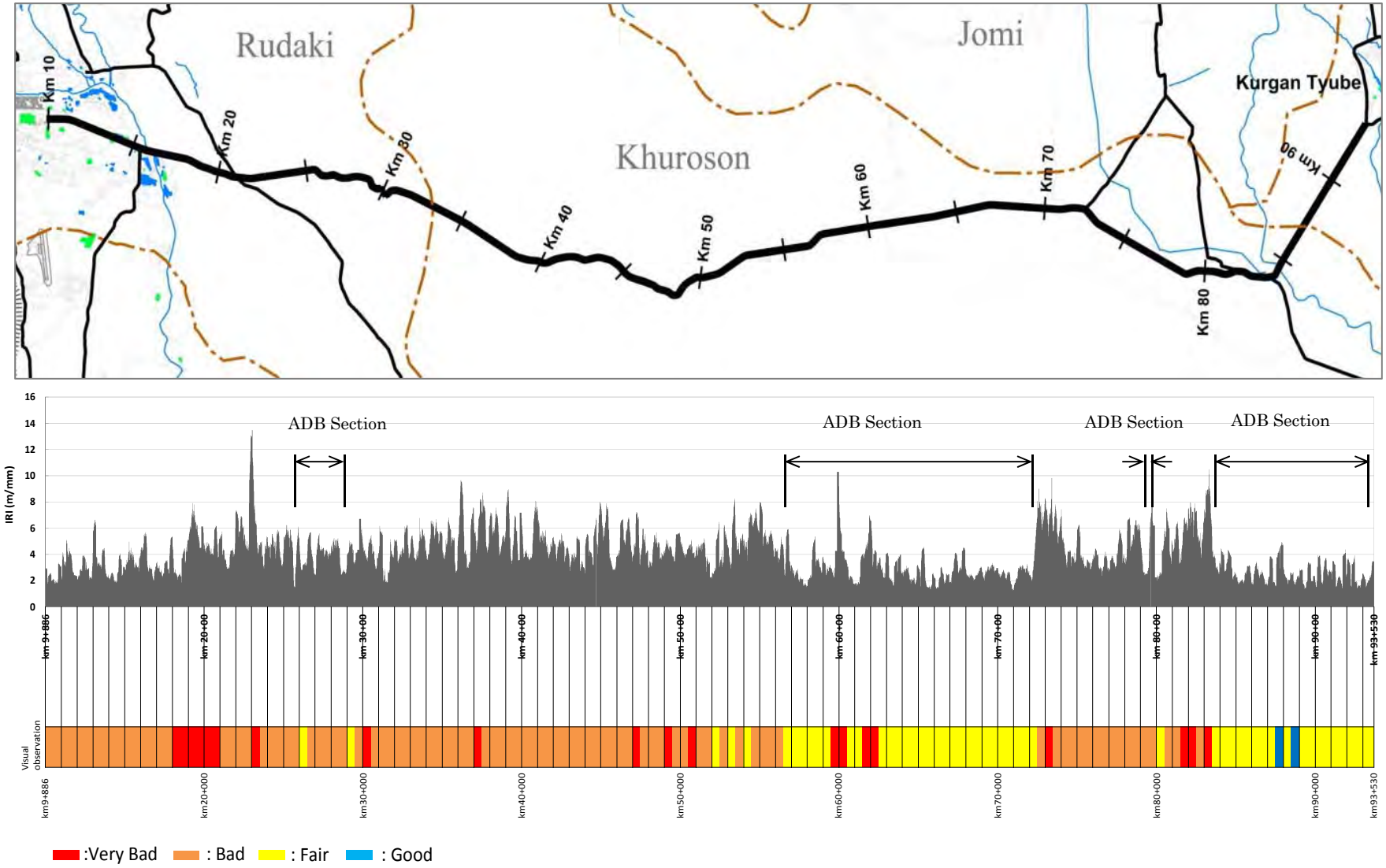
6.4.1 Existing Pavement Conditions

Visual assessment was undertaken in accordance with the criteria shown in **Table 6.4-1**. Pavement roughness in terms of International Roughness Index (IRI) was also undertaken. Visual assessment results and IRI are shown in **Figure 6.4-1**.

TABLE 6.4-1 PAVEMENT VISUAL ASSESSMENT CRITERIA

Criteria	Surface Smoothness	Crack (Crack Rate)	Pothole	Photo
Good	Very smooth	No Crack (0% to 30%)	No pothole	
Fair	Feel a bit vibration	Partial Crack /Longitudinal & Transverse Cracks (30% to 50%)	Few Potholes	
Bad	Feel vibration	Joint partial Crack/Longitudinal & transverse crack joint and covers all surface (50% to 70%)	Several Potholes	
Very Bad	Feel significant vibration	Dense Alligator Crack/Alligator crack smaller than 0.5×0.5m covers whole surface (70% to 100%)	Many potholes	

Source: JICA Study Team



Source: JICA Study Team

FIGURE 6.4-1 RESULTS OF VISUAL ASSESSMENT AND IRI

6.4.2 Test Pitting Result

In order to investigate thickness of existing pavement structure and bearing value in terms of CBR of base courses and subgrade, test pitting was undertaken at 6 locations shown in **Table 6.4-2** and **Figure 6.4-2** and the results are shown in **Table 6.4-3**.

TABLE 6.4-2 LOCATION OF TEST PITTING

No	Km Geography	Photo	No	Km Geography	Photo
TP-1	28+803 Left Cut Section / Mountainous		TP-2	28+813 Left Cut Section / Mountainous (ADB Section)	
TP-3	51+050 Right Cut Section / Rolling		TP-4	56+000 Left Fill Section / Flat	
TP-5	69+100 Left Fill Section / Flat (ADB Section)		TP-6	78+500 Left Cut & Fill Section / Flat	

FIGURE 6.4-2 LOCATION MAP OF TEST PITTING

TABLE 6.4-3 RESULTS OF TEST PITTING

Material	THK (cm)	CBR(%)
Asphalt Concrete	30	-
Base Course	40	-
Sub-base Course	20	7,15,21
Asphalt	10	-
Base Course	20	
Sub-grade	-	17,15,15

TP-1

Material	THK (cm)	CBR(%)
Asphalt Concrete	20	-
Base Course	8	-
Asphalt Concrete	10	
Base Course	40	-
Sub-base Course	20	6,21,10
Asphalt	10	
Base Course		
Sub-grade	-	22,18,29

TP-2

Material	THK (cm)	CBR(%)
Asphalt Concrete	20	-
Base Course	40	-
Asphalt Concrete	5	-
Base Course	20	
Sub-grade	-	15,18,10

TP-3

Material	THK (cm)	CBR(%)
Asphalt Concrete	28	-
Base Course	46	-
Sub-grade	-	29,25,29

TP-4

Material	THK (cm)	CBR(%)
Asphalt Concrete	5	-
Base Course	60	-
Sub-grade	-	10,13,11

TP-5

Material	THK (cm)	CBR(%)
Asphalt Concrete	12	
Base Course	60	
Asphalt Concrete	10	
Base Course	30	
Sub-grade		11,10,8

TP-6

It was found that asphalt concrete surface course is quite thick ranging from 5cm at ADB section to 30cm and base course is also very thick ranging from 40 to 60cm and well compacted. Sub-grade has high CBR value. Existing pavement structure should be utilized as much as possible.

6.5 Bridges

A summary of existing bridges, based on bridge inventory along the DK road, is presented in **Table 6.5-1**. As seen in the table, a total of 16 bridges cross various road obstructions as follows:

- Major Rivers – Two bridges, the Kofarnihon River Bridge with a total length of 297.0m and the Vakhsh River Bridge with a total length of 333.0m.
- Small to Intermediate River – Six bridges.
- Irrigation Canal – Three bridges.
- Abandoned Railways – Four bridges.
- Interchange – One bridge.

Majority of bridges are concrete bridges with precast girders, consisting of reinforced concrete (RC) and prestressed concrete (PC), and precast slabs consisting of rectangular and channel sections. At least two bridges have steel plate girder superstructures (B-12 and B-14). Single column concrete piers support multi-span bridges with concrete abutments. At least one bridge (B-7) has pile bent abutment.

Widening of the 6 bridges was done using different superstructure types and bridge configurations. This resulted to different stiffness characteristics of the original older bridge with the widened section causing cracks in the deck and carriageway surface finish.

Live Load capacity load postings are seen in most bridges with 5 bridges posted at 80 tons, 2 bridges posted at 60 tons and 4 bridges posted at 30 tons. 5 bridges do not have load postings. An initial inspection of the bridge conditions indicated that 4 bridges have fair conditions, 7 bridges have poor conditions and 5 bridges have bad conditions. These conditions, as defined in the table, were assessed based on the structural conditions of the superstructures (girders and deck slabs) and the superstructures (bearing supports, piers, abutments). Bad condition indicates a major rehabilitation or strengthening is necessary or a bridge replacement may be needed. Poor condition indicates defects or damages were observed that requires major repair or strengthening. Fair condition indicates some defects were observed that needs repair and monitoring of the defect.

FIGURE 6.5-1 and **Figure 6.5-2** shows the locations and features of the bridges.

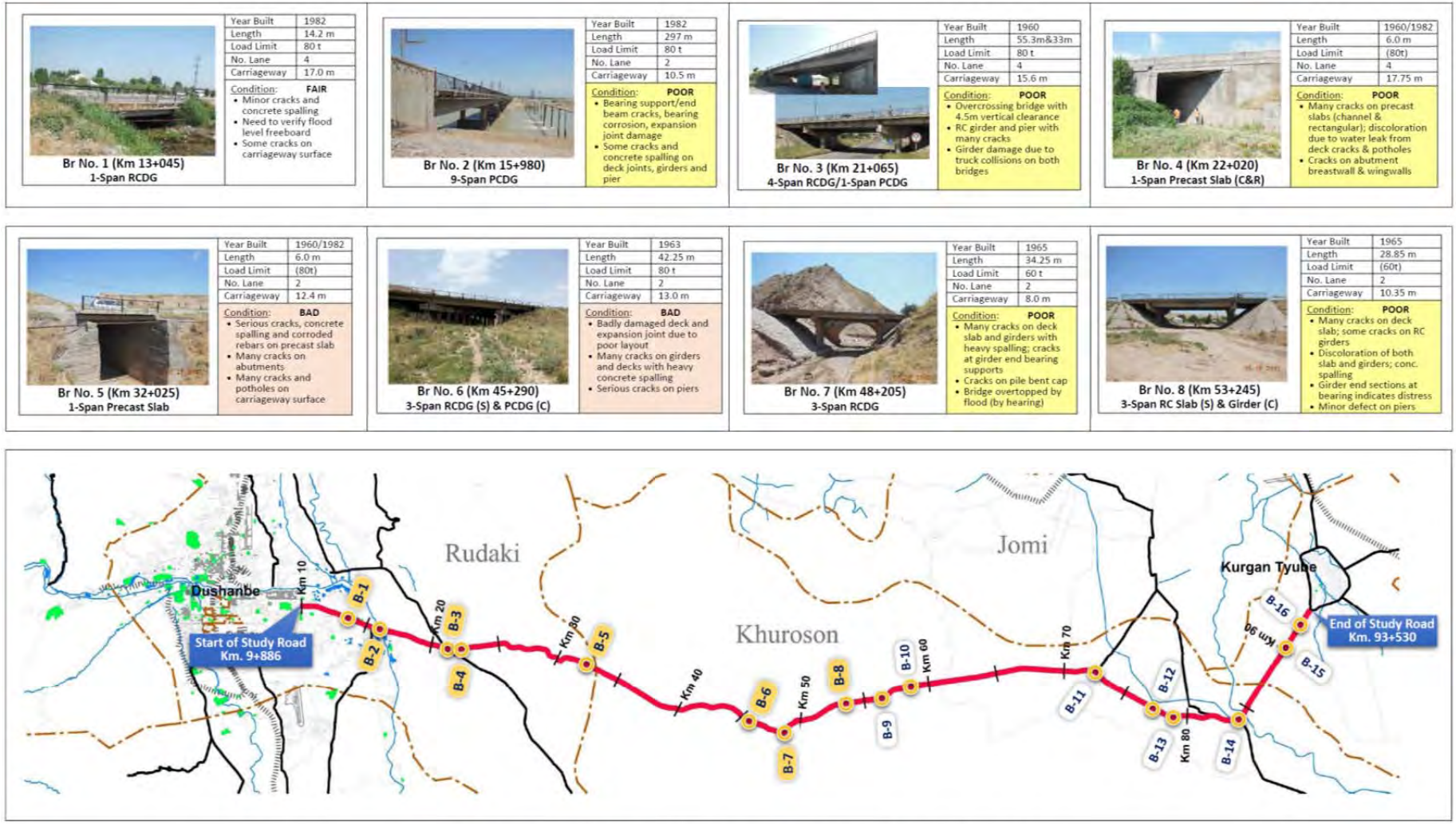
TABLE 6.5-1 INVENTORY OF BRIDGES ALONG DK ROAD

Bridge No.	Station (Km)	Length [1] (m)	Deck Width [2] (m)	Load Posting (t)	Year [3] Constructed	Bridge Type [5]	Bridge Passing Over	Condition [9]	SEHM Unit
B-1	13 + 045	14.20	26.15	80	1982	1-Span RC Girder	Irrigation Canal	Fair	Rudaki
B-2	15 + 980	297.00	14.50	80	1982	9-Span PC Girder	Kofarnihon River	Poor	Rudaki
B-3	21 + 065	53.6 & 33.00	20.80	80	1960/1982	4-Span RC Girder + 1-Span PC Girder	Interchange	Poor	Rudaki
B-4	22 + 020	6.00	19.85	80	1960/1982	1-Span Precast Slab (Channel + Rectangular)	Abandoned Railway [6]	Poor	Rudaki
B-5	32 + 025	6.00	16.15	80	1960/1982	1-Span Precast Slab (Old + Widening)	Abandoned Railway/River	**Bad**	Rudaki
B-6	45 + 290	42.25	15.60	80	1963	3-Span RC Girder + PC Girder	Abandoned Railway [6]	**Bad**	Khuroson
B-7	48 + 205	34.25	10.00	60	1965	3-Span RC Girder	River	Poor	Khuroson
B-8	53 + 245	28.85	12.30	60	1965	3-Span RC Slab + RC Girder	Abandoned Railway/Road	Poor	Khuroson
B-9	56 + 625	50.40	12.20	60	1965	3-Span RC Girder	River	Fair	Khuroson
B-10	58 + 300	24.00	14.10	30	1965	1-Span Precast U-Girder	River [7]	Poor	Khuroson
B-11	72 + 415	34.20	11.80	60	1965	3-Span RC Girder	River	Poor	Khuroson
B-12	77 + 670	16.80	13.10	30	1965	1-Span RC Girder + 1-Span Steel Plate Girder	Irrigation Canal [8]	**Bad**	Khuroson

Bridge No.	Station (Km)	Length [1] (m)	Deck Width [2] (m)	Load Posting (t)	Year [3] Constructed	Bridge Type [5]	Bridge Passing Over	Condition [9]	SEHM Unit
B-13	78 + 840	16.75	13.50	30	1965	1-Span RC Girder	Irrigation Canal [8]	Fair	Khuroson
B-14	84 + 250	333.0	12.90	80	2006 [4]	10-Span Steel Plate Girder	Vakhsh River	Fair	Bokhtar
B-15	90 + 255	13.80 & 8.70	11.70	30	1980	3-Span RC Slab + 1-Span RC Girder	River	**Bad**	Bokhtar
B-16	92 + 120	6.80	11.00	30	1980	1-Span RC Slab + 1-Span RC Girder	River	**Bad**	Bokhtar

Notes:

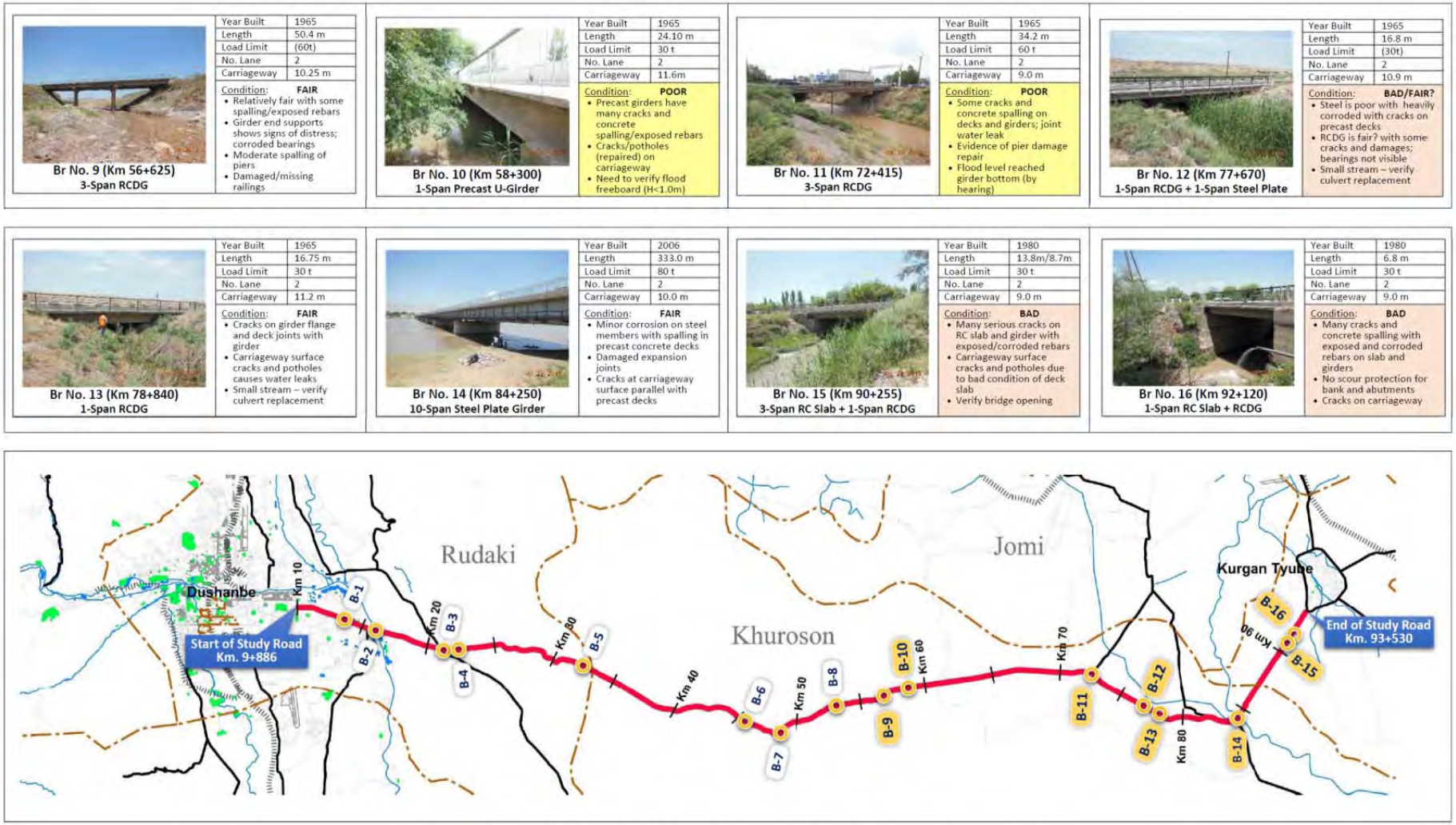
[1] *Bridge length is measured from expansion joints of abutments.*
[2] *Deck width is taken at edges of bridge deck.*
[3] *Evidence of bridge widening were seen for B-3, B-4, B-5, B-12, B-15 and B-16. Different types of superstructures were employed for the widening section.*
[4] *B-14 or the Vakhsh River Bridge used to be a single-lane road bridge and a railways bridge. It was combined to a 2-lane road bridge in 2006.*
[5] *RC – Reinforced Concrete. PC – Prestressed Concrete.*
[6] *Study the possibility of replacement with box culvert or embankment.*
[7] *Very low freeboard. May need to raise up bridge profile.*
[8] *B-12 & B-13 cross irrigation canals with low vertical clearance and narrow canal width. Study the possibility of replacement with box culvert.*
[9] *The following defines the bridge conditions:*
Good : Minor defect/damage – perform Routine Maintenance
Fair : Some defect/damage – needs Repairs and monitoring damage
Poor : Major defect/damage – needs Major Repair to Strengthening
***Bad** : Serious defect/damage – needs Major Rehabilitation/ Strengthening to Replacement*



BRIDGES ALONG DUSHANBE – KURGAN-TYUBE ROAD (BR 1-8)

NOTE:
Good : Minor defect/damage – perform Routine Maintenance
Fair : Some defect/damage – needs Repairs and monitoring damage
Poor : Major defect/damage – needs Major Repair to Strengthening
Bad : Serious defect/damage – needs Major Rehabilitation/Strengthening to Replacement

FIGURE 6.5-1a BRIDGES ALONG DUSHANBE – KURGAN-TYUBE ROAD

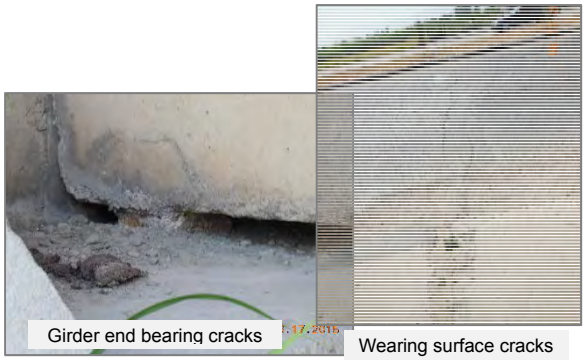


BRIDGES ALONG DUSHANBE – KURGAN-TYUBE ROAD (BR 9-16)

NOTE:
Good : Minor defect/damage – perform Routine Maintenance
Fair : Some defect/damage – needs Repairs and monitoring damage
Poor : Major defect/damage – needs Major Repair to Strengthening
Bad : Serious defect/damage – needs Major Rehabilitation/Strengthening to Replacement

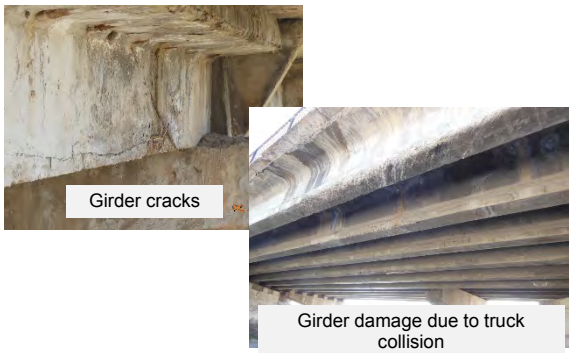
FIGURE 6.5-2b BRIDGES ALONG DUSHANBE – KURGAN-TYUBE ROAD

TABLE 6.5-2a TYPICAL BRIDGE DAMAGE / DEFECTS



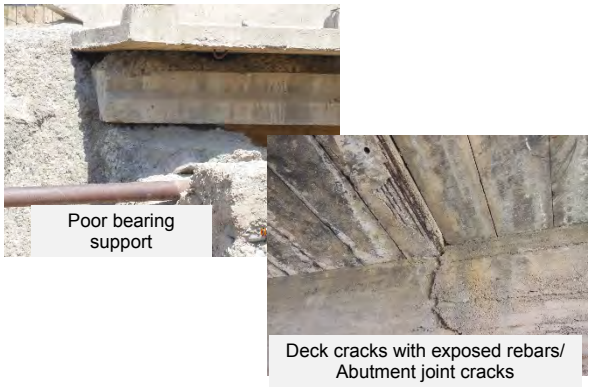
BRIDGE NO. B-1

BRIDGE NO. B-2

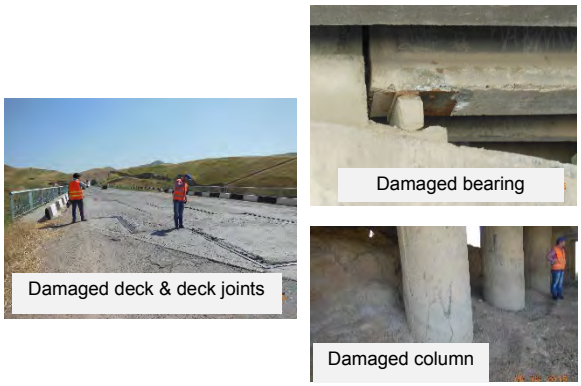


BRIDGE NO. B-3

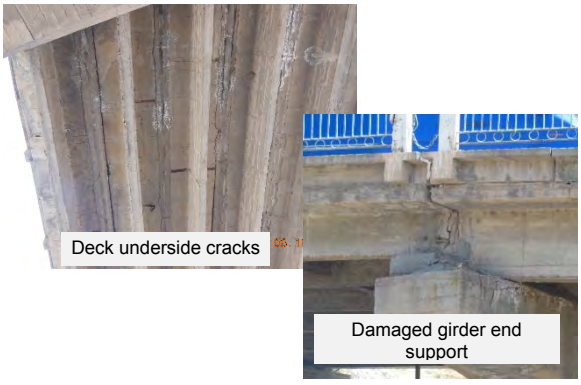
BRIDGE NO. B-4



BRIDGE NO. B-5



BRIDGE NO. B-6



BRIDGE NO. B-7

BRIDGE NO. B-8

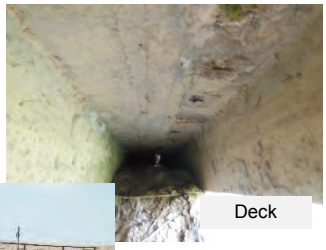
TABLE 6.5-3b TYPICAL BRIDGE DAMAGE / DEFECTS

BRIDGE NO. B-9

BRIDGE NO. B-10

BRIDGE NO. B-11

BRIDGE NO. B-12



BRIDGE NO. B-13

Expansion joint seal damage

BRIDGE NO. B-14

Girder cracks; Exposed rebars; Concrete discoloration due to water leak at cracks

BRIDGE NO. B-15

BRIDGE NO. B-16

6.6 Culverts

There are about 76 culverts (box culvert and pipe culvert) along the DK road, as summarized in **Table 6.6-1** and shown in **Figure 6.6-1**.

TABLE 6.6-1 INVENTORY OF CULVERTS ALONG DK ROAD

Terrain	Station (Km)		No. of Box Culverts (BC)	No. of Pipe Culverts (PC)
	From	To		
Flat	Km 09+886	Km 23+000	3	18
Rolling	Km 23+000	Km 26+000	2	3
Mountainous	Km 26+000	Km 33+000	2	10
Rolling	Km 33+000	Km 39+000	2	-
Mountainous	Km 9+000	Km 45+000	1	4
Rolling	Km 45+000	Km 51+000	4	4
Flat	Km 51+000	Km 93+530	6	17

As observed during the site inspection, some of the box culverts indicate insufficient flood discharge capacity, as evidenced by bank scouring at both the upstream and downstream sides of the box culverts. This resulted in floods overtopping the roads at some sections indicated in **Figure 6.6-1**. The discharge capacity at these locations need to be checked carefully during the feasibility study and detailed design. This may require additional opening or replacement by bridges.

Moreover, culverts are not provided with apron slab at the upstream and downstream sides initiating scouring at the downstream section of the culvert that caused damage to the bottom slab and the wing walls, as seen in **Photo 6.6-1**.

PHOTO 6.6-1 SOME CONDITIONS OF CULVERTS AT DOWNSTREAM SIDES

CULVERT INVENTORY SUMMARY				
Terrain	Station (Km)		No. of Box Culverts (BC)	No. of Pipe Culverts (PC)
	From	To		
Flat	Km 09+886	Km 23+000	4	18
Rolling	Km 23+000	Km 26+000	1	3
Mountainous	Km 26+000	Km 33+000	2	10
Rolling	Km 33+000	Km 39+000	2	-
Mountainous	Km 39+000	Km 45+000	1	4
Rolling	Km 45+000	Km 51+000	4	4
Rolling	Km 51+000	Km 93+530	6	17

BOX CULVERT INVENTORY				
Box Culvert No.	Station (Km)	No. Barrel	Opening	
			Width (m)	Height (m)
BC-01*	Km 17 + 940	2	8.00	2.00
BC-02	Km 19 + 016	1	2.50	2.50
BC-03	Km 19 + 653	2	8.00	2.50
BC-04	Km 23 + 130	1	4.00	1.30
BC-05	Km 23 + 482	1	4.50	2.50
BC-06	Km 26 + 909	1	1.00	2.10
BC-07	Km 32 + 986	1	1.00	0.40
BC-08	Km 35 + 605	1	3.00	2.50
BC-09*	Km 36 + 089	1	3.85	2.60
BC-10	Km 44 + 547	1	4.00	3.00

BOX CULVERT INVENTORY				
Box Culvert No.	Station (Km)	No. Barrel	Opening	
			Width (m)	Height (m)
BC-11	Km 45 + 196	1	2.00	2.50
BC-12*	Km 45 + 869	1	2.50	3.25
BC-13	Km 47 + 584	1	3.90	1.60
BC-14	Km 47 + 740	1	3.90	2.50
BC-15	Km 60 + 866	1	1.00	0.45
BC-16	Km 61 + 193	1	1.00	0.45
BC-17	Km 73 + 575	1	2.50	2.00
BC-18	Km 75 + 027	1	3.00	2.50
BC-19	Km 82 + 895	1	2.00	2.50
BC-20	Km 87 + 642	1	1.05	0.50

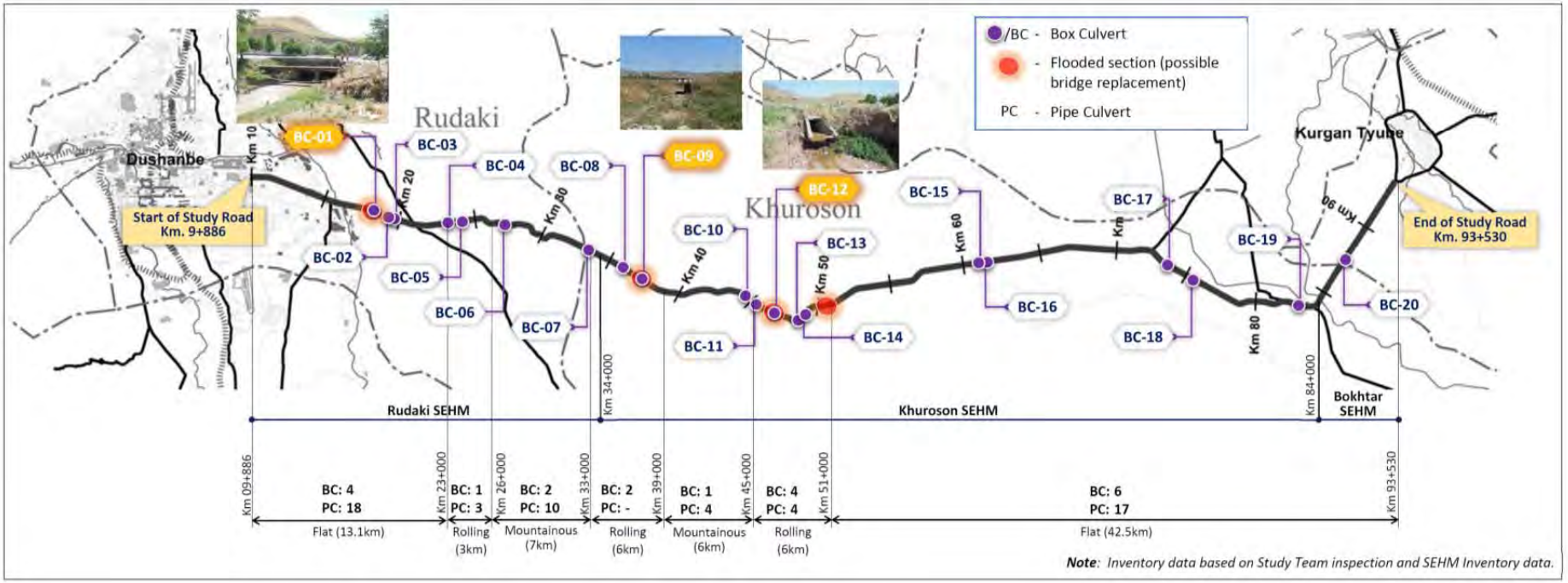


FIGURE 6.6-1 CULVERTS ALONG DUSHANBE – KURGAN-TYUBE ROAD

6.7 Roadside Drainage

The roadside drainage is basically earth ditch at almost the entire alignment with some buried system at the beginning section of the DK road until about 1km. Precast trapezoidal ditch with an opening of 600mm at the top section is provided at some cut sections of the road in the mountainous area and near the approaches to bridges and box culverts. Less than 4km of precast concrete ditch is provided along the entire alignment with earth ditches covering the rest of the road. **Figure 6.7-1** illustrates the locations of the precast concrete ditch along the alignment and shown in **Photo 6.7-1.**

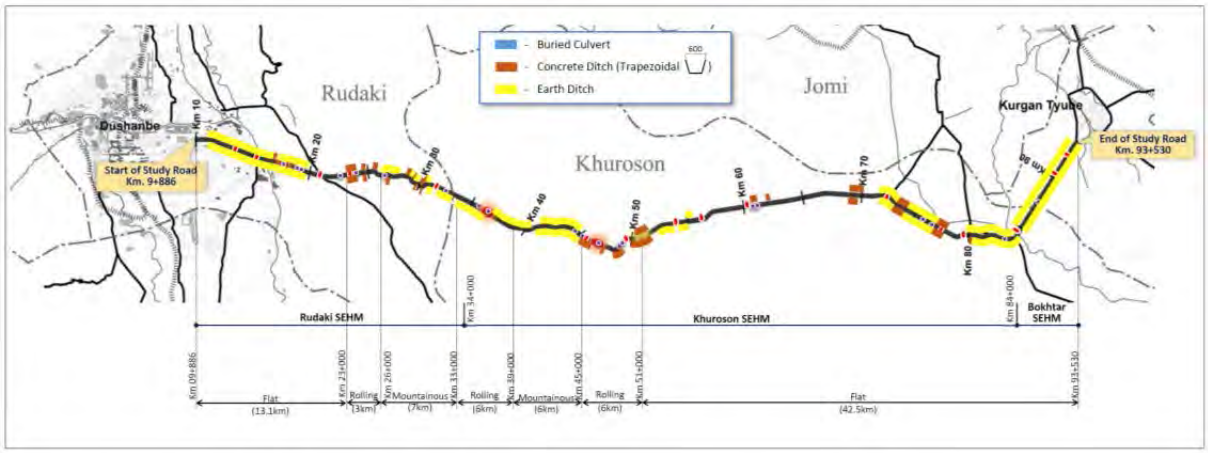


FIGURE 6.7-1 ROADSIDE DRAINAGE ALONG DK ROAD

(a) Earth Ditch

(b) Concrete Ditch

(c) No Side Drainage

PHOTO 6.7-1 ROADSIDE DRAINAGE TYPES

6.8 Flood Section

Interviews with SEHM and nearby residents indicated flooded areas in at least four road sections with three sections at culvert locations with insufficient flood discharge capacity and one location without cross-drainage facility. As seen **Figure 6.8-1**, the flooded areas during heavy rain coincide with culverts at stations Km.17+940, Km.36+089, Km.45+869. In another road section at around Km.51, flood tends to accumulate at the low point section of the road.

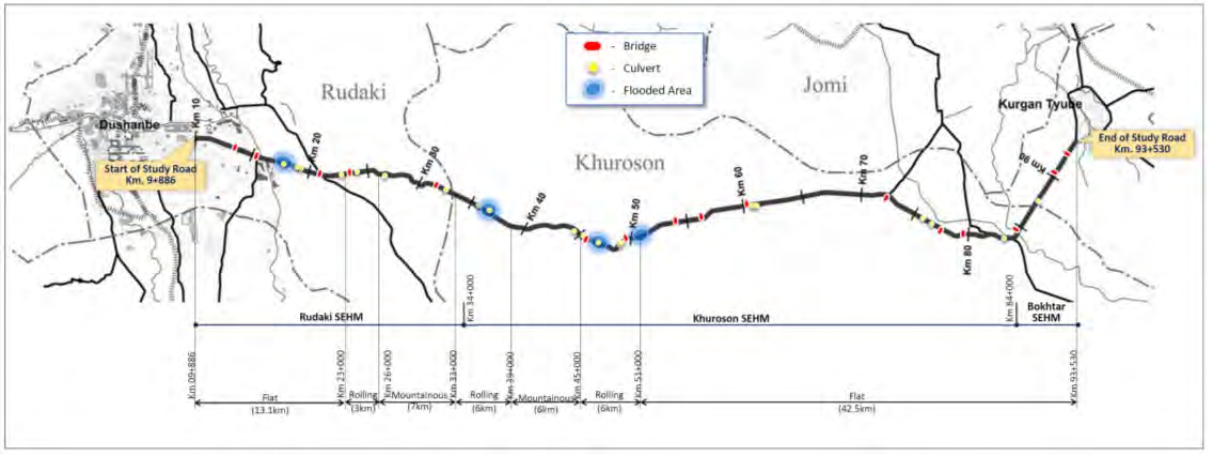


FIGURE 6.8-1 OBSERVED FLOOD ALONG DK ROAD

6.9 Traffic Safety Facilities

D-K Road has rolling and mountainous sections with deep valley on one side and flat sections with high embankment of more than 3 meters. Various types of guardrails are provided as shown in the following photos.

W-Beam Type Guardrail

New Jersey Type Barrier

Cable-type Guardrail

Concrete Post Only at Embankment Section (No cables)

VARIOUS TRAFFIC SAFETY FACILITIES

There are high risks for vehicles to fall down to the valley below or to fall down from high embankment sections of the DK road. Traffic safety facilities should be reviewed and more facilities should be provided.

Traffic regulatory signboards and warning signboards should be provided where necessary.

6.10 Traffic Accidents

Traffic accident records from 2010 to 2014 were summarized in **Table 6.10-1.**

TABLE 6.10-1 TRAFFIC ACCIDENTS ON DK ROAD

		2010	2011	2012	2013	2014
Type of Accidents	Vehicle Collision	20	17	15	19	26
	Hit Person(s) by Vehicle	16	21	9	12	13
	Overturn	6	6	5	12	13
	Total	**42**	**44**	**29**	**43**	**45**
Casualty	Dead	12	16	11	21	19
	Injured	60	58	32	39	49
	Total	**72**	**74**	**43**	**60**	**68**

Source: State Automobile Inspection

Location of traffic accidents from 2010 to 2014 is shown in **Figure 6.10-1**.

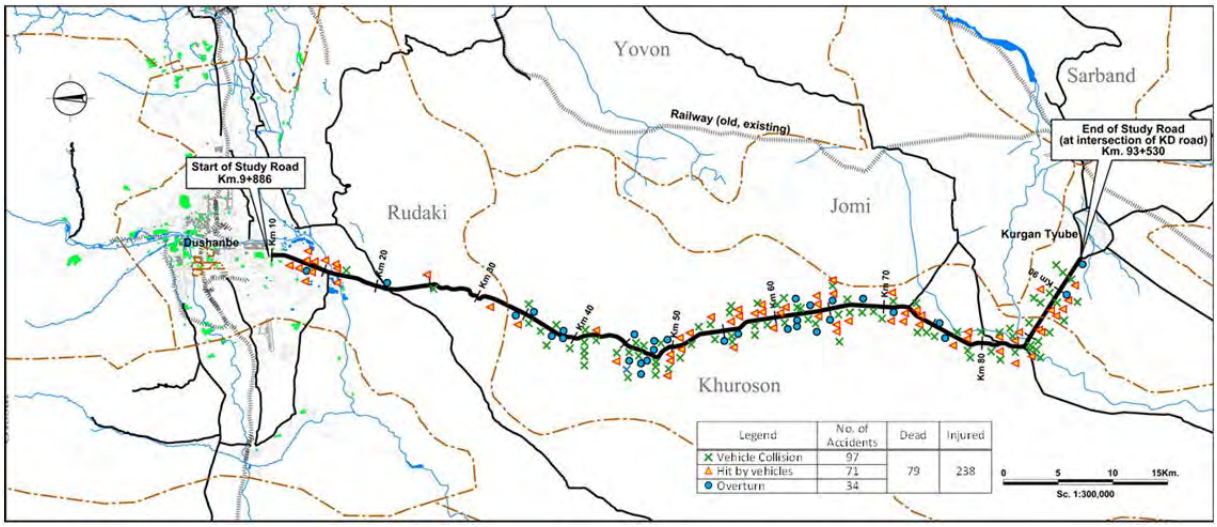


FIGURE 6.10-1 LOCATION OF TRAFFIC ACCIDENTS

A lot of traffic accidents are occurring along DK Road, particularly at flat road section, and nor so many traffic accidents at rolling and mountainous sections. Causes of traffic accidents maybe due to the following reasons;

- Over speeding: Drivers do not observe imposed speed limit of 80km/hr. more strict enforcement of traffic rules and regulations must be implemented. Fines should be reviewed and much higher fines should be imposed.
- Risky overtaking using the opposite lane: The existing road is a 2-lane 2-way road (one lane for one direction) and overtaking must be done utilizing the opposite lane, thus the risk of collision is high. With the increase of traffic, collision risk will be higher. This is one of the reasons that DK Road should be widened to a dual 2-lane road.

6.11 Effect of Snow Fall

There are 20 – 30 times of snow fall a year between December and February at the mountainous section of DK Road and thickness of snow fall is about 10 to 20 cm per snow fall. Snows are removed by a snow plough which is stationed at the mountainous section. Immediately after removal of snow, anti-slip and snow-melting material composed of sand and salt is spread on the road surface. There are anti-slip and snow-melting storage houses at Rudaki and Khuroson SEHMs. There has been no case of traffic interruption due to snow fall.

	
Antislip material storage house of Khuroson SEHM	Antislip material distributed on the shoulder near Km. 30

6.12 Existing Interchange

There is one existing interchange at about Km. 21. Interchange type is a clover leaf type (though shape is rather distorted). Problems are no merging and diverging distances are provided, therefore, with the increase of traffic volume, traffic congestion will be expected and also risk of traffic accidents will increase. **Figure 6.12-1** shows the existing interchange and **Figure 6.12-2** shows proposed improvement of the interchange.

FIGURE 6.12-1 EXISTING INTERCHANGE (KM. 21 + 065)

FIGURE 6.12-2 PROPOSED IMPROVEMENT OF INTERCHANGE (KM. 21 + 065)

6.13 Vertical Clearance

The vertical clearance requirements for bridges depend on the bridge functions. As seen in **Table 6.13-1**, there are 7 river bridges, 4 irrigation canal bridges, 3 railway overcrossing bridges (abandoned) and 2 road overcrossing bridges. Flood freeboard requirements for short to medium bridges (< 100m long) is 0.50m for a 50-year flood while for long bridges (>100m long) it is taken as 0.50m for 100-year flood. Vertical clearance for road overcrossing is 5.0m minimum or preferably 5.50m for roads with overlay. Railroad overcrossing bridge vertical requirement depends of the railroad crossing, but the lines undercrossing the DK roads are abandoned railways. Confirmation with MOT on the plan for the railroad development in this area is necessary to retain or replace the 3 railroad bridge openings.

TABLE 6.13-1 EXISTING BRIDGE VERTICAL CLEARANCES

Br. No.	Length (m)	Function	Required Vertical Clearance/ Freeboard [1] (m)	Existing Vertical Clearance (m)	Remarks
B-1	14.20	Irrigation Canal Bridge	0.50	> 0.50 (OK)	• Water level controlled by irrigation authority
B-2	297.00	Kofarnihon River Bridge	0.50 for 100 years flood	> 1.50 (OK)	• Sufficient freeboard
B-3	55.30 & 33.00	Interchange Overcrossing Bridge	5.00 (Pref. 5.50m for overlay)	4.50 (Not OK)	• Many evidence of girder collision • Need to raise up bridge level
B-4	6.00	Railroad Overcrossing Bridge	-	4.50	• Abandoned railway
B-5	6.00	Railroad Overcrossing/ River Bridge	-	5.35 > 0.50 (OK)	• Abandoned railway • Functions as river bridge during rain
B-6	42.25	Railroad Overcrossing Bridge	-	4.50	• Abandoned railway

Br. No.	Length (m)	Function	Required Vertical Clearance/ Freeboard [1] (m)	Existing Vertical Clearance (m)	Remarks
B-7	34.25	River Bridge	0.50 for 50 years flood	> 0.50 (Need verification)	• River bed scoured/lowered by 1.5-1.8m • Need verify further river discharge and flood level
B-8	28.85	Local Road Overcrossing Bridge	5.00 (Pref. 5.50m for overlay)	4.50 (Not OK)	• Some evidence of girder collision • Need to raise up bridge level
B-9	50.40	River Bridge	0.50 for 50 years flood	> 0.50 (OK)	• Sufficient freeboard
B-10	24.10	Irrigation Bridge	0.50	> 0.50 (OK)	• Water level controlled by irrigation authority
B-11	34.20	River Bridge	0.50 for 50 years flood	< 0.50 (Not OK)	• Flood level reached girder soffit in 2013 flood
B-12	16.80	Irrigation Bridge	0.50	> 0.50 (OK)	• Water level controlled by irrigation authority • Bridge has sufficient span but river banks constricted at bridge section
B-13	16.75	Irrigation Bridge	0.50	> 0.50 (OK)	• Water level controlled by irrigation authority • Bridge has sufficient span but river banks constricted at bridge section
B-14	329.50	Vakhsh River Bridge	0.50 for 100 years flood	> 1.50 (OK)	• Sufficient freeboard • Water discharge is controlled by dam at upstream section
B-15	13.80 & 8.70	River Bridge	0.50 for 50 years flood	> 0.50 (OK)	• Sufficient freeboard
B-16	6.80	River Bridge	0.50 for 50 years flood	> 0.50 (OK)	• Sufficient freeboard

Note: [1] Based on SNiP 2.05.03-84 *Source: JICA Survey Team*

6.14 Condition of Branch Line of DK Road at the Beginning

Present condition of branch line of DK Road at the beginning is shown in **Figure 6.14-1**. Number of lanes drastically changes from dual 4-lane, undivided 4-lane, and undivided 6-lane to dual 3-lane road.

It will be ideal to convert this section (from Km. 10+016 to Km. 11+163, L=1.15km) at least to a dual 3-lane road, however, relocation of many buildings (about 18 buildings) is required. It seems that relocation of buildings was quite difficult, resulting in the current number of lanes.

If the Government strongly wishes to make this section to a dual 3-lane road, it is advisable to do this work by Domestic Fund using national budget since it is difficult to estimate how long and how much will it cost for relocation of affected buildings.

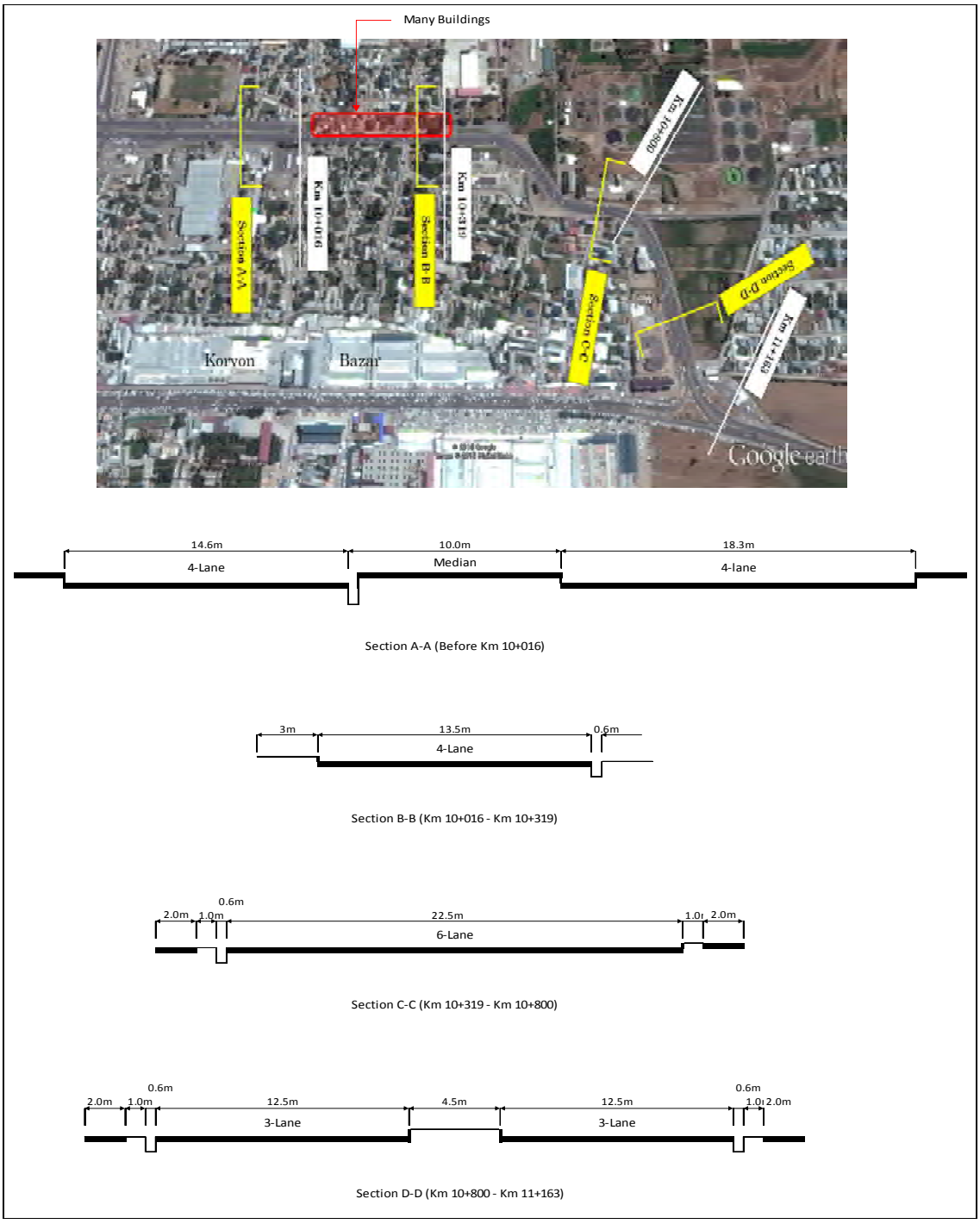


FIGURE 6.14-1 CONDITION OF BRANCH LINE OF DK ROAD AT THE BEGINNING

CHAPTER 7 ENVIRONMENTAL AND SOCIAL CONSIDERATION INFORMATION

7.1 Environmental Impact Assessment and Ecological Expertise

In Tajikistan, the Environmental Impact Assessment (hereinafter referred to as "EIA") is specified in the "Law on Environmental Protection (2011)" and the "Law on Ecological Expertise (2011)". It is conducted as a component of the State Ecological Expertise (hereinafter referred to as "SEE"). SEE is one of the Ecological Expertise in Tajikistan that assesses the project through the submitted documents like EIA report and decides the proper project implementation, and the other is called Public Ecological Expertise (hereinafter referred to as "PEE"). SEE is the procedure of project assessment from the viewpoints of environment and EIA which is directly translated "OVOS" in Russian is included the procedure. On the other hand, the PEE is required when the projects or activities are not accepted by the local people according to the Committee of Environmental Protection under the Government of the Republic of Tajikistan (hereinafter referred to as "CEP"), which is the central executive body responsible for ecological expertise.

7.2 Legal Basis

The Basic Environmental Law in Tajikistan is the "Law on Environmental Protection" which was enacted in 2011.

The Standard law in SEE implementation is the "Law on Ecological Expertise (2011)" which defines the procedure of the SEE and the rights and duties of organizations including contractors related to the expertise. Not only objects and principles but also procedures and assessment system of EIA are prescribed in "Resolution No. 509, Procedure of Environmental Impact Assessment." Projects and activities subject to EIA is prescribed in "Resolution No. 253, Objects and Type of Activities Which are Required Preparation of Environment Impact Assessment Materials",

"Land Code" which was adopted in 1996 and amended several times defines the role of national or local authorities and the rights and liabilities of land users including provisions related to payment of rent and compensation to land users. Land acquisition is actually implemented in accordance with the "Land Acquisition Rules in Tajikistan."

Laws and Regulations for Environmental and Social Considerations are listed below.

TABLE 7.2-1 LIST OF LAWS AND REGULATIONS FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

No.	Title
1	Law on Environmental Protection (2011)
2	Forestry Code (1993)
3	Law on Subsoil (1994)
4	Land Code (1996)
5	Law on Protected Areas (1996)
6	Law on Air Protection (1996)
7	Water Code (2000)
8	Law on Water User Associations (2006)
9	Law on Production and Consumption Waste (2002)
10	Law on Hydro meteorological Activity (2002)
11	Law on Sanitary and Epidemiological Safety of Population (2003)
12	Law on the Protection and Use of Plants (2004)
13	Law on the Use of Nuclear Energy (2004)
14	Law on Biological Security (2005)
15	Law on Fauna (2008)
16	Law on Land Administration (2008)
17	Law on Soil Protection (2009)
18	Law on Ecological Expertise (2011)
19	Law on Environmental Audit (2011)

Tajikistan concludes the following international environmental treaties.

TABLE 7.2-2 LIST OF INTERNATIONAL TREATIES CONCLUDED BY TAJIKISTAN

No.	Title
1	Vienna Convention on Ozone Layer Protection and Montreal Protocol on ozone depleting substances, London Amendment
2	Convention of Desertification
3	Convention on Biological Diversity
4	UN Framework Convention on Climate Change
5	Convention on Wetlands of International Importance especially as Waterfowl Habitat
6	Convention on the Conservation of Migratory Species of Wild Animals
7	Stockholm Convention on Persistent Organic Pollutants (POPs)
8	Convention on environmental impact assessment in transboundary context (EIA) (Espoo Convention)
9	Framework Convention on environment protection for Central Asia Sustainable Development
10	Cartagena Protocol on biological safety to the Convention on Biological Diversity.
11	Kyoto Protocol to the UN Framework Convention on Climate Change
12	The Ramsar Convention
13	Aarhus Convention

7.3 Environmental Impact Assessment

7.3.1 Organization related to SEE

Committee on Environmental Protection under the Government of the Republic of Tajikistan (hereinafter referred to as "CEP") is the authority responsible for environmental protection such as ecological expertise of planned and ongoing activities, environmental monitoring and management of protected areas. The committee also has the authority to issue the Conclusion of SEE based on the result of SEE.

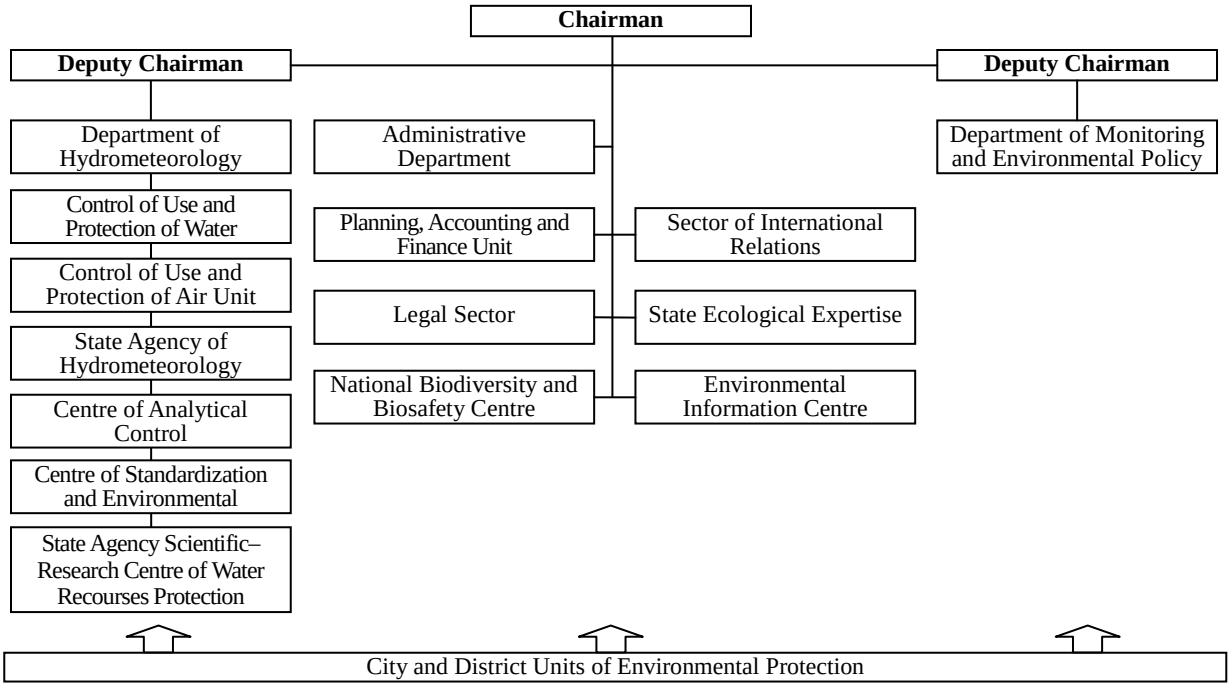


FIGURE 7.3-1 ORGANIZATION CHART OF CEP

7.3.2 EIA System

(1) EIA Guideline

The EIA procedure is prescribed by Resolution No. 509 enacted in 2014. The Resolution defines the objectives and principles of EIA and functions of contractors which implement EIA and the government which evaluates the project through the SEE.

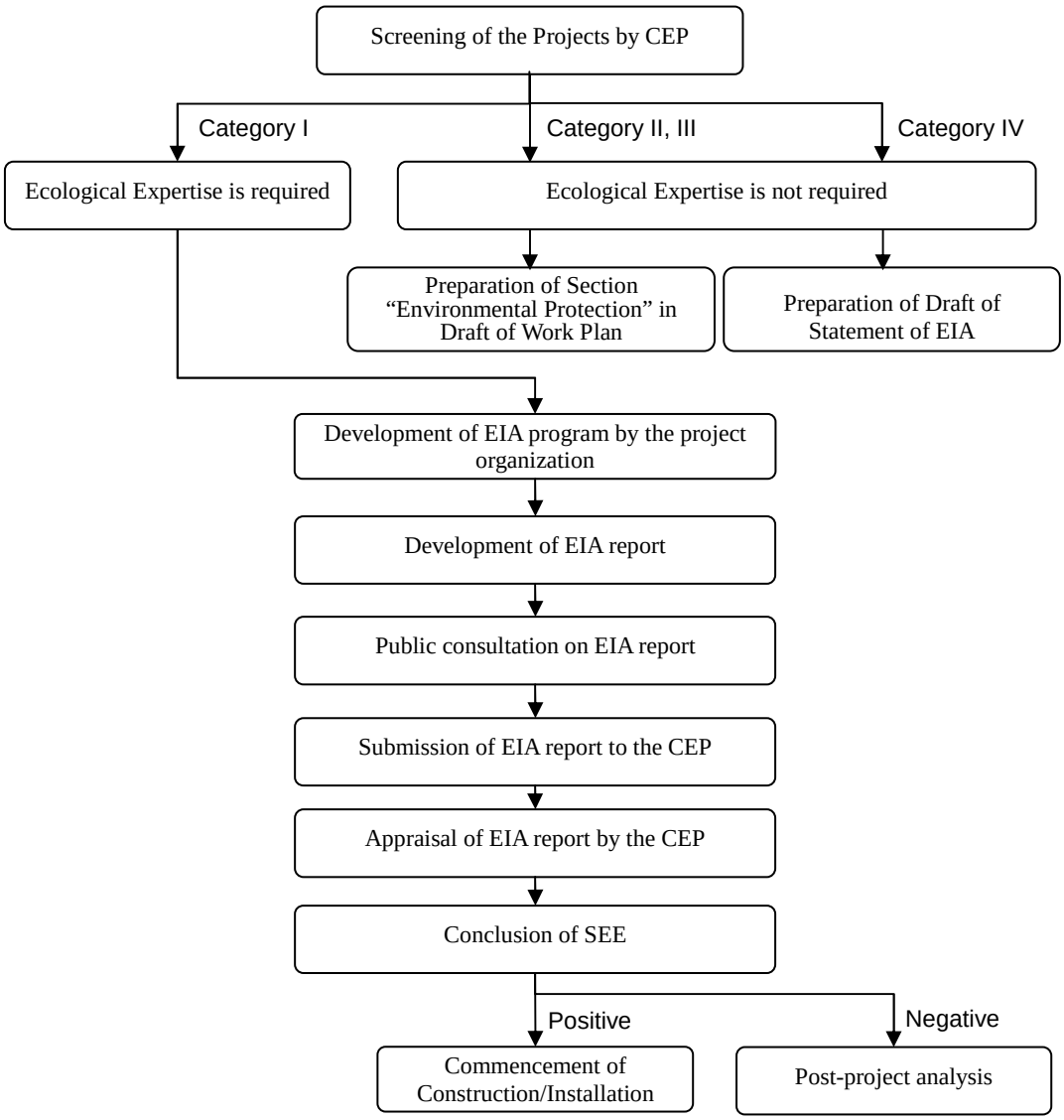
The list of facilities and activities which are required in the development of EIA materials is prescribed by "the Resolution No. 253, on facilities and activities, which is required to develop materials on environmental impact assessment." The facilities and activities are listed and classified into four (4) categories corresponding to the impact on the environment. Definition of each category and facilities and activities applied are shown below.

- Category I: applied for the facilities and activities which have high possibility of impact on the environment such as highways, subways, railways, expressway, airports with a runway of 2,100 meters or more, etc.
- Category II: applied for the facilities and activities which have medium possibility of impact on environment such as roads of regional significance, asphalt plants, airports with a runway of less than 2,100 meters, etc.
- Category III: applied for the facilities and activities which have low possibility of impact on the environment such as roads of local importance, car parks, petrol and gas stations, petrol and gas stations, etc.
- Category IV: applied for the facilities and activities which have local impact possibility on environment such as baths and saunas (public), waterways internal value, veterinary clinics, Cemetery, etc.

(2) Approval Procedures

The objective of SEE is to appraise the project and environmental impact assessment is required for the appraisal for the projects listed in the Resolution No. 253 as mentioned above. However, according to the Resolution 509, the development of full EIA report is required for the project Category I and is not required for the other categories, the Section "Environmental Protection" in the Draft of Work Plan is required for Category II and III and Draft of Statement of EIA for Category IV. After the development of EIA Program which is to define the structure of the EIA report, schedule, scope, etc. based on the characteristics of the project, EIA report is developed and submitted to the CEP by project owner. The CEP appraises the project based on the EIA report and decides the conclusion of appraisal, either positive or negative.

The conclusion of SEE is issued by CEP. If the conclusion is positive, the project is allowed to be implemented but, if negative, other documents are required or the implementation of the project is abandoned. A series of the procedures requires from 30 to 90 days depending on the project according to the results of interviews with the CEP.



Source: JICA Study Team

FIGURE 7.3-2 ECOLOGICAL EXPERTISE PROCEDURE

(3) Environmental Standards

Tajikistan has environmental standards related to air and water quality which is based on the Russian standard as shown below. Also, permissible level of noise and vibration has been set by the ministry.

TABLE 7.3-1 AIR QUALITY STANDARDS

Pollutant	Maximum Permissible Concentration (MPC) (mg/m^3)
Particulate Matter (PM)	0.15
Nitrogen Oxide (NO)	0.06
Nitrogen Dioxide (NO_2)	0.04
Sulphur Dioxide (SO_2)	0.05
Carbon Monoxide (CO)	3.00

Source: GN 2.1.5.1338-03 "Maximum Permissible Concentration of Pollutants in the ambient air of populated areas"

TABLE 7.3-2 WATER QUALITY STANDARDS

Pollutant	Maximum Permissible Concentration (MPC) (mg/l)
Cadmium	0.001
Mercury	0.0005
Lead	0.01
Zinc	1.00
Arsenic	0.01

Source: GN 2.1.5.1315-03 "Maximum Permissible Concentration of Pollutants in Water Bodies Drinking and Cultural and Community Water Use"

(4) Protected Area

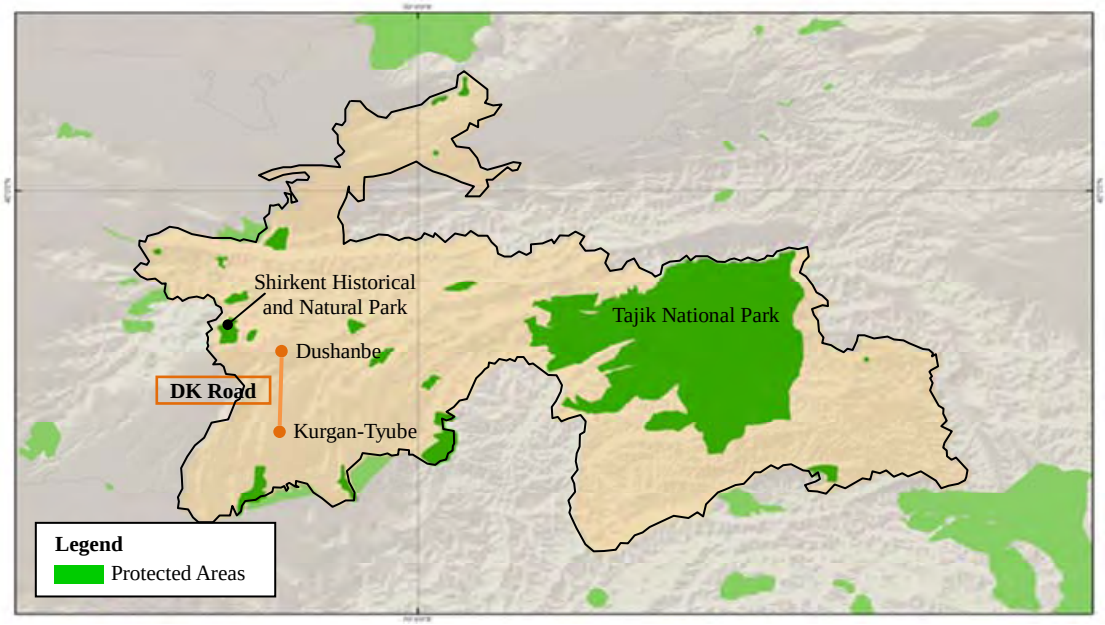
There are 26 protected areas, 31,182 km^2 in total, including two national parks; Tajik National Park which is the largest protected area in Tajikistan, 2,600 km^2 and Shirkent Historical and Natural Park in Tajikistan. The study area is far from these protected areas.

List and Map of Protected areas in Tajikistan are shown below.

TABLE 7.3-3 LIST OF PROTECTED AREAS OF TAJIKISTAN

Designation Type	Designation in English	Name of Protected Areas
International	Ramsar Site, Wetland of International Importance	Karakul Lake, Kayrakum Reservoir, Lower part of Pyandj River, Shorkul and Rangkul Lakes, Zorkul Lake
	World Heritage Site	Tajik National Park (Mountains of the Pamirs)
National	National Park	Shirkent Historical and Natural Park, Tajik National Park
	Natural Park	Sarikhosor Natural Park
	State Nature Reserve	Dashtidjum, Romit, Tigrovaya Balka, Zorkul
	Wildlife Sanctuary	Aktash, Almasinsky, Childuhtaronsky, Dashtidjum, Iskanderkulsky, Karatausky, Komorowski, Kusavlisaysky, Muzkulsky, Nurek, Sangvorsky, Sayvotinsky, Zeravshanian

Source: Protected Planet



Source: Protected Planet

FIGURE 7.3-3 PROTECTED AREA IN TAJIKISTAN

(5) Vulnerable Species

There are 41 species including 12 kinds of plants and 12 kinds of birds in Tajikistan which are assessed at Critically Endangered, Endangered or Vulnerable in the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN).

The List of vulnerable species according to the IUCN Red List is shown below.

TABLE 7.3-4 THE LIST OF VULNERABLE SPECIES

Species	Scientific Name
Plants (12)	Amygdalus bucharica, Crataegus darvasica, Crataegus necopinata, Lonicera paradoxa, Malus sieversii, Prunus tadzhikistanica, Pyrus cajon, Pyrus korshinskyi, Pyrus tadshikistanica, Rhus coriaria, Swida darvasica, Zygophyllum darvasicum
Birds (12)	Aquila heliaca, Chlamydotis macqueenii, Clanga clanga, Columba eversmanni, Falco cherrug, Haliaeetus leucoryphus, Marmaronetta angustirostris, Neophron percnopterus, Otis tarda, Oxyura leucocephala, Pelecanus crispus, Vanellus gregarius
Mammals (7)	Acinonyx jubatus, Cuon alpinus, Equus hemionus, Gazella subgutturosa, Ovis orientalis, Panthera tigris, Panthera uncia
Fish (5)	Aspiolucius esocinus, Cyprinus carpio, Luciobarbus brachycephalus, Luciobarbus capito, Pseudoscaphirhynchus fedtschenkoi
Invertebrates (3)	Onychogomphus flexuosus, Parnassius autocrator, Saga pedo
Reptiles (2)	Testudo horsfieldii, Phrynocephalus strauchi

Source: The IUCN Red List of Threatened Species, 2015

7.4 Land Acquisition and Resettlement

7.4.1 Land Ownership

All land in Tajikistan is the property of the state and the state guarantees its effective use in the interests of the people. As to land ownership, the Land Code mentions as follows.

- Reclamation of land formerly owned by the ancestors is not permitted.
- All lands in Tajikistan are divided into 7 categories in accordance with the intended use and the use of lands is restricted.
- The Land Use Right Certificate is required for people to use land in the country and land use tax is collected from them to the state. Owners of the land use rights are allowed to lease their lands to others and lessees do not have the duty of the tax payment.
- The land use right is tradable and the trading mechanism is currently being prepared.

7.4.2 Organization related to Land Acquisition and Resettlement

State Committee of Land Management and Geodesy of the Republic of Tajikistan (CLMG) owns and manages all the land in the country. It is responsible for the work related to land acquisition such as registration of land use rights and issue of Land Use Right Certificate.

The Land Committee is set up in each local government and conducts a series of land acquisition procedures together with CLMG. However, the implementation unit for land acquisition may be established depending on the project.

7.4.3 Procedure for Land Acquisition and Resettlement

The main procedures for land acquisition and resettlement according to the Land Code and the results of interviews with CEP are as follows;

- Land expropriation can be carried out with compensation for damages to land users when the land which someone has the right to use is required for state or public use including development of infrastructure, construction of public facilities and exploitation of mineral deposit.
- Land users or other registered users of the rights associated with the land must be notified in writing by the local Land Management Agency no later than one year before the implementation of land expropriation. They are entitled to exercise the rights to use of the land against the court decision including producing the necessary costs to ensure the use of the site in accordance with their purpose.
- All decisions on expropriation of land for state or public use shall be published in the national newspapers in Tajik and Russian languages within five business days after the executive authorities issued a decision.

7.4.4 Compensation for Damages to Land Users

Compensation for damages to land users when expropriation of land for state or public use is prescribed by Land Code as follows:

- When the land expropriation is conducted for public use, the land users and other registered users are required to relocate their property to the alternative land prepared by the state as compensation or, instead, to leave the land after receiving in cash the compensation payment for their properties including the money invested to the land by that time.
- The land where affected people can live with the living standards equal to or more than that of present life is selected as an alternative land as compensation.
- All damages to their properties other than lands including lost profit to be produced on the land are subject to compensation evaluated at market value.
- In case of disagreement with the size of the alternative land and results of damage evaluation, land users have the right to go to court.

7.5 Land Use along DK Road

The land along DK road is used mainly for either agriculture, grass or urban. The kinds of fruits cultivated on the agricultural land are grape, cherry, apricot, pistachio and cotton. There is also a cemetery on the slope of a hill between Obikiik and Uyali along the DK Road.

The Land Use Map along the DK Road is indicated as follows.

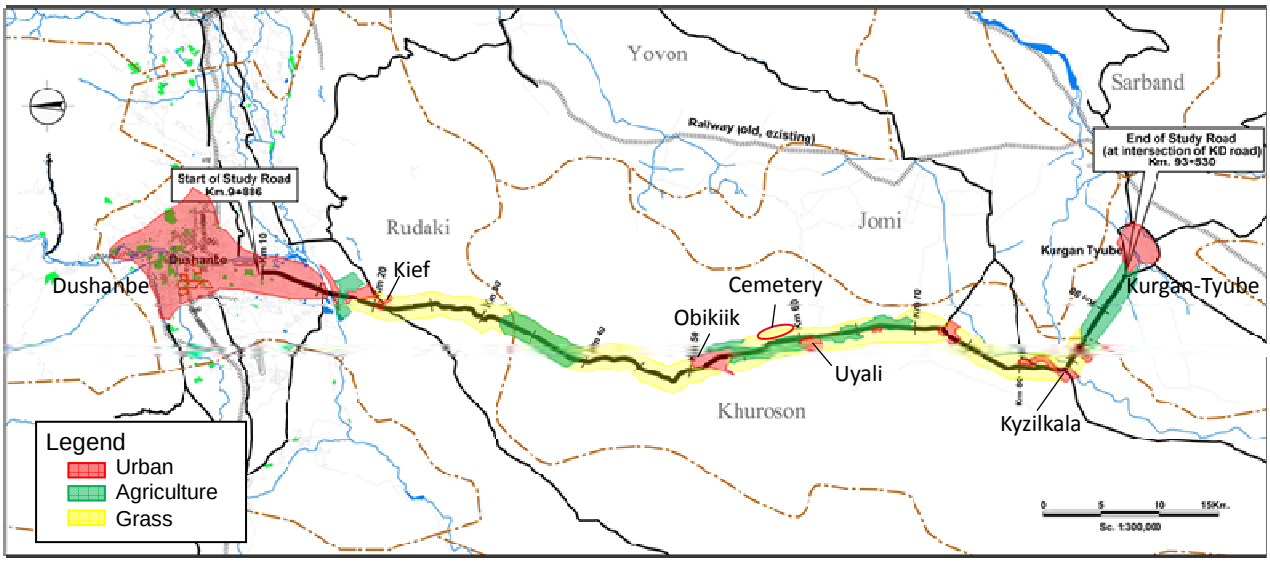


FIGURE 7.5-1 LAND USE MAP ALONG DK ROAD

7.6 ROW and Land Acquisition

The Right-of-Way of DK Road is 50m, and is 25m from the center of the road at both sides is secured as ROW. However, there are some buildings within ROW. Therefore, 30m is the recommended ROW for widening in the urban sections as the result of the survey and with the discussion with MOT. Widening to both sides is planned in five urban sections: Kief, Obikiik, Uyali, Kyzilkala and Kurgan-Tyube, and widening to either right side or left side in other sections. In Dushanbe, pavement rehabilitation of the existing 4-lane road is planned. Widening area map is shown in the figure below.

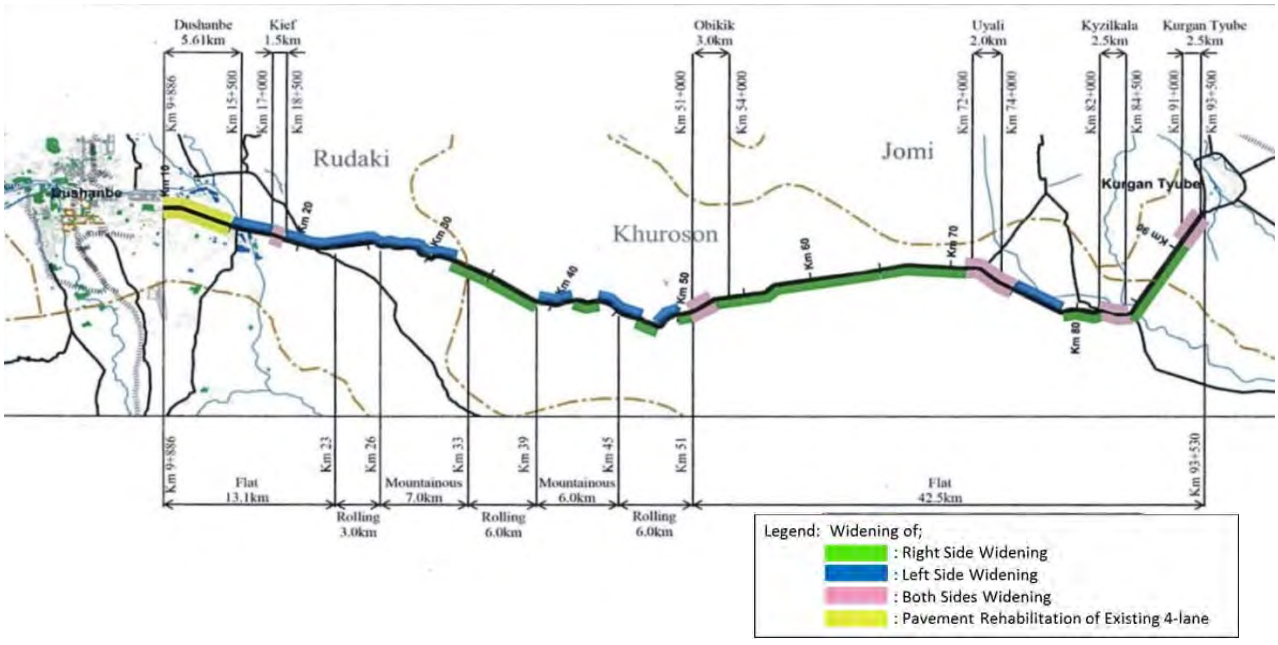


FIGURE 7.6-1 WIDENING TO 4-LANE: RIGHT SIDE, LEFT SIDE OR BOTH SIDES

7.7 Structures Affected by Widening to a 4-lane Road

The main structures along DK Road are houses, shops and gas stations. Some of them are built within the 30 meter ROW. Fifty four structures including walls and signboards are possibly to be affected and resettlement may be necessary, although the number of resettlement is unconfirmed at present, when the DK road is widened from a 2-lane to a 4-lane.

The number of structures which may be affected by the widening project is shown below.

TABLE 7.7-1 NUMBER OF STRUCTURES TO BE AFFECTED

Structures	Number of Structures to be affected
Houses	7
Buildings	40
Other Structures	7
Total	54

7.8 Identified Environmental and Social Consideration Issues

Some issues of environmental and social consideration to be taken into were identified in the survey as follows:

- Poverty rate in Khatlon Region where DK Road is located is quite high (78% in 2003) as mentioned in “3.1.5 Poverty Level”. People living in poverty possibly exist around the DK road. Therefore, EIA study and initial baseline survey need to be carefully conducted.
- There is a cemetery with more than 15 graveyards on the slope of a hill between Obikiik and Uyali along the DK Road. Widening plan shall be advanced giving due consideration to the cemetery, although widening to the opposite side is now planned.
- There are lots of roadside stalls along the DK Road including a part of shops along the road. Some of them are not authorized to sell goods but they may be considered in planning the resettlement and compensation according to JICA Guidelines for Environmental and Social Considerations as provisions are unconfirmed in laws and regulations of Tajikistan at present.

CHAPTER 8 DK ROAD IMPROVEMENT PLAN

8.1 Geometric Design Standards to be adopted

Comparison of geometric design standards of Asian Highway (AH) Standards, Tajikistan Design Standards (SNiP) and Japan's Standards are shown in **Table 8.1-1**.

Case-1 : Improvement of Existing 2-lane Road

- Cross sectional components of the existing 2-lane road seem to have adopted SNiP Class III, however, the existing maximum vertical grades and minimum horizontal curve do not satisfy the SNiP Class III Standards.
- The existing 2-lane road more or less satisfies Class II of the AH Standards.
- It is recommended that AH Standard (Class II) shall be adopted. This recommendation was approved by MOT at the meeting held on July 8, 2015.

Case-2 : Widening to a 4-lane Road

- Possible standards to be followed will be either AH Standards (Class I) or SNiP (Class I-b).
- Design standards of SNiP (Class I-b) require quite high standards, particularly for Design Speed, Minimum Horizontal Curve and Maximum Vertical Grades.
- If SNiP (Class I-b) is selected, drastic modifications on horizontal curve alignment and vertical grades of the existing alignment must be done and require huge investment.
- Existing alignment, both horizontal and vertical alignment, more or less within the requirement of AH Standard (Class I).
- It is recommended that AH Standard (Class I) should be adopted to avoid huge investment. This recommendation was approved by MOT at the meeting held on July 8, 2015.

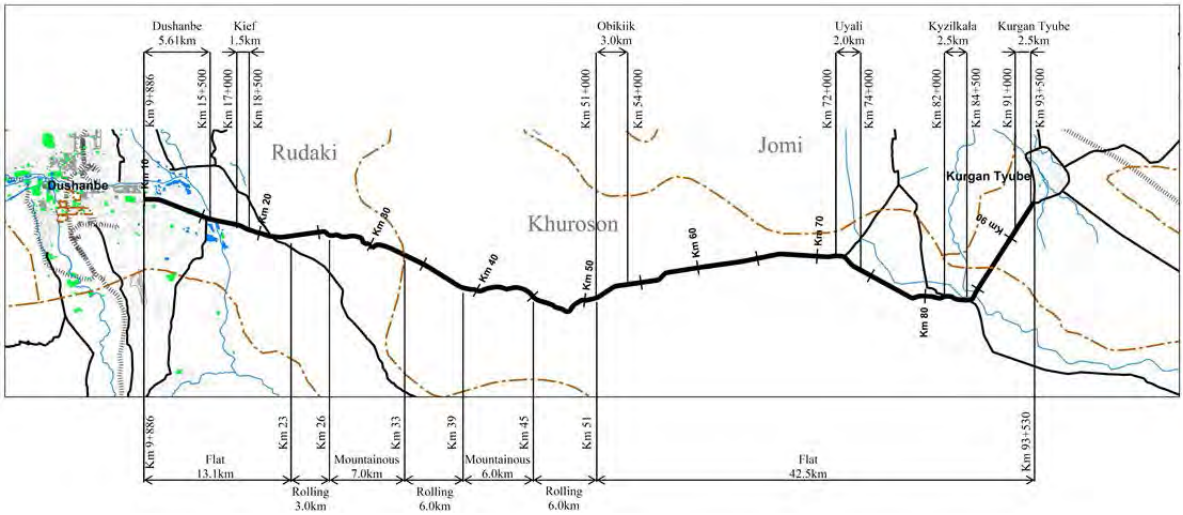
TABLE 8.1-1 COMPARISON OF GEOMETRIC DESIGN STANDARDS

Road Class		2-Lane Road				4-Lane Road			
		AH Standard (Class II)	SNiP (Class II)	SNiP (Class III)	Japan's Standard (Type-3, Class 2&3)	AH Standard (Class I)	SNiP (Class I-a)	SNiP (Class I-b)	Japan's Standard (Type-3, Class 1&2)
Design Speed (km/hr)	Flat	80	120	100	60	100	150	120	80
	Rolling	60	100	80	-	80	120	100	-
	Mountainous	40~50	60	50	40~50	50	80	60	60
Lane Width (m)		3.50	3.75	3.50	3.25	3.50	3.75	3.75	3.50
Shoulder Width (m)		2.50	3.75	2.50	0.75	3.00	3.75	3.75	1.25
Center Median (m)		-	-	-	-	3.00	6.00	6.00	1.75
Minimum Horizontal Curve (m)	Flat	210	800	600	150	350	1,200	800	280
	Rolling	115	600	300	-	210	1,000	600	-
	Mountainous	50~80	150	100	60~100	80	300	150	150
Maximum Vertical Grade (%)	Flat	4	3.5	3.5	5	4	3.5	3.5	4
	Rolling	5	3.5	3.5	-	5	3.5	3.5	-
	Mountainous	6~7	4	4	6~7	6~7	4	4	5
Road Width (m)		40	100 (50)	100 (50)	-	40	100 (50)	100 (50)	-

Japan's Standard: National Road Type 3
- Traffic Volume: 4,000 - 20,000 veh/day, Flat section Class 2, Mountainous Section Class 3
- Traffic Volume: Over 20,000 veh/day, Flat section Class 1, Mountainous Section Class 2

Source: AH Standards, SNiP, Japan's Standards

Classification of Terrain and Urban Section



Source: JICA Study Team

FIGURE 8.1-1 CLASSIFICATION OF TERRAIN AND URBAN SECTION

8.2 Number of Lanes and Proposed Typical Cross Sections

8.2.1 Number of Lanes to be Improved

In Chapter 5, future traffic demand on DK Road was estimated. Timing of widening to a 4-lane road (2-lane for each direction) was estimated and summarized in **Table 8.2-1.**

TABLE 8.2-1 TIMING OF WIDENING TO A 4-LANE ROAD AT TRAFFIC SURVEY STATION

Traffic Station	Timing of Widening to a 4-lane Road
Traffic Survey Station-1 (Km. 15)	Widening before the end of 2017
Traffic Survey Station-2 (Km. 22)	Widening before the end of 2022
Traffic Survey Station-3 (Km. 32)	Widening before the end of 2021
Traffic Survey Station-4 (Km. 57)	Widening before the end of 2021
Traffic Survey Station-5 (Km. 73)	Widening before the end of 2020
Traffic Survey Station-6 (Km. 84)	Widening before the end of 2019
Traffic Survey Station-7 (Km. 93)	Widening before the end of 2017

Source: JICA Study Team

The approximate project implementation schedule may be as shown in **Table 8.2-2**.

TABLE 8.2-2 APPROXIMATE PROJECT IMPLEMENTATION SCHEDULE

	2015	2016	2017	2018	2019	2020	2021	2022
1) Information Collection Survey (this Study)								
2) Preparatory Survey or Feasibility Study								
3) Appraisal								
4) Procurement of Consultant								
5) Detailed Design								
6) Procurement of Contractor								
7) Construction of First Priority Section								
8) Construction of Second Priority Section								

Source: JICA Study Team

Table 8.2-1 and **Table 8.2-2** indicate that if only the existing 2-lane road is improved, most of the sections suffer traffic congestion by the time of completion of the existing road improvement and widening to a 4-lane road must start during the implementation of the existing 2-lane road improvement. Thus, widening to a 4-lane road needs to be planned at this stage.

Nonetheless, the following 2 scenarios are studied;

DK ROAD DEVELOPMENT SCENARIO

Scenario-1: Only the existing 2-lane is improved. **Scenario-2**: Widening to a 4-lane road (In addition to improvement of the existing 2-lane road. Additional 2-lane to make DK Road 4-lane is constructed.

Major civil work components of each scenario are as follows;

MAJOR CIVIL WORK COMPONENT

Scenario-1	Pavement improvement Reconstruction of deteriorated bridges Construction of new bridges at flood section Improvement/construction of box-culverts Construction of roadside drainage Provision of road safety facilities
Scenario-2	Same works as Scenario-1 for the existing road Construction of additional 2-lane road

8.2.2 Typical Cross Sections

(1) Typical Cross Section of Scenario-1

Typical cross section is shown in **Figure 8.2-1.**

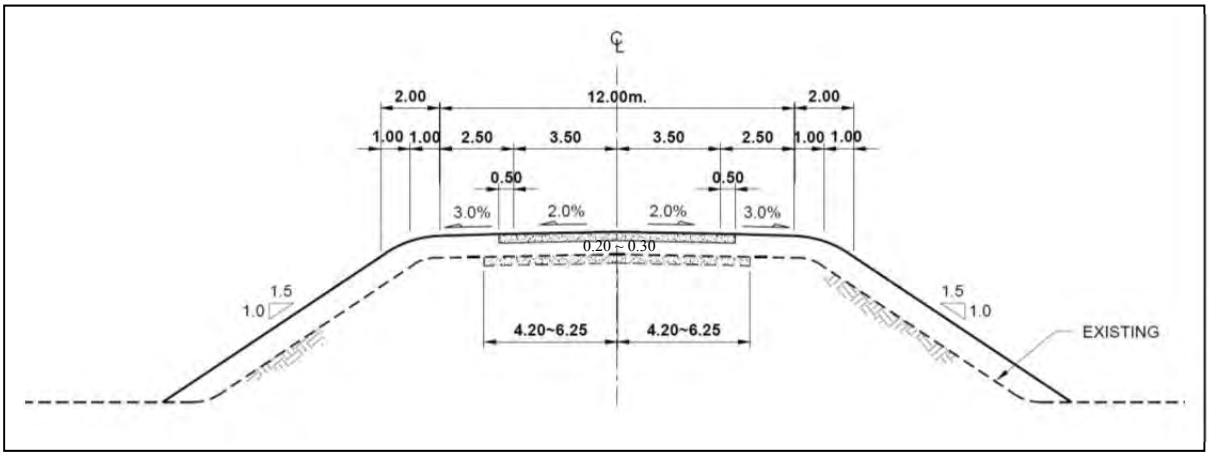


FIGURE 8.2-1 TYPICAL CROSS SECTION OF IMPROVEMENT OF EXISTING 2-LANE ROAD

(2) Typical Cross Section of Scenario-2

There are two (2) cases to be compared (see **Figure 8.2-2**);

Case-1: The Center Line of a 4-lane road is selected at the same location as the existing center line. Both sides of the existing road are widened.

Case-2: The Center Line of a 4-lane road is selected at the existing pavement edge, thus only one side is widened.

The 2 cases are compared as follows;

	Case-1	Case-2
Pavement Problems	At the edge of existing pavement, longitudinal cracks at new pavement will occur.	There is no such possibility as Case-1.
Traffic Management during Construction	Traffic should not be disturbed during construction as much as possible, however, traffic management of this case is rather difficult.	2 lanes can be secured for traffic during construction, thus traffic management of this case is much easier than Case-1.
Road Center Line and Road ROW	Existing road Center Line and ROW can be maintained.	Road Center Line must be shifted about 4.5m, however, a 4-lane road can be accommodated within the existing ROW.
Recommendation	Not Recommended	Recommended

Source: JICA Study Team

The typical road cross sections of a 4-lane road are shown in the following figures.

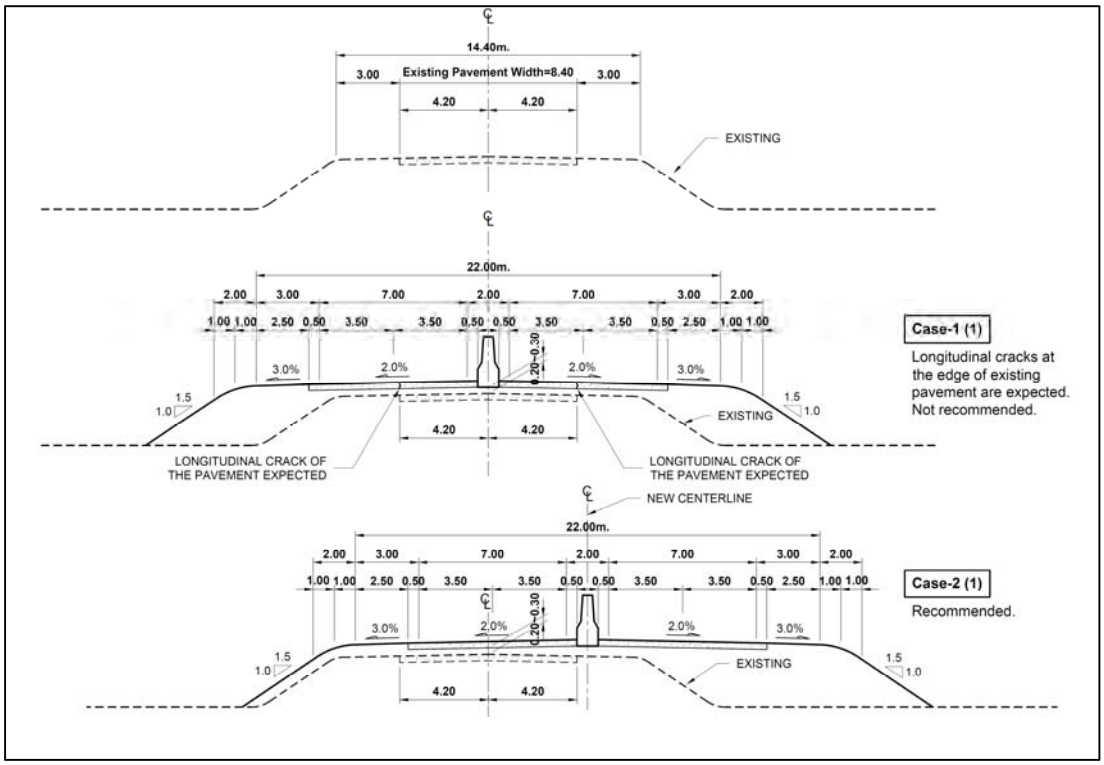


FIGURE 8.2-2 TYPICAL CROSS SECTION PATTERN-1: EXISTING PAVEMENT WIDTH=8.40M.

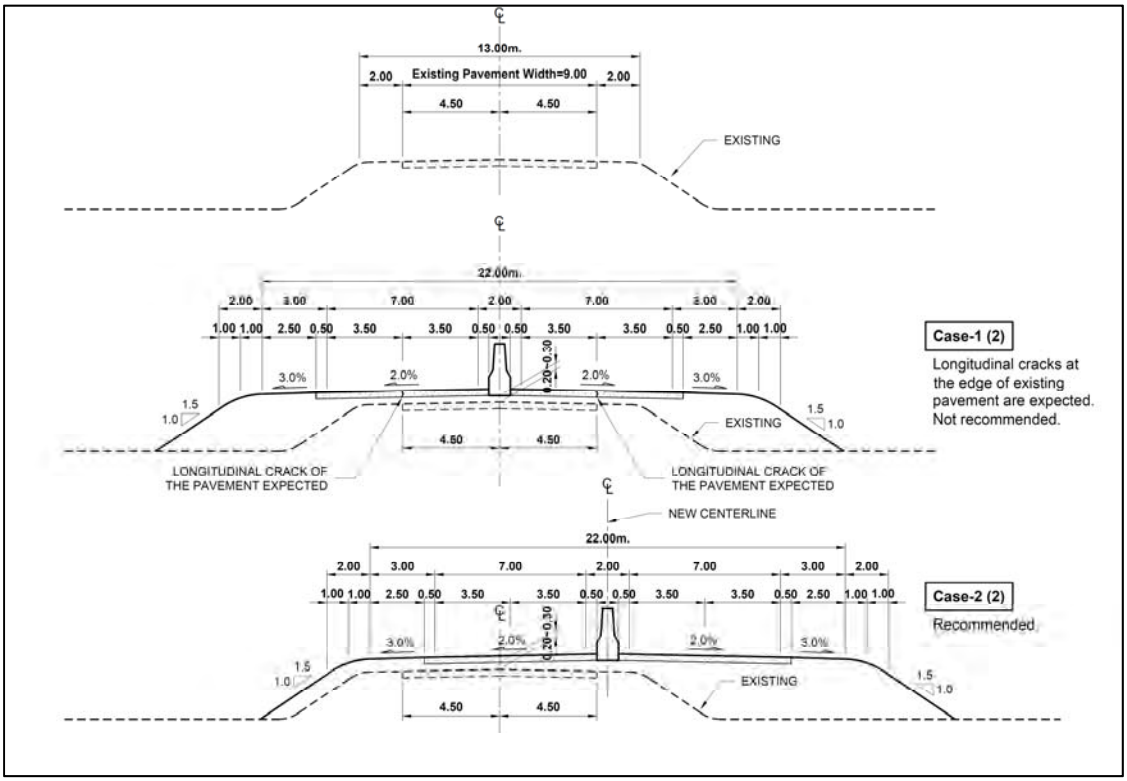


FIGURE 8.2-3 TYPICAL CROSS SECTION PATTERN-2: EXISTING PAVEMENT WIDTH=9.00M.

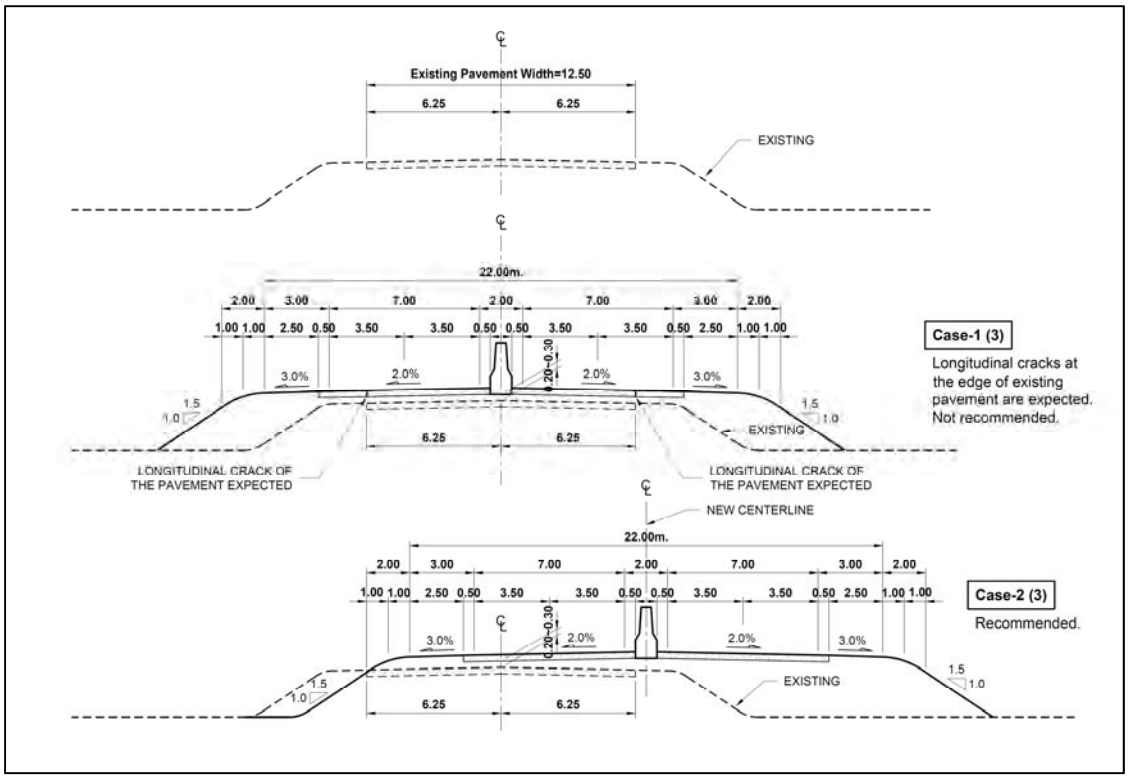


FIGURE 8.2-4 TYPICAL CROSS SECTION PATTERN-2: EXISTING PAVEMENT WIDTH=12.50M.

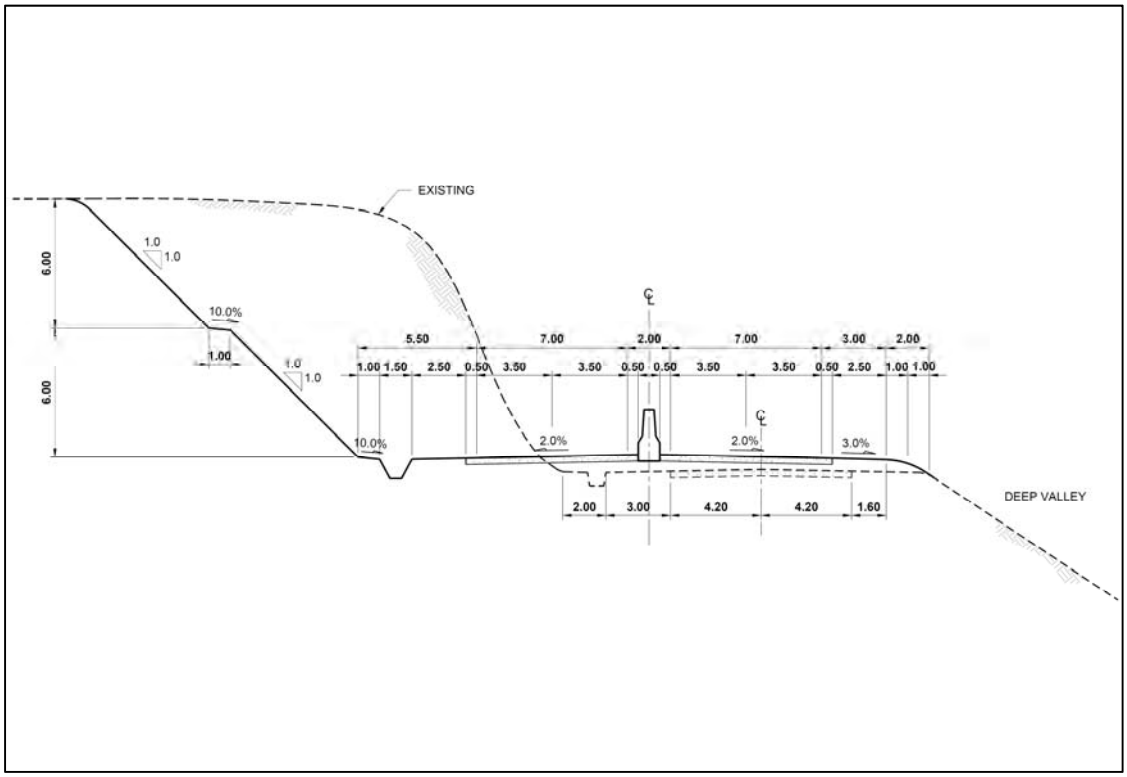


FIGURE 8.2-5 TYPICAL CROSS SECTION: AT MOUNTAINOUS SECTION

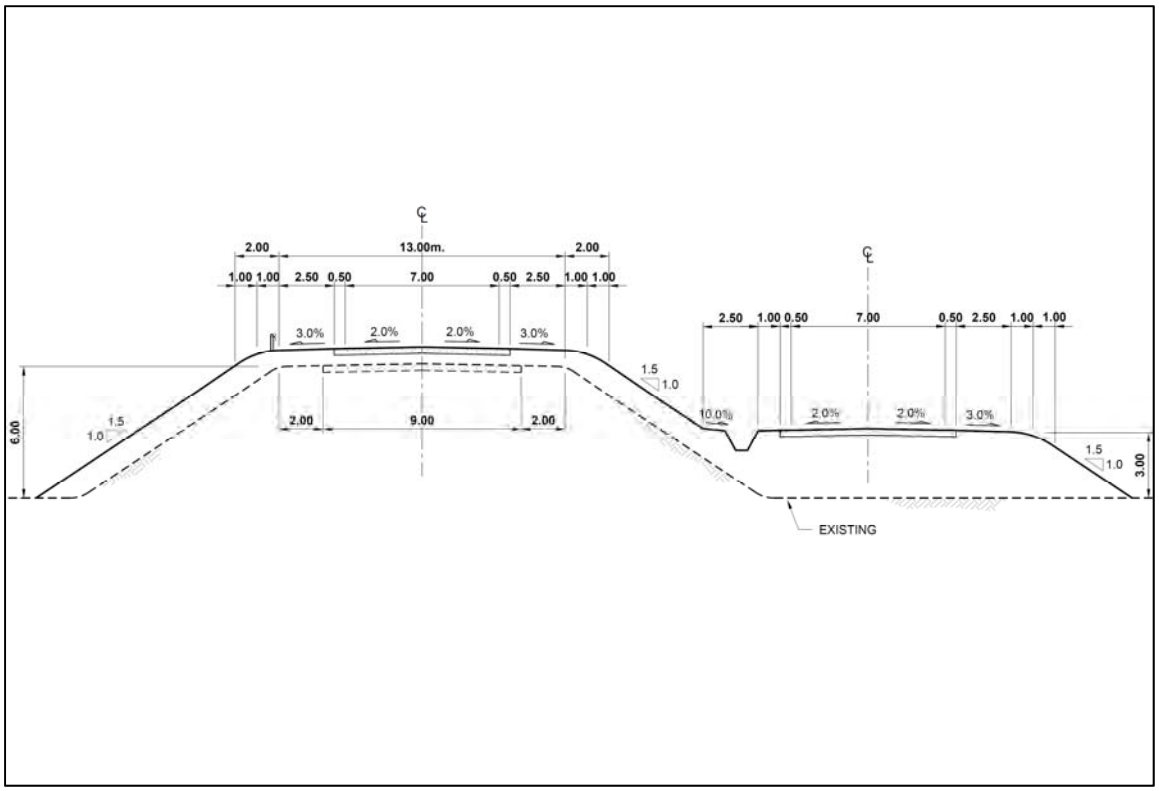
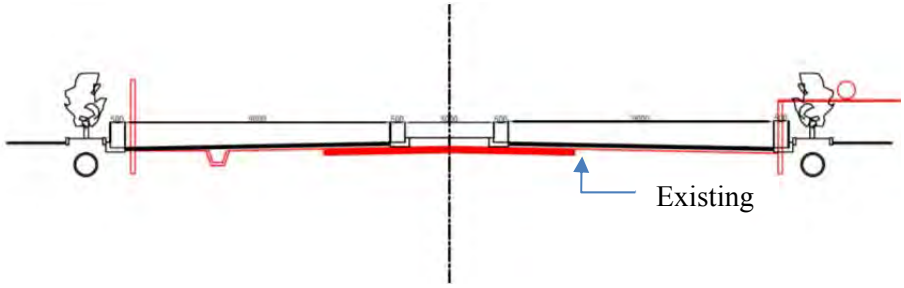
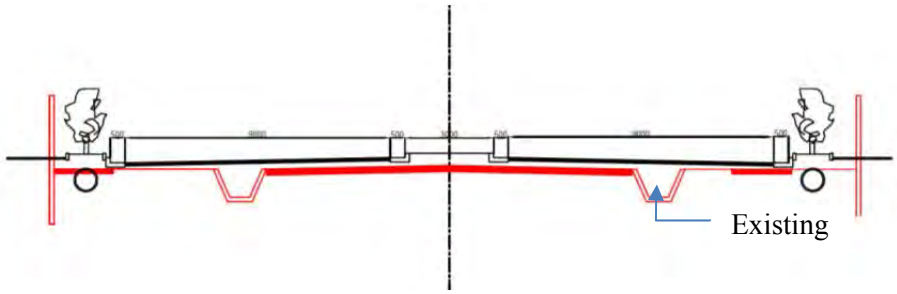


FIGURE 8.2-6 TYPICAL CROSS SECTION: AT HIGH EMBANKMENT SECTION

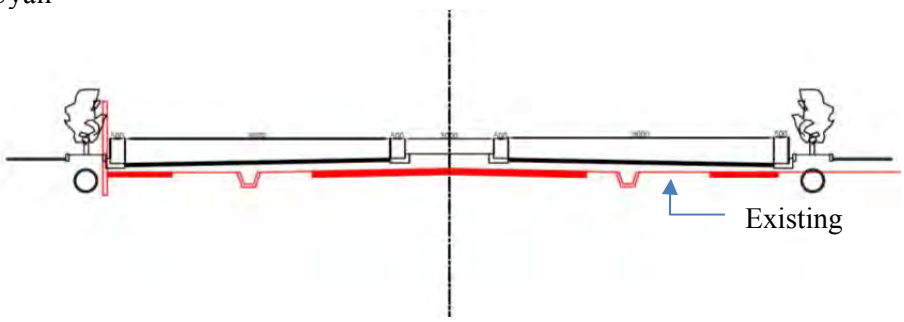
Kief



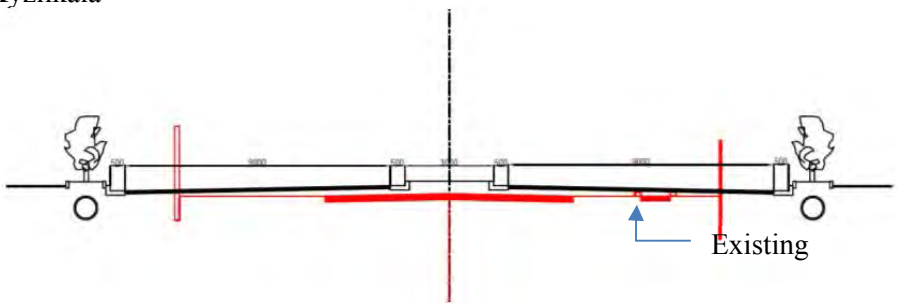
Obikiik



Uyali



Kyzilkala



Kurgan-Tyube

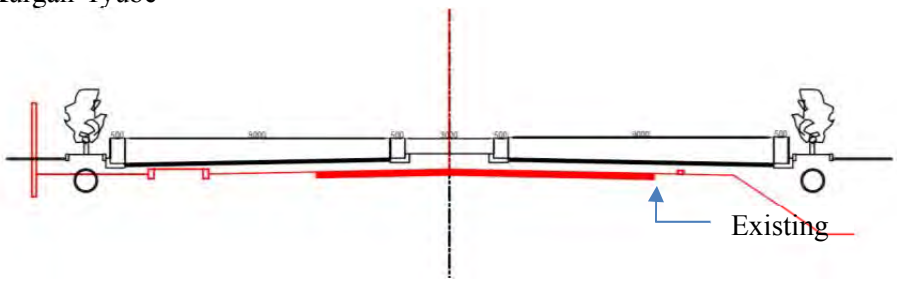


FIGURE 8.2-7 TYPICAL CROSS SECTION OF URBAN SECTION

8.2.3 Widening Policy

As shown in **Figure 8.2-5**, valley at the rolling and mountainous terrains is quite deep, therefore, widening to mountain side is recommended to reduce the construction cost of high embankment. There is an old road space between Km. 55 to Km. 70 at the right side of the existing road where the space for road construction is available.

At urban sections, there is some development on both sides. If only one side is widened, people at the affected side will complain saying why only their side is affected. It is recommended that widening should be made on both sides of the existing road at traffic survey station. In consideration of such conditions, it is proposed which side of the existing road is to be widened and shown in **Figure 8.2-8**.

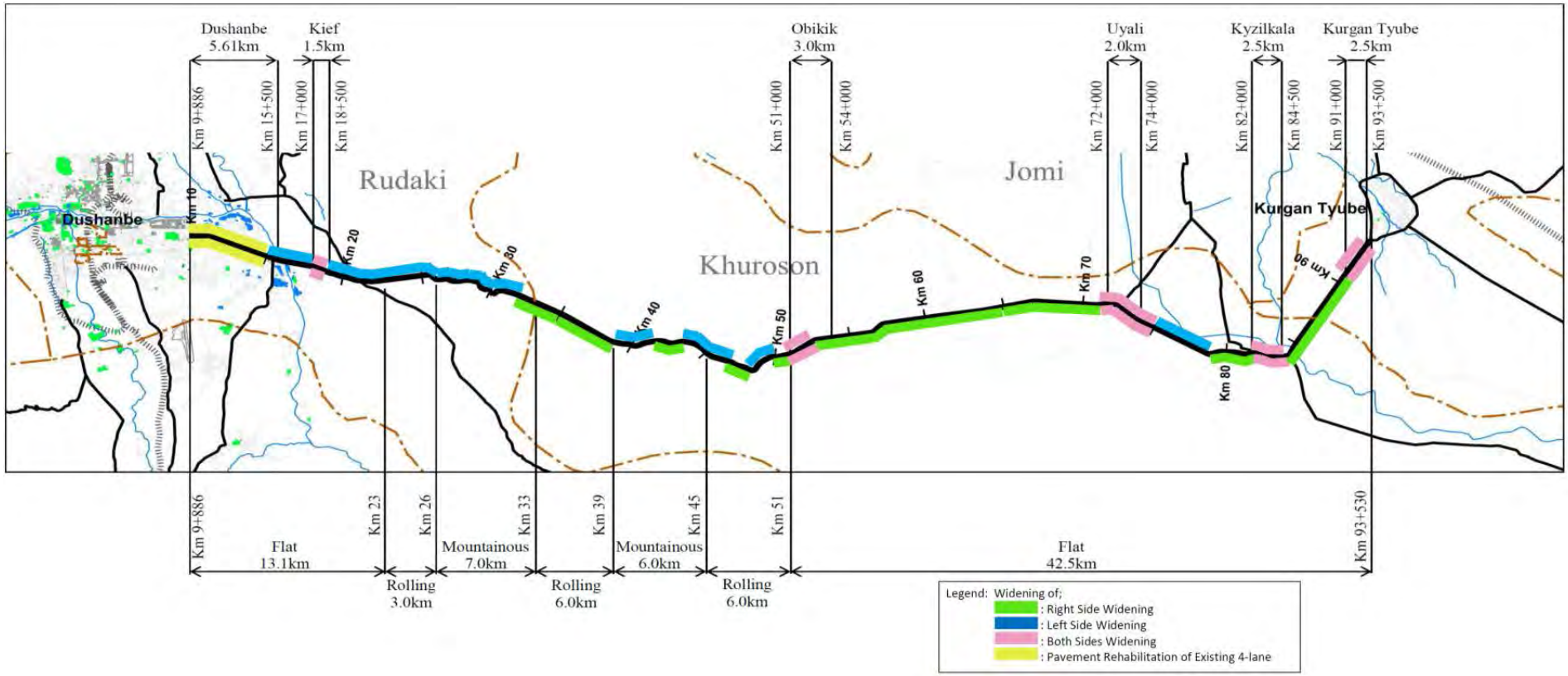


FIGURE 8.2-8 WIDENING TO 4-LANE: RIGHT SIDE, OR LEFT SIDE OR BOTH SIDE

8.3 Horizontal and Vertical Alignment Improvement

Geometric design standards of Asian Highway are recommended to be adopted for the DK Road.

AH STANDARDS (CLASS II) FOR HORIZONTAL CURVE AND VERTICAL GRADE

	Terrain		
	Flat	Rolling	Mountainous
Minimum Horizontal Curve (m)	350	210	80
Maximum Vertical Grade (%)	4	5	6 ~ 7

Source: AH Standards

The existing DK Road more or less satisfies the above standards, therefore, it is recommended that the existing horizontal alignment and vertical alignment should be followed.

8.4 Pavement Improvement of Existing Road and Additional 2-lane Road Pavement Structure

The pavement structure of additional 2-lane has been computed in **Table 8.4-1** in accordance with AASHTO Guide for Design of Pavement Structure, 1993 with cumulative ESAL values computed in 5.6 CBR Value of Sub-grade has been assumed to be 8 based on the excavation survey.

TABLE 8.4-1 REQUIRED THICKNESS OF PAVEMENT BASED ON ESAL AND CBR VALUE

	Section (Km)	Length (m)	Cumulative 18 kip ESAL (W18)	CBR value of Sub - grade	Required Pavement (SN)	AS surface Course (cm)	AS Binder Course (cm)	Base Course (cm)	Sub-base Course (cm)	Planed (SN)
Existing Road	9+886 - 15+018	5,132				5	5	Min. 20cm	-	
Addt'l 2-Lane Road	9+886 - 93+530	80,644	7,500,000	8	3.748	5	5	20	30	3.790>3.748 OK

Source: JICA Study Team

8.5 Bridge Improvement/Replacement of Existing Bridges and Additional 2-lane Bridges

The proposed improvement for existing bridges is summarized in **Table 8.5-1**.

For the existing bridges, four bridges (B-7, B-11, B-15 & B-16) are proposed to be replaced by new bridges and four other bridges are proposed to be replaced by concrete box culverts since three of these bridges (B-4, B-5 & B-6) are overcrossings for abandoned railways and bridges are no longer necessary while the other bridge (B-12) functions with smaller discharge opening. Half of the existing interchange bridge (B-3) is proposed to be replaced with a new bridge for partial replacement.

For bridge widening, it is proposed to replace and construct B-7 & B-11 as new 4-lane bridges. Other bridges are proposed to be widened with new 2-lane bridges or box culvert extensions. Bridge B-1 is already a 4-lane bridge where minor repair is recommended.

TABLE 8.5-1 PROPOSED IMPROVEMENT MEASURES FOR EXISTING BRIDGES AND WIDENING TO 4-LANES

Br. No.	Station	Problem/Issues with Current Condition	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
B-1	13 + 045	• Minor cracks, concrete spalling and deck surface crack	• Repair of cracks, spalling and replace carriageway deck surface • Repair expansion joint/replace joint seal	• No bridge widening, existing is 4-lane bridge

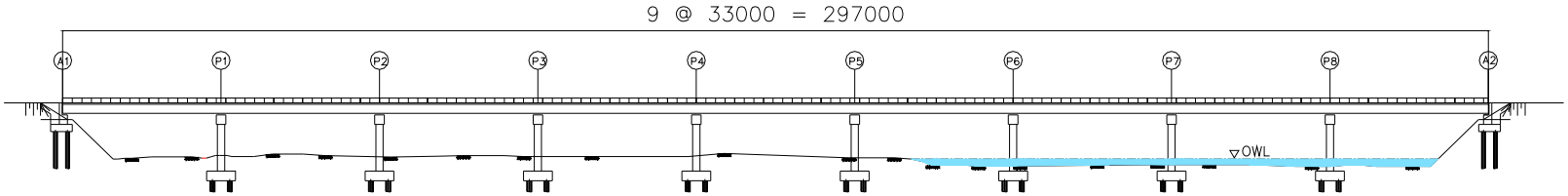
Br. No.	Station	Problem/Issues with Current Condition	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
			• Verify flood/irrigation discharge freeboard • Repair of railings	
B-2 (Kofarnihon River)	15 + 980	• Girder end bearing support cracks, corroded/ damaged/tilted bearings, minor girder and pier cracks	• Repair of girder cracks at bearing supports • Repair of bearings • Repair of concrete cracks and defects • Repair expansion joint/replace joint seal • Repair of railings	• Construction of 9-span, 2-lane bridge at upstream side (L=297m, 9@33m)
B-3 (Interchange)	21 + 065	• Many cracks and concrete spalling on slabs and girders • Different bridge type for each half section with different response characteristics causing frequent cracks at slabs and carriageway surface	• Partial replacement of south-bound half bridge section with the same type as the north-bound 1-span prestressed girder (L=33m), or Replace with a new 4-lane bridge (L=33m, 1-span) • Improve vertical clearance of bridge to 5m by lowering road profile below the bridge • Repair of railings • Repair expansion joint/ replace joint seal	• Existing bridge is 4-lane • Replacement of half section southbound by 1-span (2-lane bridge, L=33m) with the same configuration as the existing northbound bridge • Lower down undercrossing road to increase vertical clear height to 5m.
B-4	22 + 020	• Many structural cracks and defects • Different bridge type for each half section with different response characteristics causing frequent cracks at slabs and carriageway surface • Used to function as opening for railway which already abandoned	• Replace with buried 2-cell RC box culvert (1 – 3m x 3m RCBC) in between the existing abutments	• Existing bridge is 4-lane • Bridge is to be replaced by buried RCBC
B-5	32 + 025	• Many structural cracks and defects on slab and abutments • Original slab bridge was widened with shallower slab with different stiffness • Used to function as opening for railway which already abandoned	• Replace with a 2-cell RC box culvert (1 – 4m x 3m RCBC) in between the existing abutments to maintain water discharge function	• Extend the new 2-cell RCBC to cover road widening section

Br. No.	Station	Problem/Issues with Current Condition	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
B-6	45 + 290	• Serious structural defects/damage on slabs, girders and piers • Poor structural layout due to skew with saw-tooth expansion joints	• Replace with a 2-cell box culvert (2 - 3m x 3m RCBC) to maintain water discharge function	• Extend the new 2-cell RCBC to cover road widening section
B-7	48 + 205	• Many cracks on girders and slabs and concrete spalling with exposed rebars • Structural crack on cap beam of abutment pile bent	• Replace with a new 4-lane bridge and realign bridge to match 4-lane road alignment (L = 60m) • Verify flood freeboard	• The existing bridge will be demolished and replaced with a 4-lane bridge
B-8	53 + 245	• Many cracks on girders and slabs and concrete spalling with exposed rebars • Function as local road overcrossing with vertical clearance of 4.5m only	• Repair of concrete cracks and spalling, repair of expansion joint/replace joint seals • Replacement of carriageway surface • Repair of railings • Repair expansion joint/ replace joint seal • Lower existing road profile under the bridge to satisfy 5m vertical clearance	• Construct additional 1-span, 2-lane bridge (L=20m)
B-9	56 + 625	• Minor cracks and spalling, carriageway wearing surface cracks, • Girder end support cracks	• Repair of concrete cracks and spalling, replacement of wearing surface, repair of girder end support, bearing repair • Repair of railings • Repair expansion joint/ replace joint seal	• Construct additional 3-span, 2-lane bridge (L=50.55m – 3@16.85)
B-10	58 + 300	• Many cracks and concrete spalling on precast u-girders and slabs, alligator cracks and potholes in carriageway wearing surface • River opening insufficient	• Replace deck slab/carriageway wearing surface • Repair cracks and concrete spalling • Repair of railings • Verify flood freeboard and raise-up bridge level when necessary, increase opening by removing soil in front of abutment • Repair expansion joint/ replace joint seal	• Construct additional 1-span, 2-lane bridge (L=24m)

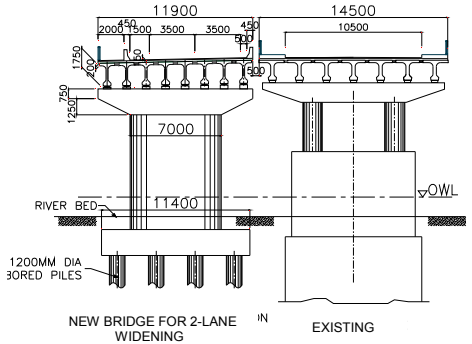
Br. No.	Station	Problem/Issues with Current Condition	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
B-11	72 + 415	• Some cracks and concrete spalling with exposed rebars on girders and deck, evidence of damage repair at bottom of piers • Flood level reached girder bottom in 2013 flood	• Need to raise-up flood freeboard level • Replace bridge when widening to 4-lane bridge by stage construction on 2, 2-lane bridges (L=38m). • Repair of railings	• Construct 2 bridges with 2-lanes each (to replace existing and for widening) by stage construction • Bridge length, L=38m (10m+18m+10m)
B-12	77 + 670	• Old steel bridge is in bad condition with heavy corrosion • Many cracks on carriageway surface due to different bridge types for each direction	• Replace with a 2-cell box culvert (2 - 4m x 3m) • Verify high water freeboard for irrigation	• Construct 2-cell RCBC (2 – 4m x 3m) to extend new culvert
B-13	78 + 840	• Minor cracks and concrete damage • Many cracks on carriageway surface • River opening constricted by soil in front of abutment	• Repair concrete damage • Replace carriageway wearing course • Repair expansion joint/ replace joint seal • Repair of railings • Remove/excavate soil in front of abutment	• Construct 2-cell RCBC (2 – 4m x 3m) for the 2-lane widening section. This section is sufficient to cover the existing bridge opening.
B-14 (Vakhsh River)	84 + 250	• Minimal corrosion of steel plate girders • Cracks on joints of precast slabs, cracks on carriageway surface • Expansion joint damage	• Repair of damaged sections, seal cracks, replace carriageway wearing course • Repair expansion joint/ replace joint seal • Repair of railings	• Construct additional 10-span bridges for the 2-lane widening at the downstream side (10@33m).
B-15	90 + 255	• Many cracks and concrete spalling on deck slab and girder • Many cracks and potholes on carriageway surface due to deck damage • Need to verify freeboard and river opening	• Bridge replacement (L=12m), • Raise bridge profile	• Construct additional 1-span, 2-lane bridge for widening (L=12m)
B-16	92 + 120	• Heavy cracks and concrete spalling on deck slab and girder with rebar corrosion • Many cracks on carriageway surface due to deck damage • Need to verify freeboard and river opening	• Bridge replacement (L=12m), • Raise bridge profile • Improve river banks and waterways both upstream and downstream of bridges	• Construct additional 1-span, 2-lane bridge for widening (L=12m)

Br. No.	Station	Problem/Issues with Current Condition	Proposed Existing Bridge Improvement Measures	Proposed Bridge Widening Improvement
B-17/BC-01	17 + 940	• Original culvert with opening of only 8m while river width is about 18m. Flood overflowed the road by 600mm in 2013.	• Replace culvert with 1-span, 18m bridge	• Construct a new 2-lane, 1-span bridge (L=18m) for widening section
B-18/BC-09	36 + 089	• Original culvert with opening of only 3.85m while river is about 16m. Flood overtopped the road with road section at downstream side eroded.	• Replace culvert with 1-span, 16m bridge.	• Construct a new 2-lane, 1-span bridge (L=16m) for widening section
B-19/BC-12	45 + 869	• Original culvert with opening of only 2.5m. Flood overflows the road every year and downstream side of the culvert is already scoured.	• Replace the culvert with 1-span, 12m bridge.	• Construct a new 2-lane, 1-span bridge (L=12m) for widening section

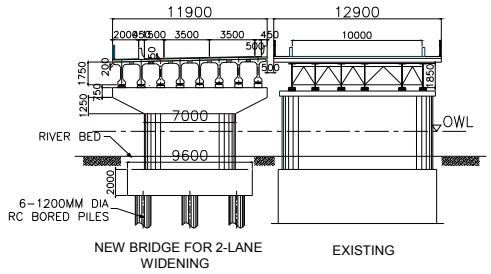
Figure 8.5-1 illustrates some typical improvement measures and widening measures for bridges and culvert along the DK Road. A summary of improvement measures for road structure is presented in **Table 8.5-2**.



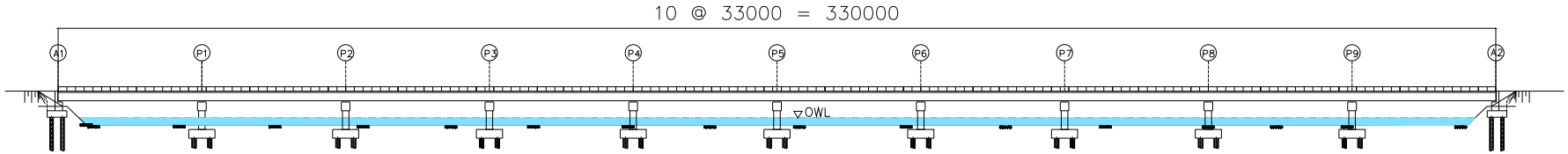
BRIDGE B-2: KOFARNIHON RIVER
ELEVATION



BRIDGE B-2: KOFARNIHON RIVER
SECTION

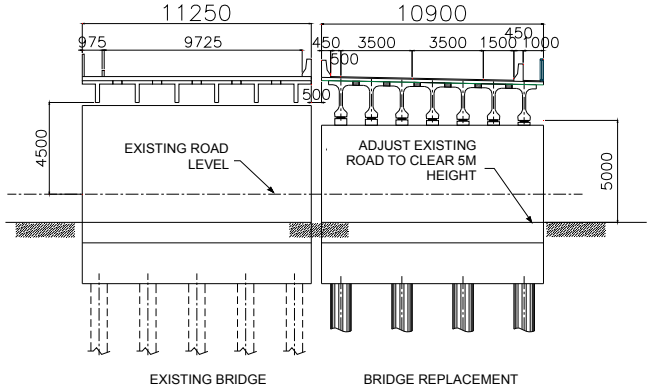


BRIDGE B-14: VASKSH RIVER
SECTION



BRIDGE B-14: VASKSH RIVER
ELEVATION

FIGURE 8.5-1 PROPOSED 2-LANE WIDENING OF LONG BRIDGES

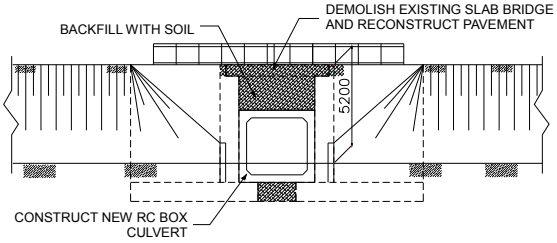


Notes:

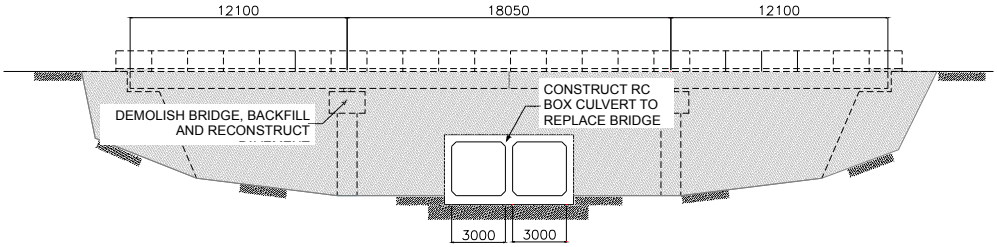
- *The existing Interchange bridge is a 4-lane bridge with different bridge types for southbound and northbound directions*
- *The southbound bridge condition is bad and is proposed to be replaced by a single-span, 33m long bridge*
- *Clearance of the undercrossing road is only 4.5m and needs to be adjusted to 5m to meet the standard requirements. The profile of this road shall be lowered to meet this requirement.*

BRIDGE B-3: INTERCHANGE BRIDGE

FIGURE 8.5-2 PROPOSED IMPROVEMENT OF INTERCHANGE BRIDGE

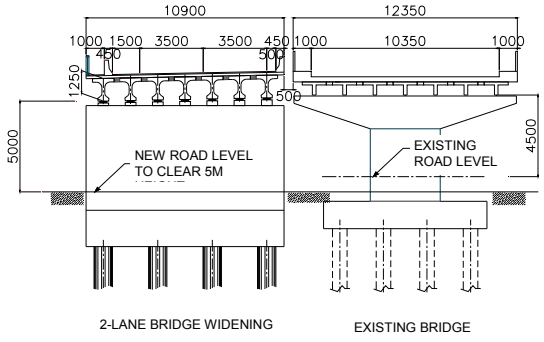


BRIDGE B-4 & B-5: BRIDGE REPLACEMENT BY CULVERT

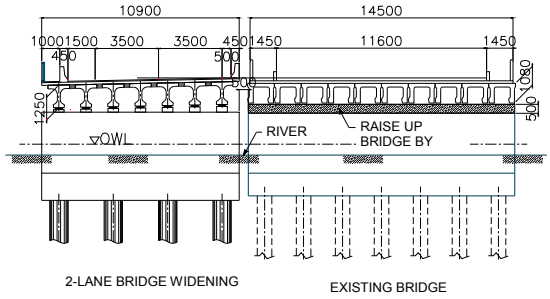


BRIDGE B-6: BRIDGE REPLACEMENT BY CULVERT

FIGURE 8.5-3 PROPOSED RECONSTRUCTION OF EXISTING BRIDGES TO CULVERTS

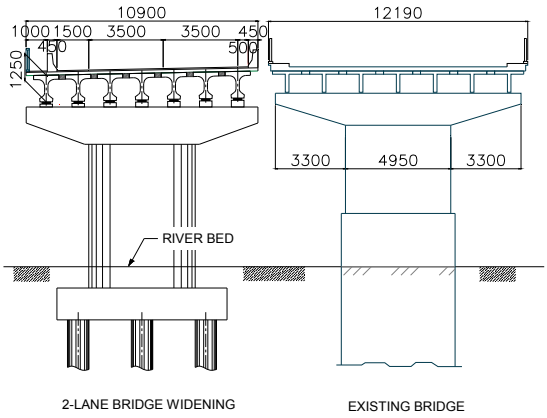


BRIDGE B-8



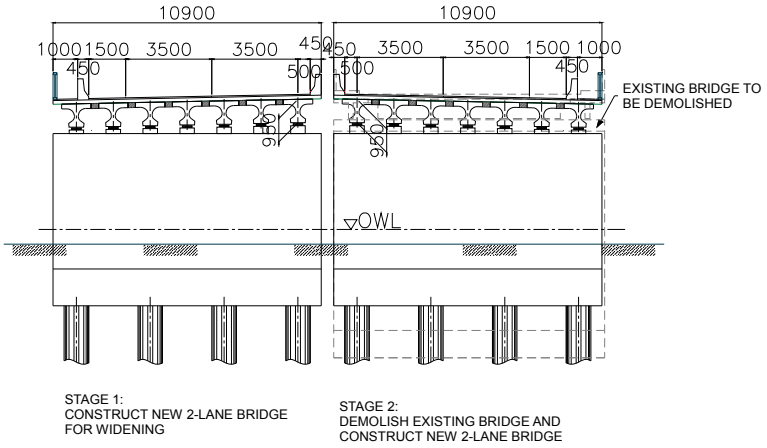
BRIDGE B-10

FIGURE 8.5-4 WIDENING WITH ADDITIONAL 2-LANE BRIDGES (1-SPAN)



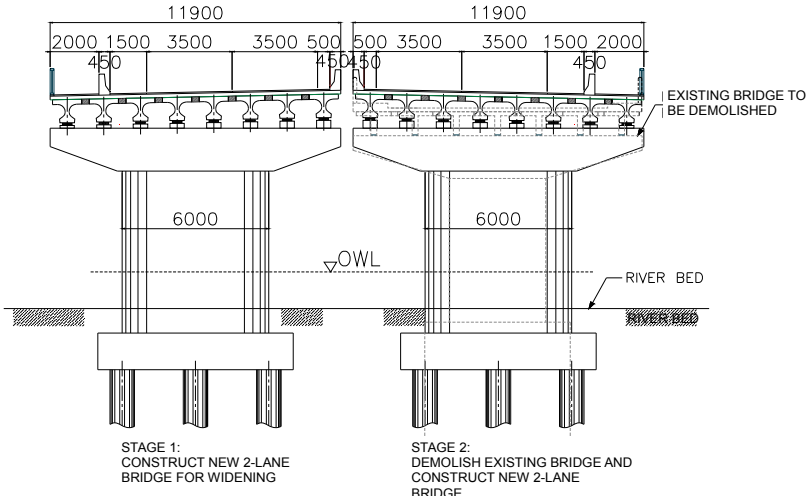
BRIDGE B-9

FIGURE 8.5-5 WIDENING WITH MULTI-SPAN 2-LANE BRIDGES



BRIDGE B-15 & B-16

FIGURE 8.5-6 REPLACEMENT OF EXISTING BRIDGE AND WIDENING WITH ADDITIONAL 2-LANE BRIDGE



BRIDGE B-7 & B-11

FIGURE 8.5-7 REPLACEMENT OF EXISTING BRIDGE AND 2-LANE WIDENING WITH MULTI-SPAN BRIDGE

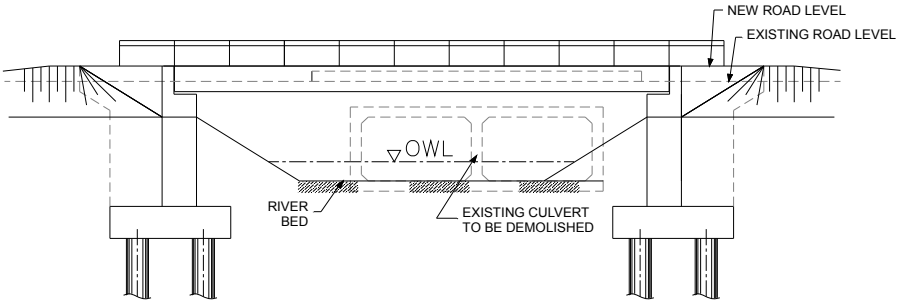


FIGURE 8.5-8 REPLACEMENT OF EXISTING BOX CULVERT WITH 1-SPAN BRIDGE

TABLE 8.5-2 SUMMARY OF PROPOSED IMPROVEMENT MEASURES FOR STRUCTURES

Bridge	Station	Existing No. of Lanes	Existing Bridge Length		2-Lane Improvement			2-Lane Widening	
			Original (m)	Widening (m)	Bridge Replacement (m)	Bridge Rehabilitation (m)	Bridge to Culvert Replacement: Opening (m)	New Bridge (m)	New Culvert Opening (m)
B-1	13 + 045	4	14.20		-	14.20	-	-	-
B-2	15 + 980	2	297.00		-	297.00	-	297.00	-
BC-01 (B-17)	17 + 940	2			18.00	-	-	18.00	-
B-3	21 + 065	4	55.30	33.00	33.00	33.00	-	-	-
B-4	22 + 020	4	6.00	6.00	-	-	3.0	-	-
B-5	32 + 025	2	6.00	6.00	-	-	4.0	-	4.0
BC-09 (B-18)	36 + 089	2			16.00	-	-	16.00	-
B-6	45 + 290	2	42.25		-	-	6.0	-	6.0
BC-12 (B-19)	45 + 869	2			12.00	-	-	12.00	-
B-7	48 + 205	2	34.25		60.00		-	60.00	-
B-8	53 + 245	2	28.85		-	28.85	-	20.00	-
B-9	56 + 625	2	50.40		-	50.40	-	50.60	-
B-10	58 + 300	2	24.10		-	24.10	-	24.00	-
B-11	72 + 415	2	34.20		38.00	-	-	38.00	-
B-12	77 + 670	2	16.80	16.80	-	-	8.0	-	8.0
B-13	78 + 840	2	16.75		-	16.75	-	-	8.0
B-14	84 + 250	2	330.00		-	330.00	-	330.00	-
B-15	90 + 255	2	13.80	8.70	12.00	-	-	12.00	-
B-16	92 + 120	2	6.80	6.80	12.00	-	-	12.00	-
				Total	**201.00**	**794.30**	**21.00**	**889.60**	**26.00**

8.6 Box Culverts

The proposed improvement for box culverts are minor repairs of the existing culvert, except for three box culverts that need to be replaced by bridges due to insufficient flood discharge. Box culverts BC-01, BC-09 and BC-12 are proposed to be replaced with 1-span bridges since the road sections at these locations are always overtopped with flood waters during heavy rains. Evidence of scouring on roadside and culvert exit opening at the downstream side of the rivers are seen. Moreover, the river sections for these culverts are much bigger than the culvert opening.

For the rest of the culverts, concrete aprons are proposed to be provided at the entry and exit openings to avoid scouring.

During widening to 4-lanes, the culverts are to be extended to cover the additional road sections together with additional 2-lane bridges for BC-01, BC-09 and BC-12.

The proposed improvement measures for culverts are presented in **Table 8.6-1**.

TABLE 8.6-1 PROPOSED IMPROVEMENT MEASURES FOR BOX CULVERTS

Br. No.	Station	Opening (m)		Proposed Improvement Measures for Existing Culvert	Proposed Widening Improvement
		Width	Height		
BC-01	17 + 940	8.00	2.00	• Culvert opening is only 8m while river width is about 18m. Flood overflowed the road by 600mm in 2013 • See bridge BC-17	• See bridge BC-17
BC-02	19 + 016	2.50	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-03	19 + 653	8.00	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-04	23 + 130	4.00	1.30	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-05	23 + 482	4.50	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-06	26 + 909	1.00	2.10	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-07	32 + 986	1.00	0.40	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-08	35 + 605	3.00	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-09	36 + 089	3.85	2.60	• Culvert opening is only 3.85m while river is about 16m. Flood overtopped the road with road section at downstream side eroded. • See bridge BC-18	• See bridge BC-18
BC-10	44 + 547	4.00	3.00	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-11	45 + 196	2.00	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to	• Extend culvert

Br. No.	Station	Opening (m)		Proposed Improvement Measures for Existing Culvert	Proposed Widening Improvement
		Width	Height		
				prevent scouring	
BC-12	45 + 869	2.50	3.25	• Culvert opening is only 2.5m. Flood overflows the road every year and downstream side of the culvert is already scoured. • See bridge BC-19	• See bridge BC-19
BC-13	47 + 584	3.90	1.60	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-14	47 + 740	3.90	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-15	60 + 866	1.00	0.45	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-16	61 + 193	1.00	0.45	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-17	73 + 575	2.50	2.00	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-18	75 + 027	3.00	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-19	82 + 895	2.00	2.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert
BC-20	87 + 642	1.05	0.50	• Retain culvert, provide concrete aprons at the openings (entry and exit) to prevent scouring	• Extend culvert

8.7 Roadside Drainage and Cross-Drainage

The proposed improvements for roadside drainage and cross-drainage are summarized in **Table 8.7-1** and shown in **Figure 8.7-1**, as follows:

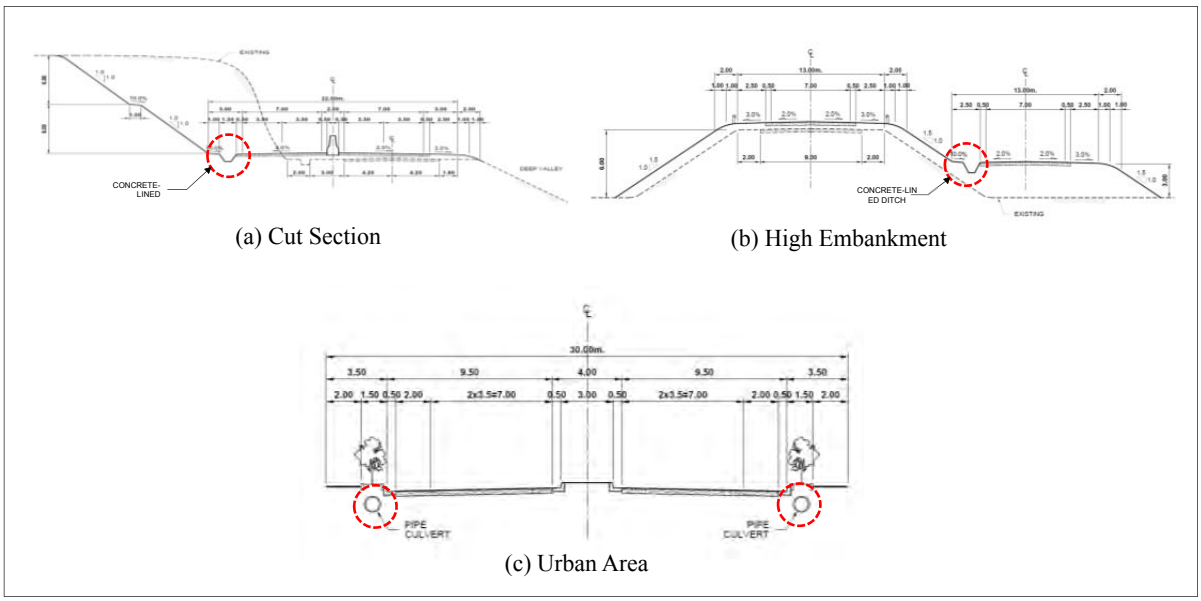
TABLE 8.7-1 PROPOSED IMPROVEMENT MEASURES FOR ROADSIDE AND CROSS-DRAINAGE

(a) Existing DK Road

Problems/Issues		Proposed Improvement
Cross-drainage along the existing DK road is not sufficient, causing rain water to overflow on the road surface from the ditches	➔	- Provide additional cross-drainage at least ϕ1.0m pipe culvert spaced between 250m-300m at mountain and rolling sections
Concrete-lined ditch are not sufficient especially at cut sections along the mountainous and rolling terrain	➔	- Provide additional concrete-lined ditch along the mountainous and rolling terrains
Few ditches are connected to culverts and bridges, making rain water discharge to rivers and streams inefficient	➔	- Connect the concrete-lined ditches to bridges and culverts for efficient rain water discharge
Roadside drainage in urban areas are damaged or not functioning	➔	- Repair damaged sections of roadside drainage at urban areas and provide covered pipe culverts

(b) Proposed Roadside and Cross-Drainage for 4-Lane Road Widening

- Concrete-lined roadside drainage/ditches with sufficient capacity shall be provided especially at cut sections along the mountainous and rolling terrains to prevent rain water from flowing on the road
- Cross-drainage with at least 1- ϕ 1.0m pipe culvert spaced between 250m-300m shall be provided to avoid concentration of rain water/flood water on one side of the road
- Ditches and drainage facilities shall be connected to culverts and bridges for efficient discharge or discharge properly on the valley sections of the road
- Buried pipe culverts shall be provided at urban sections along the DK road



(a) Cut Section (b) High Embankment

(c) Urban Area

FIGURE 8.7-1 PROPOSED IMPROVEMENT MEASURES FOR ROADSIDE DRAINAGE

8.8 Traffic Safety Facilities

As mentioned in section "6.10 Traffic Accidents," most drivers are over-speeding and many traffic accidents are occurring, thus traffic safety facilities such as guard rails, traffic regulatory sign boards, traffic warning sign boards, rumble strips at strategic locations, etc. must be provided.

8.9 Segmentation of DK Road

DK Road has a total length of 83.6km. For planning of implementation, DK Road should be divided into segments. Segmentation of DK Road was planned for each development scenario as follows;

Development Scenario-1: In view of estimated construction cost, DK Road was divided into 6 segments as shown in **Figure 8.9-1**. Length of one segment was targeted about 13km.

Development Scenario-2: Since huge investment cost is required under this scenario, DK Road was divided into 13 segments in consideration of terrain as shown in **Figure 8.9-2**. Length of one segment was targeted about 6km.

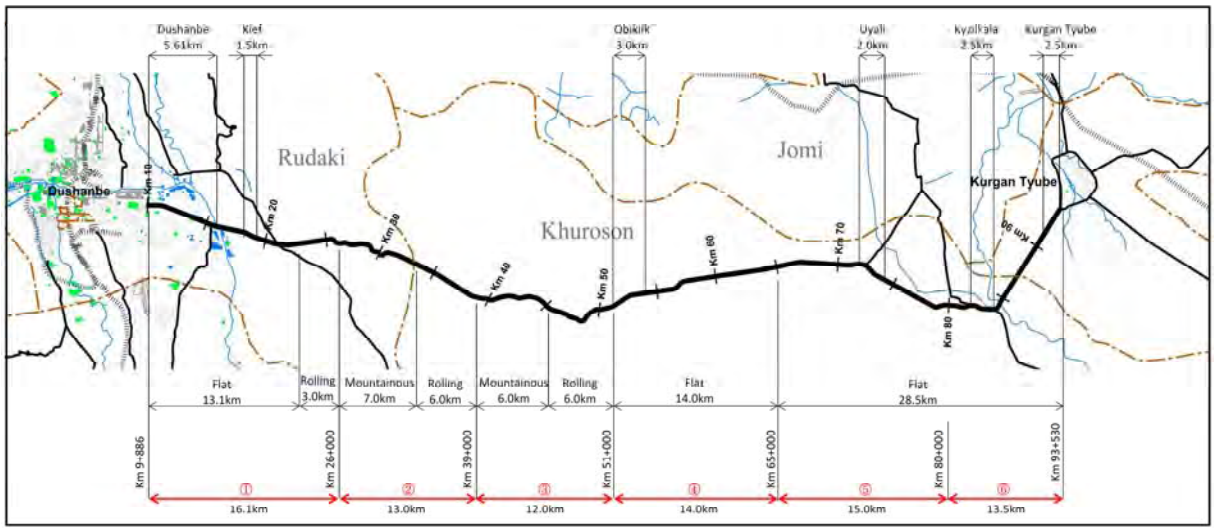


FIGURE 8.9-1 SEGMENTATION OF SCENARIO-1

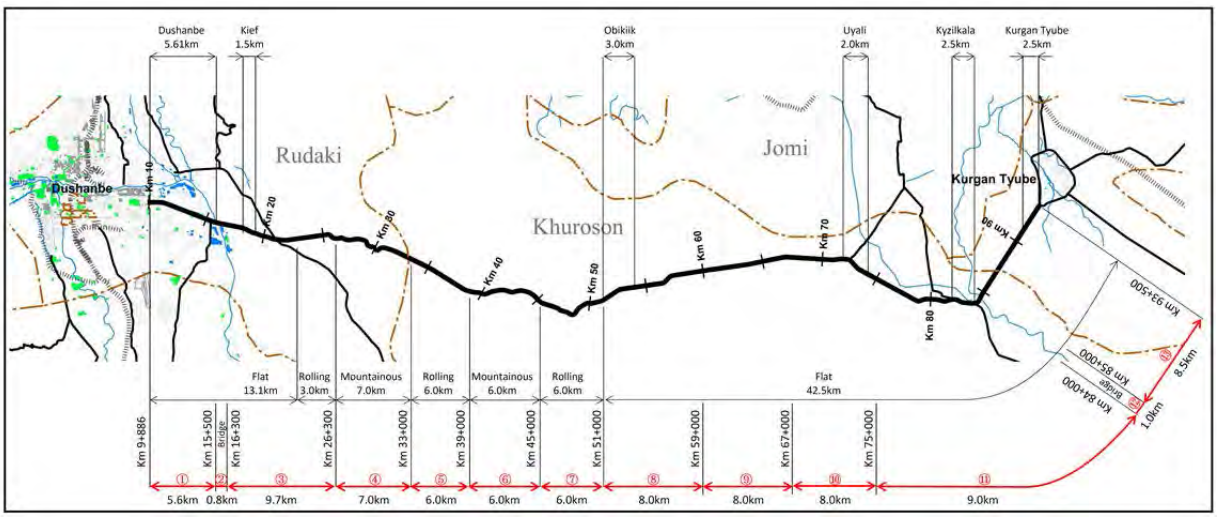


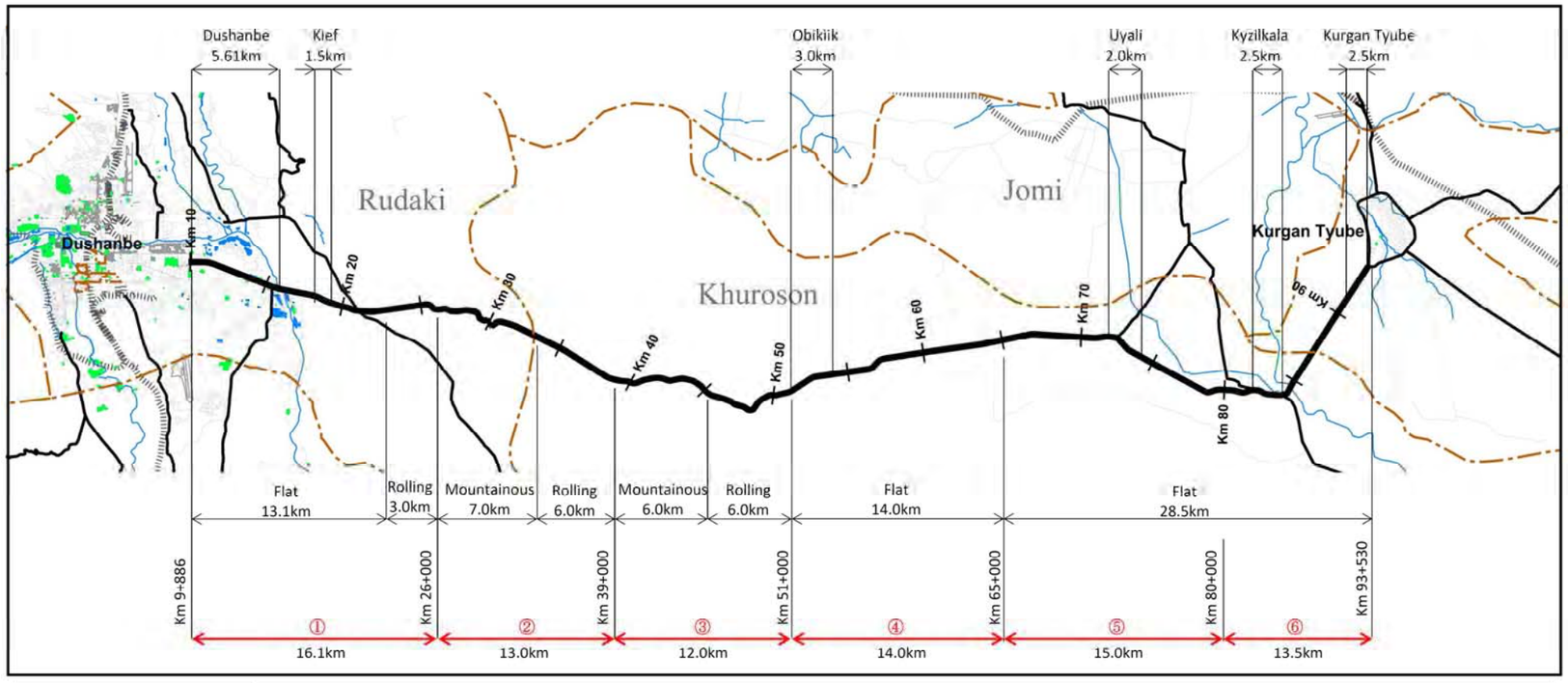
FIGURE 8.9-2 SEGMENTATION OF SCENARIO-2

8.10 Characteristics of Each Segment

8.10.1 Characteristics of Each Segment

Characteristics of each segment are summarized in **Table 8.10-1** for Scenario-1, **Table 8.10-2** and **Table 8.10-3** for Scenario-2.

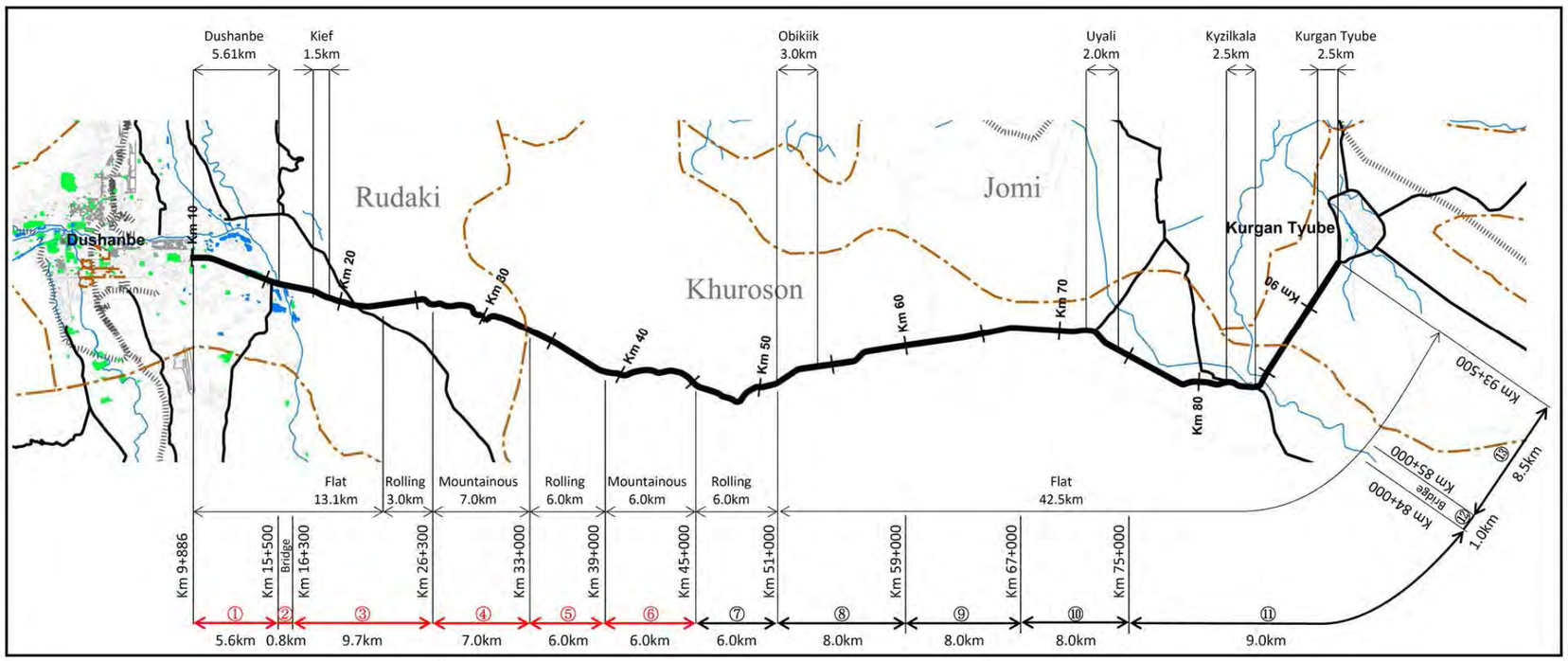
TABLE 8.10-1 CHARACTERISTICS OF EACH SEGMENT: SCENARIO-1



		Segment					
		①	②	③	④	⑤	⑥
Distance (km)		16.1km	13.0km	12.0 km	14.0 km	15.0 km	13.5 km
Terrain		Flat, Rolling	Mountainous, Rolling	Mountainous, Rolling	Flat	Flat	Flat
Urban Section		Dushanbe City (5.6km) Kief (1.5km) **Total = 7.1 km**	None	None	**Obikiik (3.0km)**	**Uyali (2.0km)**	Kyzilkala (2.5km) Kurgan Tyube (2.5km) **Total = 5.0km**
Traffic Volume (2015)		10,500 ~ 17,300 ~ above	9,900 ~ 10,500	9,900 ~ 11,600	11,600 ~ 12,200	12,200 ~ 13,700	13,700 ~ 11,600 ~ above
Pavement Condition		2nd Worst	Worst	Worst	2nd Worst	2nd Worst	2nd Worst
Traffic Accidents (Past 5 years)		17 (1.06/km)	12 (0.92/km)	37 (3.08/km)	41 (2.93/km)	38 (2.53/km)	57 (4.22/km)
Preliminary Scope of Civil Work	Pavement Work	Base Course: 38,000 m^3 AC Concrete Base Course (5cm) = 211,000 m^2 AC Concrete Base Course (5cm) = 211,000 m^2	48,000 m^3 162,000 m^2 162,000 m^2	34,000 m^3 112,000 m^2 112,000 m^2	45,000 m^3 138,000 m^2 138,000 m^2	46,000 m^3 130,000 m^2 130,000 m^2	56,000 m^3 166,000 m^2 166,000 m^2
	Bridge Work	Replacement: n=2, L=51m Rehabilitation: n=3, L=344m Bridge to Culvert: n=1, L=3m	n = 1, L = 16m n = 0, L = 0m n = 1, L = 4m	n = 2, L = 72m n = 0, L = 0m n = 1, L = 6m	n = 0, L = 0m n = 3, L = 103m n = 0, L = 0m	n = 1, L = 38m n = 1, L = 17m n = 1, L = 8m	n = 2, L = 24m n = 1, L = 330m n = 0, L = 0m
	Reconstruction of Culvert	n = 1 L = 3.0 m	n = 1 L = 4.0 m	n = 1 L = 6.0 m	-	n = 1 L = 8.0 m	-
Number of Buildings to be removed	Houses	0	0	0	0	0	0
	Buildings	0	0	0	0	0	0
	Other Structure	0	0	0	0	0	0
	Total	0	0	0	0	0	0
Proposed Implementation Priority Group		1	3	3	2	2	1

Source: JICA Study Team

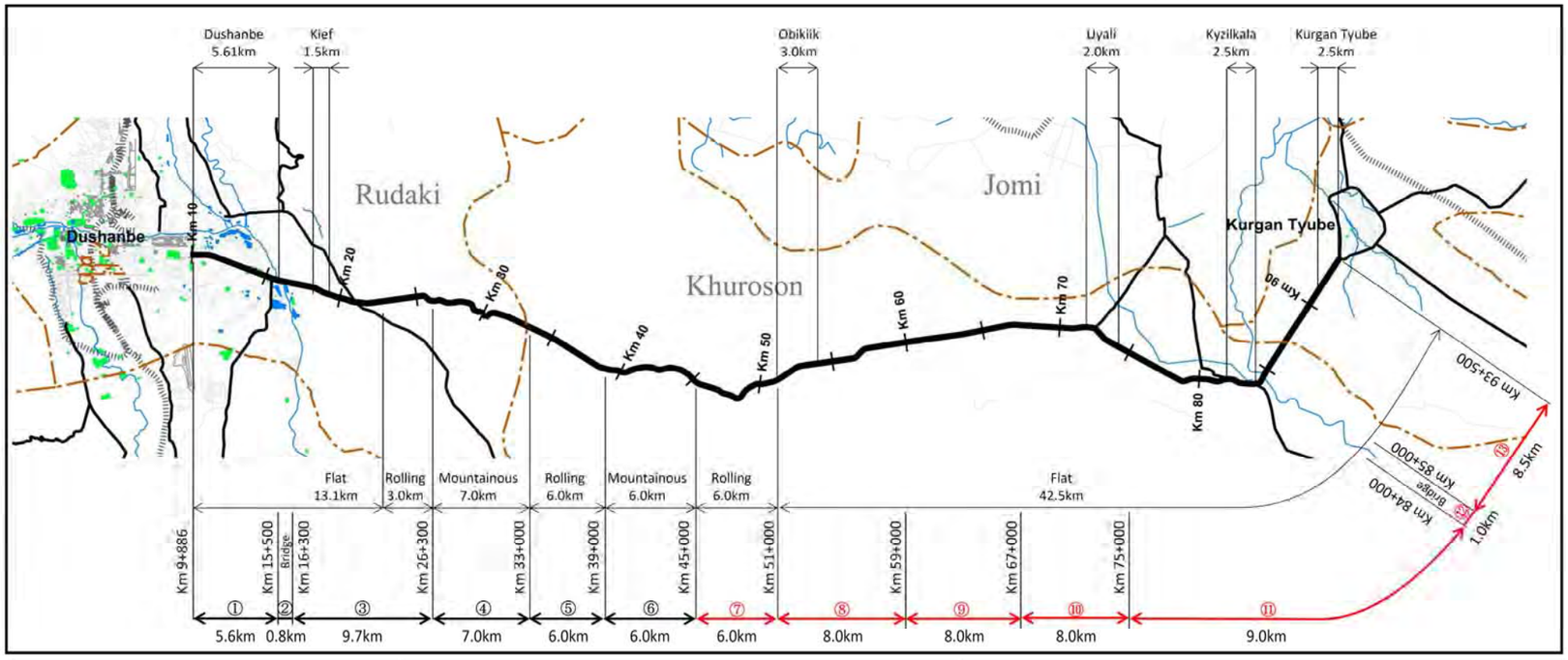
TABLE 8.10-2 CHARACTERISTICS OF EACH SEGMENT: SCENARIO-2 (1/2)



			Segment					
			①	②	③	④	⑤	⑥
Distance (km)			5.6	0.8	9.7	7.0	6.0	6.0
Terrain			Flat	Flat	Flat, Mountainous	Mountainous	Rolling	Mountainous
Urban Section			Dushanbe City (5.6km)	None	Kief (1.5km)	None	None	None
Traffic Volume (2015)			17,300 ~ above	10,500 ~ 17,300	9,900 ~ 10,500	9,900 ~ 10,500	9,900 ~ 11,600	9,900 ~ 11,600
Year Widening Required			2017	2017	2022	2021	2021	2021
Traffic Accidents (Past 5 years)			9 (1.61/km)	1 (1.25/km)	7 (0.72/km)	1 (0.10/km)	11 (1.83/km)	10 (1.66/km)
Preliminary Scope of Civil Work	Pavement Work	Existing 2-lane	Base Course: 3,000 m^3 AC Concrete Base Course (5cm) = 50,000 m^2 AC Concrete Base Course (5cm) = 50,000 m^2	2,000 m^3 5,000 m^2 5,000 m^2	35,000 m^3 77,000 m^2 77,000 m^2	24,000 m^3 54,000 m^2 54,000 m^2	22,000 m^3 48,000 m^2 48,000 m^2	22,000 m^3 48,000 m^2 48,000 m^2
		New 2-lane	Base Course: 4,000 m^3 AC Concrete Base Course (5cm) = 50,000 m^2 AC Concrete Base Course (5cm) = 50,000 m^2	3,000 m^3 5,000 m^2 5,000 m^2	45,000 m^3 77,000 m^2 77,000 m^2	22,000 m^3 54,000 m^2 54,000 m^2	17,000 m^3 48,000 m^2 48,000 m^2	33,000 m^3 145,000 m^2 145,000 m^2
	Bridge Work	Reconstruction of Existing Bridge	Replacement: n=0, L=0m Rehabilitation: n=1, L=14m Bridge to Culvert: n=0, L=0m	n=0, L=0m n=1, L=297m n=0, L=0m	n=2, L=51m n=1, L=33m n=1, L=3m	n=0, L=0m n=0, L=0m n=1, L=4m	n=1, L=16m n=0, L=0m n=0, L=0m	n=0, L=0m n=0, L=0m n=0, L=0m
		Const'n of New 2-lane Bridge	-	n = 1, L = 297m	n = 1, L = 18m	-	n = 1, L = 16m	-
	Culverts Work	Reconstruction (n) , (m)	-	-	n = 1, L = 3m	n = 1, L = 4m	-	-
		Extension (n) , (m)	-	-	n = 4, L = 19m	n = 3, L = 6m	n = 1, L = 4m	n = 1, L = 4m
	Side Drainage Length		0 m	0 m	2,300 m	5,600 m	6,000 m	5,800 m
	Earthwork Work	Rough Cut Volume (m^3)	0	0	7,000	0	0	0
		Rough Embankment Volume (m^3)	46,000	33,000	664,000	1,215,000	127,000	527,000
Number of Building to be removed	Houses		0	0	1	0	0	0
	Buildings		0	2	5	0	2	1
	Other Structure		0	1	0	1	0	0
	Total		0	3	6	1	2	1
Proposed Implementation Priority Group			1	2	5	5	4	4

Source: JICA Study Team

TABLE 8.10-3 CHARACTERISTICS OF EACH SEGMENT: SCENARIO-2 (2/2)



			Segment						
			⑦	⑧	⑨	⑩	⑪	⑫	⑬
Distance (km)			6.0 km	8.0 km	8.0 km	8.0 km	9.0 km	1.0 km	8.5 km
Terrain			Rolling	Flat	Flat	Flat	Flat	Flat	Flat
Urban Section			None	**Obikiik (5.6km)**	None	**Uyali (2.0km)**	**Kyzilkala (2.5km)**	None	**Kurgan Tyube (2.5km)**
Traffic Volume (2015)			9,900 ~ 11,600	9,900 ~ 11,600	11,600 ~ 12,200	11,600 ~ 12,200	12,200 ~ 13,700	13,700 ~ 16,600	13,700 ~ 16,600
Year Widening Required			2021	2021	2021	2020	2019	2017	2017
Traffic Accidents (Past 5 years)			18 (3.00/km)	32 (4.00/km)	29 (3.63/km)	18 (2.25/km)	30 (3.33/km)	2 (2.00/km)	34 (4.00/km)
Preliminary Scope of Civil Work	Pavement Work	Existing 2-lane	Base Course: 22,000 m^3 AC Concrete Base Course (5cm) = 48,000 m^2 AC Concrete Base Course (5cm) = 48,000 m^2	29,000 m^3 64,000 m^2 64,000 m^2	29,000 m^3 64,000 m^2 64,000 m^2	29,000 m^3 64,000 m^2 64,000 m^2	32,000 m^3 72,000 m^2 72,000 m^2	6,000 m^3 13,000 m^2 13,000 m^2	27,000 m^3 60,000 m^2 60,000 m^2
		New 2-lane	Base Course: 28,000 m^3 AC Concrete Base Course (5cm) = 48,000 m^2 AC Concrete Base Course (5cm) = 48,000 m^2	37,000 m^3 64,000 m^2 64,000 m^2	38,000 m^3 64,000 m^2 64,000 m^2	37,000 m^3 64,000 m^2 64,000 m^2	41,000 m^3 72,000 m^2 72,000 m^2	9,000 m^3 13,000 m^2 13,000 m^2	33,000 m^3 60,000 m^2 60,000 m^2
	Bridge Work	Reconstruction of Existing Bridge	Replacement: n=2, L=72m Rehabilitation: n=0, L=0m Bridge to Culvert: n=1, L=6m	n=0, L=0m n=3, L=103m n=0, L=0m	n=0, L=0m n=0, L=0m n=0, L=0m	n=1, L=38m n=0, L=0m n=0, L=0m	n=0, L=0m n=1, L=17m n=1, L=8m	n=0, L=0m n=1, L=330m n=0, L=0m	n=2, L=24m n=0, L=0m n=0, L=0m
		Const'n of New 2-lane Bridge	n = 2, L = 72m	n = 3, L = 95m	-	n = 1, L = 38m	-	n = 1, L = 330m	n = 2, L = 24m
	Culverts Work	Reconstruction (n), (m)	n = 1, L = 6m	-	-	-	n = 1, L = 8m	-	-
		Extension (n) , (m)	n = 4, L = 16m	-	n = 2, L = 2m	n = 1, L = 3m	n = 4, L = 21m	-	n = 1, L = 1m
	Side Drainage Length		1,400 m	6,000 m	8,000 m	5,200 m	1,500 m	0 m	1,500 m
	Earthwork Work	Rough Cut Volume (m^3)	0	18,000	0	0	22,000	0	28,000
		Rough Embankment Volume (m^3)	625,000	195,000	264,000	265,000	170,000	92,000	150,000
Number of Building to be removed	Houses		0	1	0	2	3	0	0
	Buildings		2	4	4	7	6	1	6
	Other Structure		0	0	1	1	0	2	1
	Total		2	5	5	10	9	3	7
Proposed Implementation Priority Group			4	4	3	3	1	2	1

Source: JICA Study Team

8.10.2 Implementation Priority of Each Segment

Implementation priority of each segment was studied by establishing prioritization criteria.

(1) Implementation Priority of Scenario-1

Under Scenario-1, objectives of the scenario are as follows;

- Pavement condition improvement
- Replacement of deteriorated bridges

Thus, traffic capacity expansion of DK Road and improvement of traffic safety cannot be achieved. Priority of segment of this scenario is determined focusing on the following;

Factors of Prioritization for Scenario-1

- Pavement Condition: Priority should be given to the segment where existing pavement condition is bad.
- Traffic Volume: When pavement condition is bad and traffic volume is high, more vehicle operating cost is required. Priority should be given for the segment where traffic volume is high.

Priority of each segment was evaluated as shown in **Table 8.10-4**.

TABLE 8.10-4 SEGMENT PRIORITIZATION OF SCENARIO-1

Evaluation Item	Point	Segment-①	Segment-②	Segment-③
Pavement Condition	10	2nd Worst (8 points)	Worst (9 points)	Worst (10 points)
Traffic Volume	10	2nd Highest (10 points)	3rd Highest (4 points)	Highest (4 points)
Total Point	20	18	13	14
Priority Group	Rank	1	4	3
	Priority	1st Priority Group	4th Priority Group	3rd Priority Group

Evaluation Item	Point	Segment-④	Segment-⑤	Segment-⑥
Pavement Condition	10	2nd Worst (7 points)	2nd Worst (7 points)	2nd Worst (6 points)
Traffic Volume	10	2nd Highest (8 points)	3rd Highest (8 points)	Highest (10 points)
Total Point	20	15	15	16
Priority Group	Rank	2	2	1
	Priority	2nd Priority Group	2nd Priority Group	1st Priority Group

Source: JICA Study Team

(2) Implementation Priority of Scenario-2

Under Scenario-2, objectives of the scenario are as follows;

- Traffic capacity expansion from a 2-lane road to a 4-lane road
- Improvement of traffic safety (no more overtaking using opposite direction lane)
- Reduction of travel cost (less vehicle operating cost and travel time cost)

Priority of the segment of this scenario is determined focusing on the following;

Factors of Prioritization for Scenario-2

- Present Traffic Level: Priority given to the segment where existing traffic volume is high.
- Year when a 4-lane road required: Future traffic growth and the terrain of the segment are major factors which determine when a 4-lane road is needed.
- Traffic Accidents: A segment with high rate of traffic accidents has higher implementation priority.
- Pavement Condition of Existing Road: A segment with bad pavement condition should be given higher priority.

Priority of each segment was evaluated as shown in **Table 8.10-5**.

TABLE 8.10-5 SEGMENT PRIORITIZATION OF SCENARIO-2

Evaluation Item	Point	Segment-①	Segment-②	Segment-③	Segment-④	Segment-⑤
Present Traffic Level	10	17,300 ~ above (Highest) (10 Points)	10,500 ~ 17,300 (2nd highest) (9 Points)	9,900 ~ 10,500 (6th highest) (5 Points)	9,900 ~ 10,500 (6th highest) (5 Points)	9,900 ~ 11,600 (5th highest) (6 Points)
Year When a 4-lane Road Required	10	2017 (1st) (10 Points)	2017 (1st) (10 Points)	2022 (5th) (6 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)
Traffic Accidents	15	9 (1.61/km) (4th) (10 Points)	1 (1.25/km) (5th) (9 Points)	7 (0.72/km) (6th) (7 Points)	1 (0.10/km) (7th) (5 Points)	11 (1.83/km) (4th) (10 Points)
Pavement Condition of Existing Road	5	3rd Worst (3 Points)	3rd Worst (3 Points)	Worst (5 Points)	2nd Worst (4 Points)	2nd Worst (4 Points)
Total Points	40	33	31	23	21	27
Priority Group		1	2	5	5	4

Evaluation Item	Point	Segment-⑥	Segment-⑦	Segment-⑧	Segment-⑨	Segment-⑩
Present Traffic Level	10	9,900 ~ 11,600 (5th highest) (6 Points)	9,900 ~ 11,600 (5th highest) (6 Points)	9,900 ~ 11,600 (5th highest) (6 Points)	11,600 ~ 12,200 (4th highest) (7 Points)	11,600 ~ 12,200 (4th highest) (7 Points)
Year When a 4-lane Road Required	10	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2021 (4th) (7 Points)	2020 (3rd) (8 Points)
Traffic Accidents	15	10 (1.66/km) (4th) (10 Points)	18 (3.00/km) (3rd) (12 Points)	32 (4.00/km) (1st) (15 Points)	29 (3.63/km) (2nd) (14 Points)	18 (2.25/km) (3rd) (12 Points)
Pavement Condition of Existing Road	5	3rd Worst (3 Points)	2nd Worst (4 Points)	4th Worst (2 Points)	3rd Worst (3 Points)	3rd Worst (3 Points)
Total Points	40	27	29	30	30	30
Priority Group		4	4	3	3	3

Evaluation Item	Point	Segment-⑪	Segment-⑫	Segment-⑬
Present Traffic Level	10	12,200 ~ 13,700 (3rd highest) (8 Points)	13,700 ~ 16,600 (2nd highest) (9 Points)	12,200 ~ 13,700 (Highest) (10 Points)
Year When a 4-lane Road Required	10	2019 (2nd) (9 Points)	2017 (1st) (10 Points)	2017 (1st) (10 Points)
Traffic Accidents	15	30 (3.33/km) (2nd) (13 Points)	2 (2.00/km) (3rd) (12 Points)	34 (4.00/km) (1st) (15 Points)
Pavement Condition of Existing Road	5	2nd Worst (4 Points)	5th Worst (1 Points)	5th Worst (1 Points)
Total Points	40	34	32	35
Priority Group		1	2	1

Source: JICA Study Team

CHAPTER 9 PRELIMINARY COST ESTIMATE AND CONSTRUCTION PERIOD

9.1 Construction Materials

9.1.1 Locally Available Materials and Their Material Sources

List of locally available materials is shown in **Table 9.1-1**.

TABLE 9.1-1 LIST OF LOCALLY AVAILABLE MATERIALS

Name of Products	Remarks
Cement	Tax can be exempted
Aggregate for Asphalt and & Concrete	
Base Course Material	
Fill Material	
PVC Pipe	

Source: JICA Study Team

9.1.2 Materials and Their Material Sources to be Imported

List of materials and their material sources to be imported are shown in **Table 9.1-2**.

TABLE 9.1-2 LIST OF IMPORTED MATERIALS

Name of Products	Source	Remarks
Reinforcing Steel Bar	Russia, Iran, China	GOST[1)]
Angular Bar, Flat Bar	Russia	GOST
Straight Asphalt	Russia, Iran	
Asphalt Emulsion	Russia, Iran	
Gasoline, Diesel	Russia	
Steel Pipe	Russia	
Plywood for formwork	China, Pakistan	

Note 1): National Standard in Soviet Union

Source: JICA Study Team

9.2 Construction Equipment and Plants

9.2.1 Equipment and Plants Locally Available and to be Brought from Foreign Countries

List of Equipment and Plants which are locally available and to be brought from foreign countries is shown in **Table 9.2-1.** Most of the equipment is available in Dushanbe. However, most of the equipment might be necessary to be imported because the equipment for rental has not been confirmed in the local market and quantity of the equipment available in Dushanbe might not be sufficient.

TABLE 9.2-1 LIST OF EQUIPMENT AND PLANT

Name of Equipment	Locally Available	To be brought from foreign countries
Asphalt Plant	○	○
Concrete Plant	○	○
Crashing Plant	○	○
Bulldozer	○	○
Backhoe	○	○

Name of Equipment	Locally Available	To be brought from foreign countries
Tractor Shovel	○	○
Wheel Loader	○	○
Dump Truck	○	
Truck Crane	○	○
Truck	○	
Trailer	○	
Motor Grader	○	○
Macadam Roller	○	○
Tire Roller	○	○
Vibration Roller	○	○
Asphalt Finisher	○	○
Distributer	○	○
Water Sprinkler	○	○
Transit Mixer	○	○
Ramer Tamper	○	○
Line Marker	○	○
Compressor		○
Generator		○

Source: JICA Study Team

Six crashing plants, one asphalt and concrete plant are confirmed along Kafirnigan River in the suburbs of Dushanbe City and 2 crashing plants are confirmed along Bakhsh River in the suburbs of Kurgan-Tyube City as shown in **Figure 9.2-1** and **Figure 9.2-2.**

However, it is required that asphalt and concrete plants should be imported because the production rate of the existing plants are not enough for this project and the distance to the project site is too far to keep the quality of asphalt and concrete. Further, crashing plants might also be necessary to be imported because the productivity rate might not be enough. It can be considered that the raw material for the crashing is sufficient in both river beds.

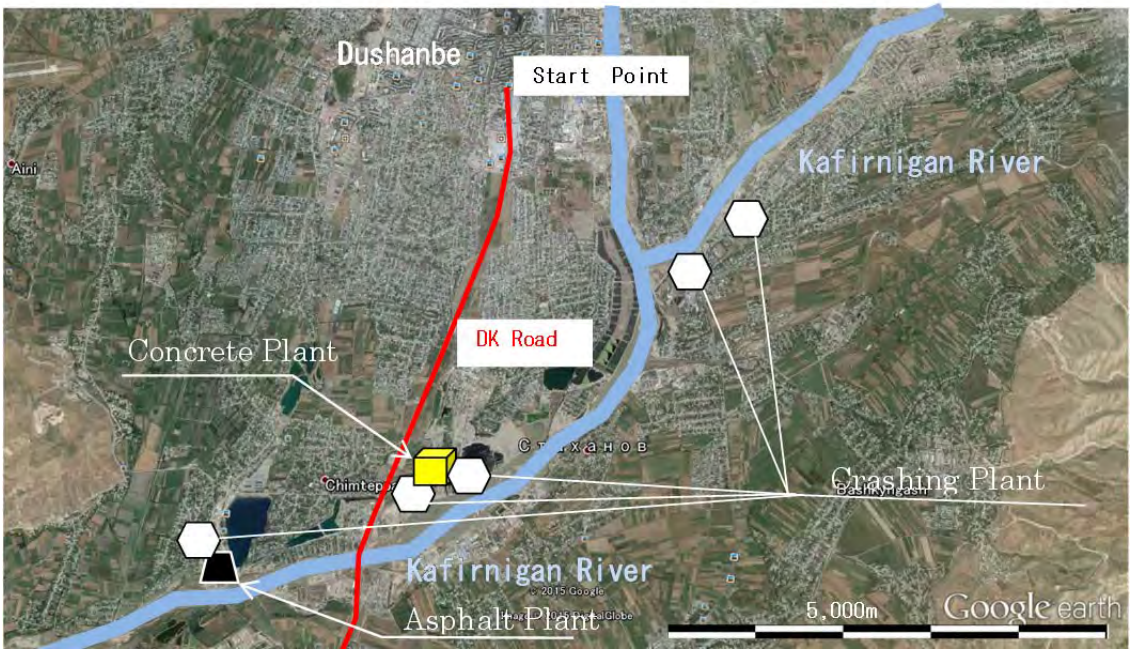


FIGURE 9.2-1 LOCATION OF PLANTS NEAR DUSHANBE

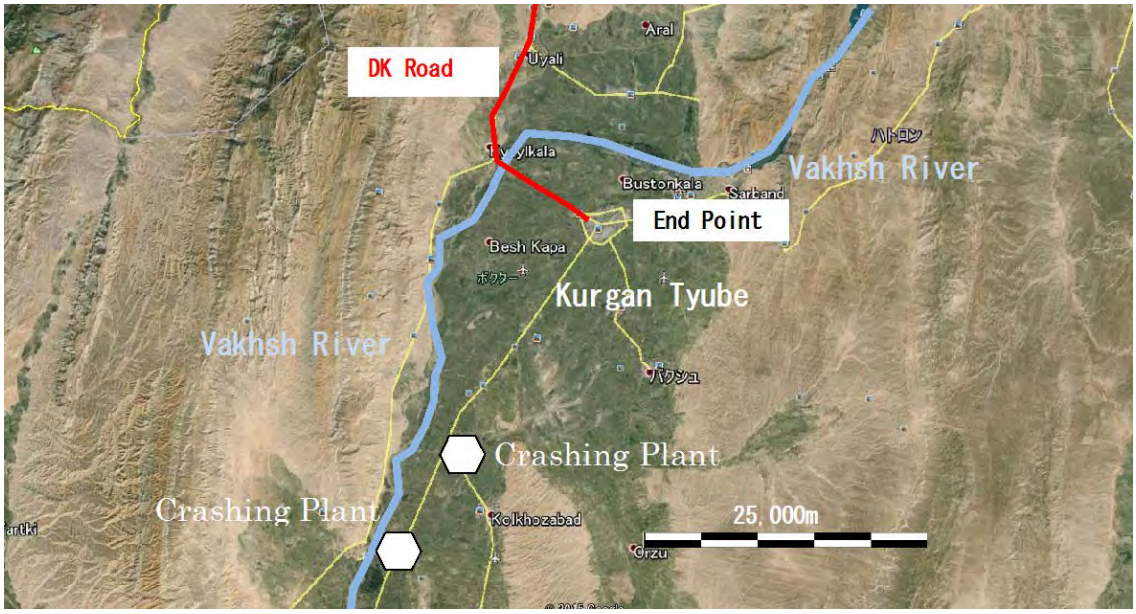


FIGURE 9.2-2 LOCATION OF PLANTS NEAR KURGAN TYUBE

9.2.2 Equipment and Plants to be brought from Foreign Countries and Their Transport Route

There are two transportation routes of heavy equipment from Japan, which are Iran route and China route. The comparisons of two transportation routes are shown in **Table 9.2-2** and two routes are shown in **Figure 9.2-3**.

TABLE 9.2-2 COMPARISONS OF TWO TRANSPORTATION ROUTES

	China Route	Iran Route
Port of discharge	Lianyungang	Bandar Abbas
Transportation Method	Train / Container	Truck
Via	China - Kazakhstan - Uzbekistan - Tajikistan	Iran - Turkmenistan - Uzbekistan – Tajikistan
Required period （Inland Transportation）	40days ～ 45days	15days ～ 20days

Source: JICA Study Team

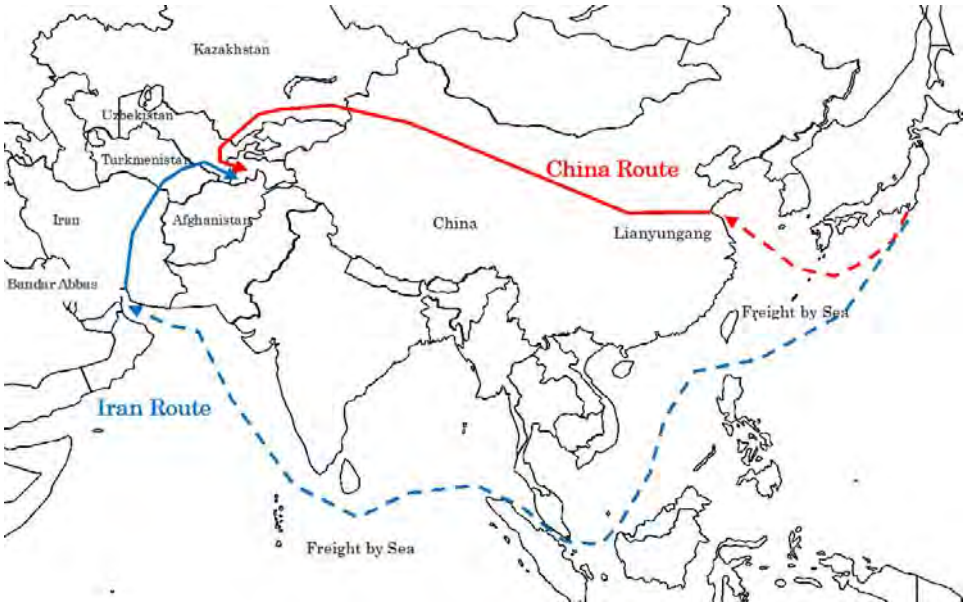


FIGURE 9.2-3 ROUTE OF TRANSPORTATION

9.3 Custom Clearance

The construction materials and temporary facilities and equipment including heavy equipment and plants for Japanese ODA projects can be imported to Tajikistan with free of tax. The important procedure is as follows:

1. Tax exemption for the importing materials / equipment is applied to MOT. The documents are consist of i) master list of importing materials /equipment (all the materials are described), ii) Copy of Company registration in Tajikistan, iii) Company Stamp and iv) Company bank account.
2. Tax exemption for importing materials and equipment to custom office is applied to tax and custom office. Tax exemption letter for importing materials/equipment are issued by tax and custom office.
3. i) Tax exemption letter for importing materials/equipment issued by tax and custom office and ii) Project contract documents with transportation to Tajik language are submitted during custom clearance. And the taxes are exempted.
4. However, the temporary facilities and equipment including heavy equipment and plants to be exported after the project shall be imported with free of tax under the condition of export of the facilities and equipment. And the tax of the materials and temporary facilities and equipment to be sold after the project shall be paid before the transaction.

Further, the refund of the tax for the materials purchased in Tajikistan is impossible as of July 2015. The products manufactured by government-run company like cement can be purchased with free of tax.

9.4 Summary of Roughly Estimated Project Cost

Roughly estimated project cost is summarized in **Table 9.4-1**.

TABLE 9.4-1 ROUGHLY ESTIMATED PROJECT COST

	Scenario-1	Scenario-2
Construction Cost	10,168 M. ¥en (466 M. TJS) (85.4 M. US$)	31,886 M. ¥en (1,461 M. TJS) (267.9 M. US$)
Detailed Design Cost	406 M. ¥en (18.6 M. TJS) (3.4 M. US$)	1,275 M. ¥en (58.4 M. TJS) (10.7 M. US$)
Construction Supervision Cost	610 M. ¥en (27.9 M. TJS) (5.1 M. US$)	1,913 M. ¥en (87.6 M. TJS) (16.1 M. US$)
ROW Acquisition/Compensation Cost	0	77 M. ¥en (3.56 M. TJS) (0.65 M. US$)
Total	11,184 M. ¥en (512.5 M. TJS) (93.9 M. US$)	35,151 M. ¥en (1,610.6 M. TJS) (295.4 M. US$)

Source: JICA Study Team

9.5 Roughly Estimated Construction Period by Segment

Roughly estimated construction period by segment for Scenario-1 and 2 is shown in **Table 9.5-1** and **Table 9.5-3** respectively.

TABLE 9.5-1 CONSTRUCTION SCHEDULE OF SCENARIO-1 (IMPROVEMENT OF EXISTING 2-LANE ROAD)

Work Items		Construction Priod / Q'ty	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Seg-1	16.114km	22 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	211,000 m2	24,000m2/M						8.8																		
	AC Surface （5cm）	211,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										
Seg-2	13km	20 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	162,000 m2	24,000m2/M						6.8																		
	AC Surface （5cm）	162,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										
Seg-3	12km	18 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	112,000 m2	24,000m2/M						4.7																		
	AC Surface （5cm）	112,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										
Seg-4	14km	19 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	138,000 m2	24,000m2/M						5.8																		
	AC Surface （5cm）	138,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										
Seg-5	15km	19 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	130,000 m2	24,000m2/M						5.4																		
	AC Surface （5cm）	130,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										
Seg-6	13.53km	20 month																									
	Mobilization																										
	Base Course																										
	AC Binder （5cm)	166,000 m2	24,000m2/M						6.9																		
	AC Surface （5cm）	166,000 m2	24,000m2/M																								
	Incidental Work																										
	Demobilizaition																										

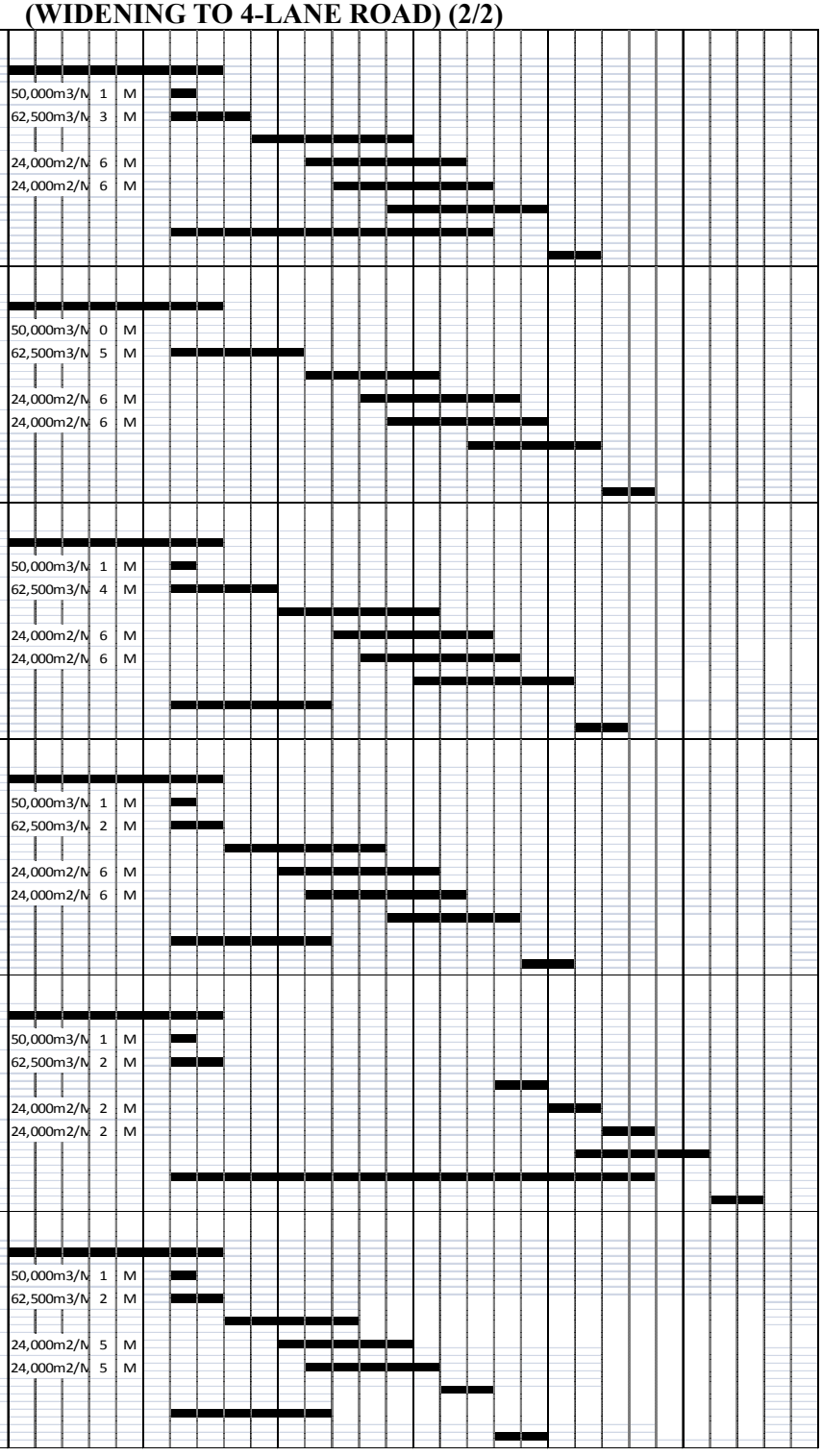
Source: JICA Study Team

TABLE 9.5-2 CONSTRUCTION SCHEDULE OF SCENARIO-2 (WIDENING TO 4-LANE ROAD) (1/2)

Work Item		Construction Period / Q'ty		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Seg-1	5.914km	19 month		
	Mobilization			
	Cutting Soil	0	m3	50,000m3/M 0 M
	Embankment	36,000	m3	62,500m3/M 1 M
	Base-Course	7,000	m3	
	AC Binder （5cm)	100,000	m2	24,000m2/M 5 M
	AC Surface （5cm）	100,000	m2	24,000m2/M 5 M
	Incidental Work			
	Bridge / 1bridge	14	m	
	Demobilization			
Seg-2	900m	28 month		
	Mobilization			
	Cutting Soil	0	m3	50,000m3/M 0 M
	Embankment	33,000	m3	62,500m3/M 1 M
	Base-Course	5,000	m3	
	AC Binder （5cm)	10,000	m2	24,000m2/M 1 M
	AC Surface （5cm）	10,000	m2	24,000m2/M 1 M
	Incidental Work			
	Bridge / 1bridge	300	m	
	Demobilization			
Seg-3	9.6km	25 month		
	Mobilization			
	Cutting Soil	82,000	m3	50,000m3/M 2 M
	Embankment	313,000	m3	62,500m3/M 6 M
	Base-Course	80,000	m3	
	AC Binder （5cm)	154,000	m2	24,000m2/M 7 M
	AC Surface （5cm）	154,000	m2	24,000m2/M 7 M
	Incidental Work			
	Bridge / 3bridges	106	m	
	Demobilization			
Seg-4	6.7km	27 month		
	Mobilization			
	Cutting Soil	661,000	m3	50,000m3/M 14 M
	Embankment	147,000	m3	62,500m3/M 3 M
	Base-Course	46,000	m3	
	AC Binder （5cm)	109,000	m2	24,000m2/M 5 M
	AC Surface （5cm）	109,000	m2	24,000m2/M 5 M
	Incidental Work			
	Bridge / 1bridge	6	m	
	Demobilization			
Seg-5	6.0km	19 month		
	Mobilization			
	Cutting Soil	68,000	m3	50,000m3/M 2 M
	Embankment	28,000	m3	62,500m3/M 1 M
	Base-Course	39,000	m3	
	AC Binder （5cm)	96,000	m2	24,000m2/M 4 M
	AC Surface （5cm）	96,000	m2	24,000m2/M 4 M
	Incidental Work			
	Bridge / 1bridge	12	m	
	Demobilization			
Seg-6	6.0km	22 month		
	Mobilization			
	Cutting Soil	222,000	m3	50,000m3/M 5 M
	Embankment	118,000	m3	62,500m3/M 2 M
	Base-Course	41,000	m3	
	AC Binder （5cm)	96,000	m2	24,000m2/M 4 M
	AC Surface （5cm）	96,000	m2	24,000m2/M 4 M
	Incidental Work			
	Bridge / no bridge	0	m	
	Demobilization			
Seg-7	6.0km	25 month		
	Mobilization			
	Cutting Soil	167,000	m3	50,000m3/M 4 M
	Embankment	213,000	m3	62,500m3/M 4 M
	Base-Course	50,000	m3	
	AC Binder （5cm)	96,000	m2	24,000m2/M 4 M
	AC Surface （5cm）	96,000	m2	24,000m2/M 4 M
	Incidental Work			
	Bridge / 3bridges	100	m	
	Demobilization			

TABLE 9.5-3 CONSTRUCTION SCHEDULE OF SCENARIO-2 (WIDENING TO 4-LANE ROAD) (2/2)

Seg-8	8.0km	22 month				
	Mobilization					
	Cutting Soil	16,000	m3	50,000m3/M	1	M
	Embankment	174,000	m3	62,500m3/M	3	M
	Base-Course	66,000	m3			
	AC Binder（5cm)	128,000	m2	24,000m2/M	6	M
	AC Surface（5cm）	128,000	m2	24,000m2/M	6	M
	Incidental Work					
	Bridge / 3bridges	103	m			
	Demobilization					
Seg-9	8.0km	24 month				
	Mobilization					
	Cutting Soil	0	m3	50,000m3/M	0	M
	Embankment	264,000	m3	62,500m3/M	5	M
	Base-Course	67,000	m3			
	AC Binder（5cm)	128,000	m2	24,000m2/M	6	M
	AC Surface（5cm）	128,000	m2	24,000m2/M	6	M
	Incidental Work					
	Bridge / no bridge	0	m			
	Demobilization					
Seg-10	8.0km	23 month				
	Mobilization					
	Cutting Soil	31,000	m3	50,000m3/M	1	M
	Embankment	222,000	m3	62,500m3/M	4	M
	Base-Course	66,000	m3			
	AC Binder（5cm)	128,000	m2	24,000m2/M	6	M
	AC Surface（5cm）	128,000	m2	24,000m2/M	6	M
	Incidental Work					
	Bridge / 1bridge	34	m			
	Demobilization					
Seg-11	9.0km	21 month				
	Mobilization					
	Cutting Soil	49,000	m3	50,000m3/M	1	M
	Embankment	101,000	m3	62,500m3/M	2	M
	Base-Course	73,000	m3			
	AC Binder（5cm)	144,000	m2	24,000m2/M	6	M
	AC Surface（5cm）	144,000	m2	24,000m2/M	6	M
	Incidental Work					
	Bridge / 2bridges	35	m			
	Demobilization					
Seg-12	1.0km	28 month				
	Mobilization					
	Cutting Soil	4,000	m3	50,000m3/M	1	M
	Embankment	88,000	m3	62,500m3/M	2	M
	Base-Course	15,000	m3			
	AC Binder（5cm)	27,000	m2	24,000m2/M	2	M
	AC Surface（5cm）	27,000	m2	24,000m2/M	2	M
	Incidental Work					
	Bridge / 1bridge	330	m			
	Demobilization					
Seg-13	8.5km	20 month				
	Mobilization					
	Cutting Soil	22,000	m3	50,000m3/M	1	M
	Embankment	120,000	m3	62,500m3/M	2	M
	Base-Course	60,000	m3			
	AC Binder（5cm)	120,000	m2	24,000m2/M	5	M
	AC Surface（5cm）	120,000	m2	24,000m2/M	5	M
	Incidental Work					
	Bridge / 2bridges	21	m			
	Demobilization					



Source: JICA Study Team

CHAPTER 10 RECOMMENDATIONS

10.1 Needs of the Project

Needs of the project can be summarized as follows;

1) <u>The project is the Government's high priority project.</u>

The National Development Strategy of the Republic of Tajikistan for the period to 2015 (NDS 2015) gives high priority to this project, thus the project is in line with the Government's policies and priority.

2) <u>The project constitutes a part of important international highway.</u>

The project road constitutes a part of Asian Highway (AH) No. 7 and is also regarded as one of the most important corridors in CAREC which connects Tajikistan with Afghanistan and Pakistan in the south and the Kyrgyz Republic and Russia in the north. Thus the project is important not only domestically but also internationally.

3) <u>The project plays an important role as a commodity transport route domestically and internationally.</u>

Tajikistan is a landlocked country, and commodity transport highly relies on road transport. The project is important for domestic and international commodity transport.

4) <u>Traffic on the project road is rapidly increasing requiring a 4-lane (or dual 2-lane) road.</u>

The project road is a 2-lane road (1-lane per each direction) at present and carries 17,300 ~ 9,930 veh./day. In the past, traffic grew at the speed of 7.5% to 9.3% per annum. It is expected that traffic will continuously increase at the speed of 7% per annum in the future. Road sections near Dushanbe City and Kurgan-Tyube City require a widening to a 4-lane road by 2017 and even least traffic section requires a widening by 2022.

It is recommended that the project be commenced as early as possible to cope with the increasing traffic.

5) <u>The project will greatly contribute to reduction of traffic accidents.</u>

There are many traffic accidents and lives of road users have been lost. Major causes of traffic accidents are: *i)* over speeding and *ii)* risky overtaking.

Over speeding should be controlled by strict enforcement of traffic rules and regulations and provisions of warning signs, rumble strips and traffic safety measures. Risky overtaking can be drastically reduced by widening to a 4-lane road, since overtaking utilizing the opposite direction lane can be eliminated.

6) <u>The project contributes to reduction of transport cost and travel time.</u>

Pavement condition of the existing 2-lane road is aggravating. International Roughness Index (IRI) exceeds 4.0 at most of the sections and 6.0 at many sections. High IRI requires higher transport cost. By improving the pavement condition, transport cost will be reduced and travel time will also be reduced.

Lower transport cost and lesser travel time will contribute to economic and social development of the Region and the country as a whole.

7) <u>The project will contribute to reduction of poverty level of Khatlon Region.</u>

The project is located mostly in Khatlon Region where the poverty level is high at 78% in 2003. Cheaper travel cost and faster travel time contributed by the project will activate economic activities and provide more opportunities for job chances and intention to produce more, all of which will contribute to reduction of poverty level of Khatlon Region.

10.2 Expected Effects of the Project

10.2.1 Summary of Expected Effects

The project will bring about various effects as summarized in **Table 10.2-1.**

TABLE 10.2-1 EXPECTED EFFECTS OF THE PORJECT

Favorable/ Adverse Effect	Description of Effects	Remarks
Favorable Effect	1) Many people will be benefited by the project	Number of beneficiaries quantified (sec. 10.2.2)
	2) Reduction of road users' travel/travel time	Travel time saving quantified (Sec. 10.2.3)
	3) Reduction of travel cost	—
	4) Reduction of traffic accidents	Roughly quantified (Sec. 10.2.4)
	5) Reduction of poverty level of Khatlon Region	—
	6) Contribution to national/regional economic development	—
	7) Contribution to smoother commodity transport	—
Minor Adverse Effect	8) National environment will be slightly affected at mountainous section due to slope cutting, but effect is minor.	—
	9) Additional lands will be acquired. Mostly un-utilized mountain areas and agricultural lands.	—
	10) Some roadside vendors and fruits stands will be affected.	—

Source: JICA Study Team

10.2.2 Number of beneficiaries

(1) Number of Passengers on DK Road

Number of passengers on DK Road was estimated based on the OD Survey results and shown in **Table 10.2-2.**

TABLE 10.2-2 NUMBER OF PASSENGER ON DK ROAD

Year	Description	Vehicle Type	Station-1 (km.15)	Station-4 (Km.57)	Staion-7 (Km.93)
2015	Traffic Volume (veh/day)	Car	14,003	10,025	14,320
		Small Bus	1,590	186	527
		Large Bus	148	20	6
	Passenger Volume (persons/day)	Car	44,249	31,679	45,251
		Small Bus	10,192	1,192	3,378
		Large Bus	7,301	987	296
		Total	61,742	33,858	48,925
2020	Traffic Volume (veh/day)	Car	19,640	14,061	20,085
		Small Bus	2,230	261	739
		Large Bus	208	28	8
	Passenger Volume (persons/day)	Car	62,062	44,431	63,467
		Small Bus	14,295	1,672	4,738
		Large Bus	10,240	1,384	415
		Total	86,597	47,487	68,620

Source: JICA Study Team

(2) Commodities transported on DK Road

Commodities transported on DK Road based on the OD Survey results are shown in **Table 10.2-3.** These commodities are used for economic activities or used for people's daily lives. As shown in Truck OD pattern in **Chapter 5**, OD of truck covers quite wide areas which means many people are depending on DK Road:

TABLE 10.2-3 COMMODITIES TRANSPORTED ON DK ROAD

Direction	Commodities Transported
From Dushanbe to Kurgan-Tyube	Food, Construction Materials, Fuel, Cement, Clothes, Cattle, Coal, Boiler Oil, etc.
From Kurgan-Tyube to Dushanbe	Food. Construction Materials, Cattle, Wood, Fuel, Cement, Coal, Compound Feed

Source: JICA Study Team

(3) Number of Beneficiaries

As discussed above, people in the wide area will be benefited by the project. Number of beneficiaries is estimated to be about 1.4 Million people (see **Table 10.2-4**).

TABLE 10.2-4 NUMBER OF BENEFICIARIES OF THE PROJECT

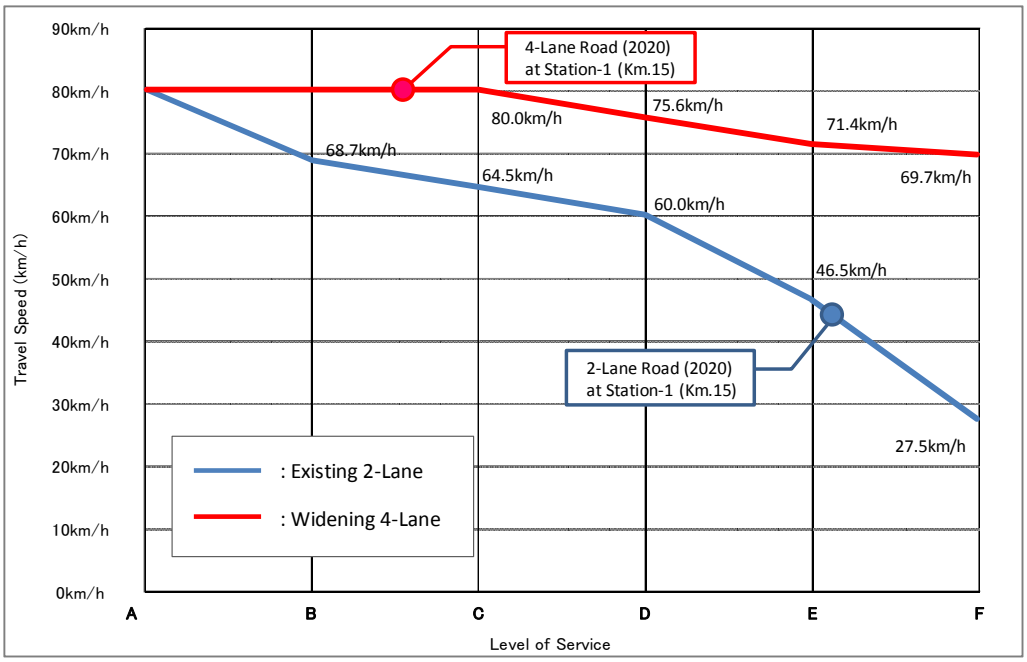
Area	Number of Beneficiaries
Dushanbe City	791,700
Along DK Road	152,700
Kurgan-Tyube City	103,000
South of Kurgan-Tyube City	386,500
Total	**1,433,900**

Source: Estimated by JICA Study Team based on Statistics Department of each District

10.2.3 Reduction of Road Users' Travel Time

Comparison of travel speed between a 2-lane road and a 4-lane road at Station-1 (Km. 15) is shown in **Figure 10.2-1.**

- Travel speed of a 2-lane road in 2020 = 45.9 km/hr
- Travel speed of a 4-lane road in 2020 = 80.0 km/hr



Source: Estimated by JICA Study Team based on HCM 2000

FIGURE 10.2-1 TRAVEL SPEED OF 2-LANE AND 4-LANE ROAD

Assuming that the above travel speed is constant for the full stretch (or 83.6km) of DK Road, travel time savings per day and per year in 2020 are estimated as shown in **Table 10.2-5.**

TABLE 10.2-5 TRAVEL TIME SAVING IN YEAR 2020

	Total Travel Time per Day	Total Travel Time per Year
Travel Time in case of a 2-lane Road	26,900 hr/day	9.8 Million hour/year
Travel Time in case of a 4-lane Road	15,400 hr/day	5.6 Million hour/year
Travel Time Saving of a 4-lane road	11,500 hr/day	4.2 Million hour/year

Source: JICA Study Team

10.2.4 Reduction of Traffic Accidents

It is quite difficult to predict how many percent (%) of traffic accident will be reduced, since many accidents were caused by drivers' bad manners. However, vehicle collisions will be drastically reduced by providing 2 lanes for each direction and fatal casualties can also be reduced by providing traffic safety facilities. Target level of traffic accidents can be set to be 90% of level of 2014. Even though traffic is increased in the future, traffic accidents and casualties level would be able to maintain 90% of the level of 2014.

TABLE 10.2-6 TRAFFIC ACCIDENT AND CASUALTY LEVEL

Type of Accidents and Casualty		2014	Target
Type of Accidents	Vehicle Collision	26	23
	Hit person(s) by Vehicle	13	12
	Overturn	13	12
	Total	45	47
Casualty	Dead	19	17
	Injured	49	44
	Total	68	61

Source: JICA Study Team

10.3 Project Implementation Organization

10.3.1 Project Implementation Organization Up To Construction

The Tajikistan Government has been adopting two cases of project implementation organization. The Government may adopt Case-2 for this project as in the case of the previous JICA-funded projects.

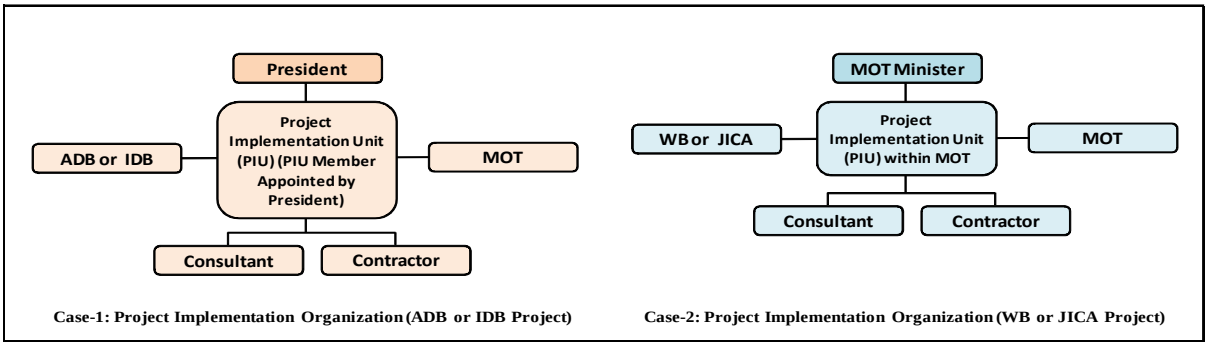
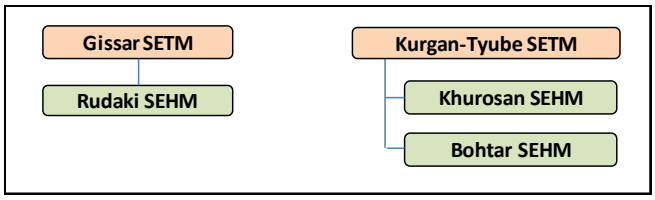


FIGURE 10.3-1 PROJECT IMPLEMENTATION ORGANIZATION

10.3.2 Operation and Maintenance of the Project

After completion of the project, it will be operated and maintained by the following field offices;



10.4 Additional studies required

The additional studies including but not limited to the following items will be required for the realization of the Project.

(1) Topographic Survey

Survey Items	Flat Terrain	Rolling / Mountainous Terrain
a) Center Line Survey	• At 50 m interval	• Preferably at 25 m interval
b) Profile Survey	• At 50 m interval	• Preferably at 25 m interval
c) Cross Section Survey	• At 50 m interval for the width of 60 m	• Preferably at 25 m interval for the width of 100 m
d) Topographic Survey and Mapping	• All structures • Topographic changes • Contour interval : 1 m	• All structures • Topographic changes • Contour interval : 1 m
e) Bridge Site Topographic Survey	• River profile and cross section survey, 300 m each for up-and down-stream side (total 600 m) • Bridge site topographic map	

(2) Bridge Site Boring

Boring with SPT shall be undertaken. Number of borings shall be as follows:

Bridge Length	No. of Borings
Less than 50 m	1
50 – 100 m	3
100 – 400 m	5

Boring depth may be about 25 m.

(3) Existing Pavement Survey

Test pitting: At 500 m interval at the pavement edge. Pavement thickness and CBR measurement of base course and subgrade shall be undertaken.

(4) Material sources Survey

Material sources of aggregate for asphalt concrete and structural concrete and borrow materials shall be identified and quality of material shall be tested.

(5) Underground and Overhead Utilities Survey

Such underground utilities as water pipes, optical fiber cables etc. shall be surveyed their location, size, depth and owners. Similarly overhead utilities such as power transmission lines/ towers, electric posts, etc. shall be surveyed their location and owners.

(6) Irrigation Canal Survey

There are irrigation channels along the road. Their locations, size of canal, etc., shall be surveyed.

(7) Roadside Vendors and Fruit Stands Survey

There are roadside vendors and fruit stands within road right-of-way. Legal status, owners, sales amount, etc. shall be surveyed.

(8) EIA and RAP

EIA and RAP shall be prepared to obtain the environmental approval.

(9) Economic Evaluation

Economic evaluation of the project shall be carried out.