

The Project for the Operation and Maintenance of
the Sindhuli Road Phase 2

Technical Report (Draft)

Examination on the Introduction of Toll
Road System in Sindhuli Road

JUNE 2019

Kiyoshi Narita

JICA Expert Team

Contents

Chapter1 Current Toll Road System of Nepal and the Present Condition of the Sindhuli Road

- 1-1. The Roles and Responsibilities of RBN
- 1-2. Current Toll Roads and the toll Road Systems
- 1-3. Sindhuli Road

Chapter2 Review on the Toll Road System Proposed by RBN

- 2-1. Toll Collection Section
- 2-2. Toll Road Fee to be Applied for Sindhuli Road
- 2-3. Location of Toll Plaza
- 2-4. Number of Lanes
- 2-5. Toll Plaza Facilities
- 2-6. The Toll Collection System
- 2-7. Road Maintenance Budget
- 2-8. Counterfeit Measures

Chapter3 Proposed the Toll Road System to be Introduced in the Sindhuli Road

- 3-1. Concept Concerning Toll Road System to Sindhuli Road
- 3-2. Traffic Forecast
- 3-3. Cost Forecast
- 3-4. Preconditions of Case Study for Introduction of Toll System
- 3-5. Financial Analysis
- 3-6. Division of Roles Between RBN and DOR
- 3-7. Implementation Plan

Chapter4 Conclusion and Recommendation

- 4-1. Conclusion
- 4-2. Recommendation

Appendix

Chapter1 Current toll Road System of Nepal and the Present Condition of the Sindhuli Road

1-1. The Roles and Responsibilities of RBN

Roads Board Nepal (RBN) was established under the Roads Board Act 2002 with the aim of providing sustainable fund for planned maintenance of the roads. The aim of planned maintenance is to keep existing maintainable roads in serviceable condition, reduce vehicle operating cost and provide more comfort to the road users. The major function of RBN is to collect, manage and allocate fund for road maintenance to the Road Agencies(RAs). RBN is fully devoted in providing better road service to the road users as they pay in the form of direct road toll, fuel levy and vehicle registration fee.

1-1-1. Activity

The primary objective of RBN, as set out in the Act and the accompanying rules and regulations, is to generate and allocate funding for road maintenance and oversee its execution by RAs. RBN is to undertake independent technical and financial audits of the works executed by RAs.

Based on the following strategies, operations and functions, RBN is carrying out in cooperation with relevant organizations.

(1) Strategies

- To establish RBN as a competent funding agency for road maintenance
- To improve service delivery through planned maintenance management process
- To progressively generate the fund commensurate to demand
- To ensure reduced Vehicle operating cost and travel time
- To demonstrate excellence in fund management
- To support RAs for better implementation of RBN programs
- To introduce control measures for enhanced management practice by timely planning, implementing and reporting activities of the RAs

(2)Operations

- To improve efficiencies in terms of partnership with RAs
- To improve data registry system at the RAs and RBN
- To establish business plan and rolling plan of RBN activities
- To establish an efficient corporate culture environment in RBN Secretariat
- To create awareness among the stakeholders about the need of road maintenance
- To play a pivotal role in delivering services towards road transport sector and meet the

expectancy of the road users by efficient service delivery

(3) Functions

- To cause to carry out repair and maintenance of the road
- To formulate integrated annual plan for repair and maintenance of the road
- To approve the annual budget and program of the board
- To recommend government of Nepal on the matters of fixation of the road toll or fuel levy to be collected under the ACT, additional charges and fines to be collected for plying the motor vehicles contravening to the specified standards

1-1-2.Organization

The organization chart of RBN is shown as Figure1.Planning of toll system introduction and procurement of toll fee collection contractor are undertaken by Senior Technical Engineer about Planning, Programming, Budgeting (PPB). Fee collection activity by the contractor is under supervision of Senior Technical Engineer about Operation, Monitoring, and Engineering (OME).

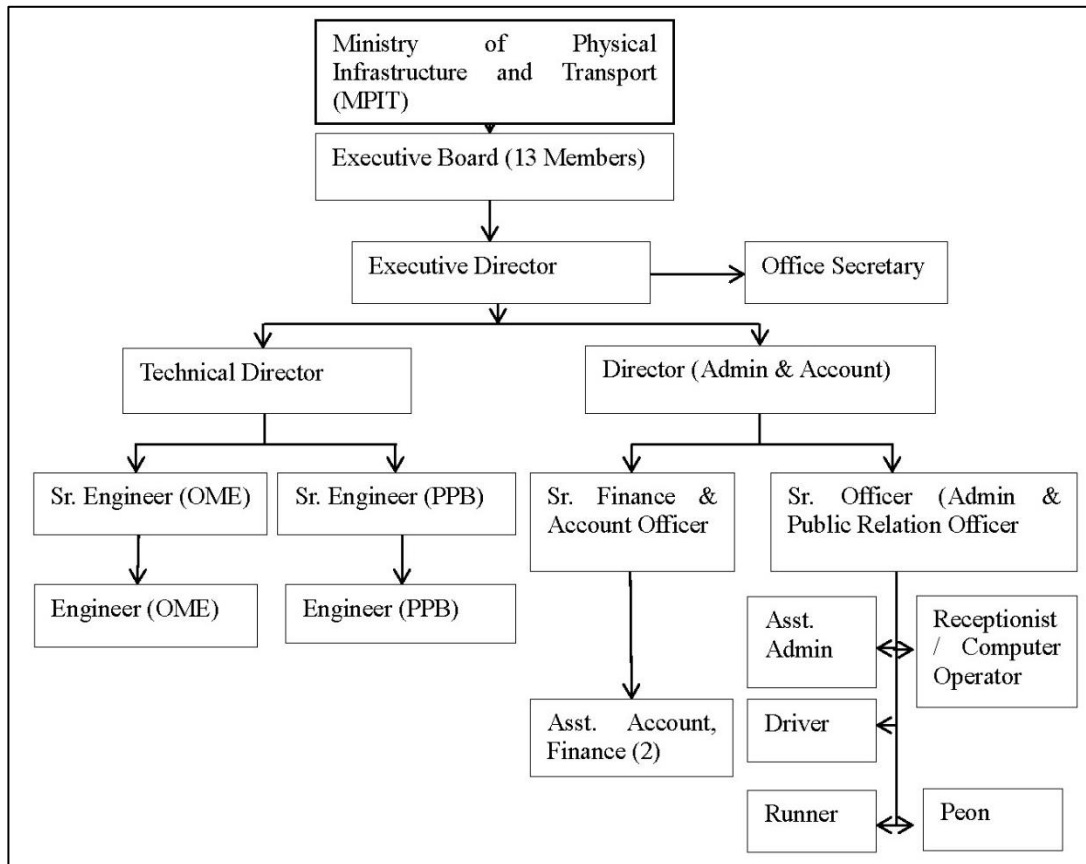


Figure 1 Organization Structure of RBN

Source:RBN

1-1-3. Composition of Roads Board

The board member is consisting 13 members as mentioned below.

- (1) Secretary, Ministry of Physical Infrastructure & Transport : Chairperson
- (2) Joint Secretary, Ministry of Finance
- (3) Joint Secretary, Ministry of Federal Affairs and Local Development
- (4) Joint Secretary, Ministry of Supply
- (5) Director General , Department of Road
- (6) Representative, Federation of Nepal Chamber of Commerce
- (7) Representative Municipal Association
- (8) Representative VDC Federation
- (9) Representative, Transport Entrepreneur's Association
- (10) Representative, Consumer's Association
- (11) Representative, Commercial Farmers
- (12) A Road/Transport Expert

(13) Executive Director, RBN

1-1-4. Financial Resources

The financial resources of RBN are specified in the Road Fund Act and are shown as follows:

(1) Government of Nepal(GON) may by a notification published in the Nepal Gazette levy such toll as maybe prescribed in such a notification on the motor vehicle making use of the road prescribed in the said notification

(2) The board shall collect or cause to collect the toll prescribed by GON by notification published in the Nepal Gazette

RBN has currently been availing the following resources as follows:

So far, although there is revenue from (1) (2) (3), there is no revenue from (4) (5).

The rates for (1) and (2) were revised in 2016.

(1)Fuel levy on diesel and petrol (Gasoline : 4NRs/lit. Diesel : 2NRs/lit.)

(2)Vehicle registration fees (7%~10% of the purchase price)

(3)Road user charges

(4)Charge on motor vehicles registered outside of Nepal(collected upon entering the country).

(5)Subsidies and grants from GON and support from donors and internals, if any.

Toll collection system will be introduced by RBN on the basis of a request by DOR to consider the concrete implementation method and receive approval from the Nepalese government. RBN consigns toll collection to a private company. The collected toll are collected in RBN once and then distributed to the maintenance budget of the road on which the toll is collected.

1-1-5. Breakdown of Financial Resources

Table 1 shows the transition of financial resources(allocated amount) for road maintenance in RBN. Fuel levy and Vehicle registration levy account for about over 99% of total revenue, and toll road tolls are less than 1% of total revenue.

Thus, most resources for road maintenance costs in Nepal are levy.

Table 1 The transition of financial resources for road maintenance in RBN

(Unit: RNs. million)

Source of Revenue	FY2013/14	FY2014/15	FY2015/16	FY2016/17	Rate (%)
Fuel Levy & Vehicle Registration	10,242.18	14,027.87	14,989.53	20,278.61	99.5%
Toll roads fee	91.95	81.35	90.87	95.36	0.5%
Total	10,334.13	14,109.22	15,080.40	20,373.91	100%

Source : RBN

Table 2 shows the maintenance costs actually paid by RBN.

RBN allocated road maintenance budget for RAs, which actually implement the road maintenance works. The department of roads (DOR) is identified as the RAs for the maintenance of strategic road network (SRN). Maintenance of urban, district, and local roads is governed through the department of local infrastructure development and agricultural roads (DoLIDAR), which coordinates the district development committees (DDC) and municipalities (MC) recognized as the RAs for local road network (LRN). Over 90 % of road maintenance budget has been disbursed to DOR since FY2015/16 to FY2018/19 as follow.

Table 2 Road Maintenance Budget Disbursed by RBN

(Unit: NRs. Million)

		FY2015/16	FY2016/17	FY2017/18	FY2018/19	%
a	DOR	3,324	4,523	4,742	3,956	93.6%
b	District Development Committee	230	230	96	3.3	0.1%
c	Municipality	499	521	608	269	6.3%
Total		4,053	5,274	5,446	4,228.3	100.0%

Source: RBN

Table 3 is shown as the transition of the budget allocated to DOR and the expenses actually spent. DOR approved budget and disbursed by RBN since FY2015/16 to FY2018/19 are shown as follows. Approximately 80% of approved budget for DOR has been disbursed by RBN since FY2015/16 to present. About 500 NRs. Million have not been spent in FY2018/2019.

Table 3 Approved and Disbursed Budget for DOR (FY2015/16-FY2018/19)

(Unit: NRs. Million)

Description		FY2015/16	FY2016/17	FY2017/18	FY2018/19
a	Approved Budget	4,960.0	5,636.65	5,099.36	4,501.36
b	Disbursed	3,324.37	4,523.70	4,742.41	3,956.41
c	Budget Balance (a-b)	1,635.63	1,112.95	356.95	544.95
% (b/a)		67%	80%	93%	88%

Source: RBN

1-2. Current Toll Roads and the toll Road Systems

1-2-1. Overview

As one of fund sources for road maintenance, road user's fee is collected from toll roads.

The current toll road section of Highway is 4 lines in Nepal as shown in Table 4 and toll road section is illustrated in the map of Figure 2.

Under the control of RBN, the private contractor has been given the responsibility to collect the fees from toll road users.

Table 4 Toll Roads in Nepal

	Name of Road	Road Section	Length
1)	Prithivi Highway	Naubise - Mugling	84 km
2)	East-West Highway	Hetauda-Narayanghat	77 km
3)	East-West Highway	Narayanghat-Butwal	114 km
4)	Bhumahi Road Section	Bhairahawa - Bhumahi	29 km
	Total		304 km

Source:RBN



Figure 2 Toll Roads in Nepal

Source: JICA Expert Team

Table 5 shows annual maintenance budget and toll fee collected amount by existing toll road. According to the table, total collected toll fee is accounted for approximately 20% of total maintenance budget. Basically, toll fee collected amount is not sufficient to cover maintenance cost. However, actual expenses of toll is less than toll fee collected amount. Surplus (collected toll fee - actual expenses) is carried forward to next year's funding.

Table 5 Maintenance Cost and Toll Fee Collected by Road

(Unit: NRs. Million)

Road Section	FY2012/13				FY2013/14				FY2014/15			
	(a) Allocate d Maint. Budget	(b) Toll Fund Budget	(c) Collected Toll Fee	% (c/a)	(a) Allocate d Maint. Budget	(b) Toll Fund Budget	(c) Collected Toll Fee	% (c/a)	(a) Allocat ed Maint. Budget	(b) Toll Fund Budget	(c) Collected Toll Fee	% (c/a)
1) Naubise - Mugling	200.1	40.0	25.9	13%	970.5	40.0	41.3	4%	48.3	35.0	29.5	61%
2) Hetauda-Narayanghat	106.5	10.0	23.8	22%	346.5	10.0	25.4	7%	208.6	11.8	25.2	12%
3) Narayanghat-Butwal	87.9	20.0	30.0	34%	221.8	20.0	23.3	11%	115.6	33.2	24.4	21%
4) Bhairahawa - Bhumahi			2.0				2.0				2.3	
A) Sub-total	394.5	70.0	81.7	21%	1538.8	70.0	92.0	6%	372.5	80.0	81.4	22%
B) Actual Expenses of Toll			62.7				45.0				65.7	
C) Forwarding in the Next Year (A-B)			19.0	23%			47.0	51%			15.7	19%

Source: RBN
Source: Progress Report No.7(January2015-August2015) The Project for the Operation and Maintenance of The Sindhuli Road

1-2-2. Revenue from Toll Collection

The revenue from toll collection is as shown in Table 6.

It has risen from 2015 to 2017 on any toll roads.

Table 6 Revenue from toll collection

(Unit: NRs. Thousands)

Toll Roads	Collected Revenue		
	2015/2016	2016/2017	2017/2018
Naubise - Mugling	38,431.88	40,385.08	43,191.67
Hetauda-Narayanghat	22,438.60	22,979.41	27,168.62
Narayanghat-Butwal	28,314.95	29,070.79	30,837.65
Bhairahawa - Bhumahi	1,680.00	2,928.64	5,607.69
Total	90,865.43	95,363.92	106,805.63

Source: RBN

Table 7 shows the toll revenue estimated based on the 2016 traffic volume on the Hetauda-Narayanghat section surveyed by the DOR. The difference with the actual toll income is 74 NRs. Million, and the ratio is 23.55%. Therefore, there is a huge difference between toll revenue according to traffic volume and actual toll revenue.

The estimated toll revenue for fiscal 2016 applying this to other routes is as shown in Table 8. The difference with the actual toll income is about 300 NRs. Million.

From this, it can be inferred that the charge according to the traffic volume cannot be collected because of the inadequacy of the collection method, fraud, etc.

Table 7 Traffic Volume ,Estimated Revenue, and Collected Revenue
(FY 2016 Hetauda-Narayanghat section)

Target	Traffic Volume			Estimated Revenue(a) (Unit: NRs.)	Collecte Revenue(b) (Unit: NRs.)	(a)-(b) (Unit: NRs.)
	VPD	VPY	%			
Two wheels	6,706	2,447,690	39.30%	12,238,450	-	-
Light Vehicle	2,628	959,220	17.09%	19,184,400	-	-
Heavy Vehicle	6,043	2,205,695	43.61%	66,170,850	-	-
Total	15,377	5,612,605	100%	97,593,700	22,979,410	74,614,290

Source: JICA Expert Team

Table 8 Estimated Revenue and Collected Revenue
(FY 2016 All toll roads)

(Unit: NRs.)

Toll Roads	Estimated Revenue(a)	Collected Revenue(b)	(a)-(b)
Naubise - Mugling	171,515,690	40,385,080	131,130,610
Hetauda-Narayanghat	97,593,700	22,979,410	74,614,290
Narayanghat-Butwal	123,463,830	29,070,790	94,393,040
Bhairahawa - Bhumahi	12,437,950	2,928,640	9,509,310
Total	405,011,170	95,363,920	309,647,250

Source: JICA Expert Team

1-2-3. Procurement and Contract of Toll Collection Company

Collection of Road User Fee through private contractor is conducted on the basis of competitive bidding according to the Bid Document prepared by the RBN.

RBN invites the bids from eligible registered companies and partnership firms for collection of road user fee from vehicles playing on the specified section of the Highway.

(1) Award of Fee Collection Rights

The Bidder whose Bid amount is proposed to be highest shall be awarded the Contract. The Contract initially shall be for one year. However, Extension of contract is possible to subject contract price shall be increased.

(2) Remittance of Agreed Amount

The fee shall be collected by the successful Bidder (the Contractor) and the agreed amount shall be remitted to the RBN on equal monthly installment basis by way of Bank voucher deposited in the RBN account.

(3) Projected Vehicles Traffic Data

Data is mentioned by type of vehicle in a Bid Document. The Bidder is encouraged to visit and examine the road and obtain for himself on its own responsibility all information that may be necessary for preparing the Bid.

There are two main features about the contract.

- It is the contractor who decides the charge collection place.
Furthermore, the toll plaza must be located in a place away from the village.
- The contractor does not receive the charge from the motorcycle user living in the local area.

1-2-4. Field Survey

In May 2019, the toll plaza of the existing toll roads shown in Table 9, Figure3 and Figure4 were surveyed. The survey items and the results are as shown in Table 10.

There are the following points to be noted.

- The collection staff collects without wearing a helmet on the road.
Furthermore, since there is no roof on the toll gate, the rain weather deteriorates the working environment.
- The motorcycle user who should pay the toll in rule rarely pay the toll.
According to the contractor, collectors gave up to collect tolls because there is no space(toll booth) to do.
- The target of the collection was different at each toll plaza.
- When handing over the fee, the staff needs to come out of the office space. Therefore, collection time becomes longer. (about three times than the change-free vehicle)
- People can see the cash in management room from outside.
It can be seen that security management is inadequate.
- There are no facilities that meet the working environment of the staff, such as air conditioners and toilets.
- Because the toll plaza and each lane are not independent, motorcycle's user pass from the opposite lane without paying toll.

There is a shortage of facilities that satisfy the working environment of the staff.

In addition, collection methods are different at each toll plaza. In other words, facilities and collection methods related to toll collection are not standardized.

Table 9 Field survey target route

	Name of Road	Road Section	Length
1)	Prithivi Highway	Naubise - Mugling	84 km
2)	East-West Highway	Hetauda-Narayanghat	77 km



Figure 3 Hetauda toll plaza



Figure 4 Naubise toll plaza

Source: JICA Expert team

Table 10 Survey items and the results

Highway Section	Hetauda-Narayanghat (77 km)		Mugling-Naubise (84 km)	
Fee Collection Booth Location	Hetauda	Narayanghat	Mugling	Naubise
Target Vehicle	From Hetauda to Narayanghat	From Narayanghat to Hetauda	From Mugling to Naubise	From Naubise to Mugling
Toll Rate by Type of Vehicle				
Two Wheels (Motor-Cycles)	NRs.5	NRs.5	NRs.5	NRs.5
Light Vehicle (Car, Taxi, Jeep, etc.)	NRs.20	NRs.20	NRs.25	NRs.25
Heavy Vehicle (Truck, Bus, etc.)	NRs.30	NRs.30	NRs.35	NRs.35
Number of Lanes	1	2	1	1
Number of Working Staff at Booth				
Daytime	4 persons	7 persons	6 persons	6 persons
Nighttime	5 persons	7 persons	6 persons	6 persons
Operation hours	24 hours	24 hours	24 hours	24 hours
With or Without facilities (With: ○ / Without: ×)				
Office space	○	○	○	○
Roof	×	×	×	×
Toll Booth	×	×	×	×
Safe Box	×	×	×	×
Lounge	○	×	○	○
AC or Fan	×	Fan	Fan	×
Toilet	×	×	×	×
Gate bar	×	×	×	×
Collection processing time per car (second)	8.3	12.2	10.4	8.3
Pay or Not pay toll				
Motorcycle	Not pay	Pay (only part)	Not pay	Not pay
Emergency car	Not pay	Pay	Not pay	Not pay
Official car	Not pay	Not pay	Not pay	Not pay
Diplomatic car	Not pay	Pay	Not pay	Not pay
Local residents	Not pay	Not pay	Not pay	Pay (only one time)
Others	Pay	Pay	Pay	Pay
Contact Period	One year (1 year extension possible)			
Name of Contractor	Britanic Maulakalika			
Remarks	<ul style="list-style-type: none"> ▪ There is no charge from the motorcycle. It is because of giving up the collection. ▪ The collection method is left to the person in charge of each toll booth. ▪ It is based on self-reporting system of users whether the user is a local resident. 			

Source: JICA Expert Team

1-2-5. Recent Situation

The toll being levied by RBN on vehicles in different routes has not been reviewed since long while the road maintenance cost has been increasing every year. The annual budget that the government issues for road maintenance is inadequate to keep road networks in better conditions. Even Though effective collection of vehicle toll is one of the sources to generate funds for road maintenance, the currently levied toll is very low. RBN also has not been able to enforce such fees on vehicles in a number of routes authorized by the government.

This is presumably because, in addition to the fact that the toll rate has not been revised for many years, as described in 1-2-4, the charge is not collected from the vehicle to be collected.

At present, RBN collects toll levy only on four road sections.

RBN plans to collect toll levy on all highways and road sections across the country where vehicular movement exceeds 900 units per day.

The 14 road sections shown in Table 11 are publicized as toll road introduction routes.

No.1 (Hetauda-Narayanghat Section) and No.3 (Naubise-Muglin Section) are under consideration in RBN to introduce an automatic toll collection system.

Table 11 Toll Road Introduction Routes

No	Road Section	Length (Km)
1	Hetauda - Narayanghat Section	77.00
2	Narayanghat - Butwal Section	115.00
3	Naubise - Muglin Section	82.00
4	Bhairahawa - Bhumahi Section	29.00
5	Kakadbhitta - Damak Section	47.00
6	Damak - Itahari Section	94.00
7	Biratnagar - Dharan Section	41.00
8	Koshi - Chauharwa Section	78.00
9	Chauharwa - Pathlaiya Section	158.00
10	Hetauda - Birgunj Section	53.00
11	Birgunj - Pathlaiya Section	24.00
12	Dhulikhel - Khurkot Section	87.00
13	Khurkot - Sindhuli - Bardibas Section	73.00
14	Panchkhal - Melamchi Section	23.00

Source:RBN

1-3. Sindhuli Road

1-3-1.Route

Sindhuli Road (National Route 6) is an important highway connecting Nepal's capital city, Kathmandu, with the southern Terai plain bordering the Indian border.

The position map is as shown in Figure 5.

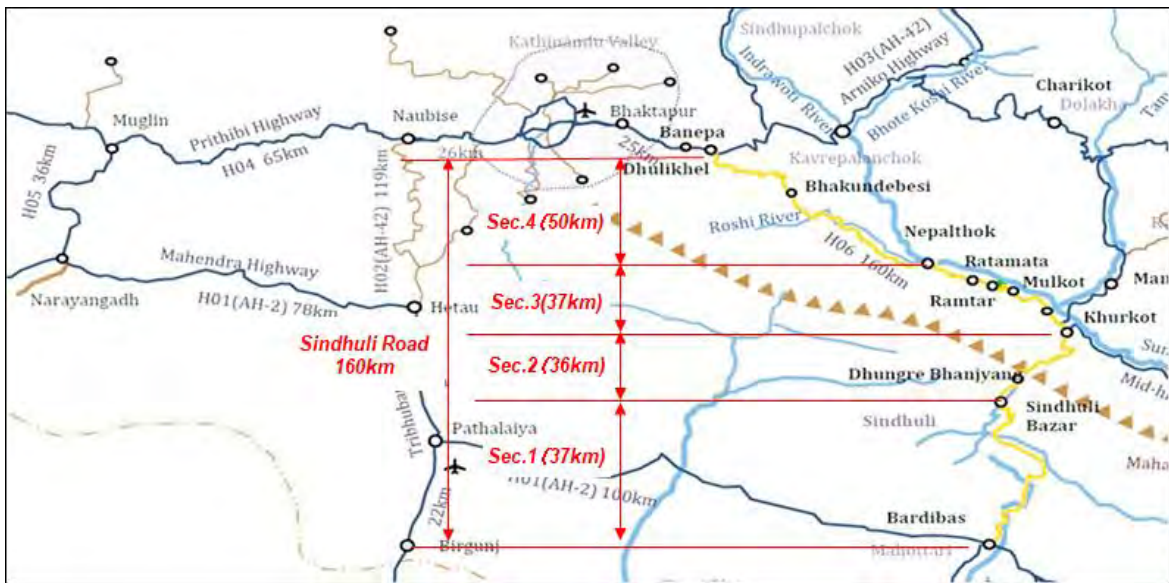


Figure 5 The position map in Sindhuli Road

Source: JICA Expert Team

1-3-2. Traffic Characteristics

Table 12 shows the traffic volume by vehicle type for 2017 based on the traffic volume survey. The number of vehicles per day (VPD) is classified into vehicle types and sections because toll road charges are classified into three types of vehicles according to the existing toll roads. The traffic at each point is 9,268 for Dhulikhel, 2,890 for Ramtar near Khurkot, 2,714 for Khurkot, and 7,779 for Bardibas.

There is more traffic at Dhulikhel and Bardibas than that of other points.

The rate of heavy traffic is 21% in Dhulikhel, compared with 11% in Bardibas.

This indicates that there are a lot of traffic of vehicles that affect road maintenance in the Dhulikhel side.

Table 12 Traffic Volume by Section in Sindhuli Road in 2017

Location by Section	Dhulikhel		Ramtar		Khurkot		Bardibas	
	VPD	%	VPD	%	VPD	%	VPD	%
a) Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment	1,913	21%	744	26%	747	28%	841	11%
b) Car, Jeep, Pickup Van and Tractor	2,404	26%	932	32%	840	31%	905	12%
c) Three-Wheeler Tempo and Motorcycle L	4,952	53%	1,215	42%	1,127	42%	6,033	78%
Total	9,268	100%	2,890	100%	2,714	100%	7,779	100%

Source: JICA Expert Team

1-3-3. Roadside Conditions, Socio-economic Conditions after Whole Line Opening

Table 13 shows the change from before the whole line opening (2012) to after the whole line opening (2015) for the main indicators based on the socio-economic survey along Sindhuli Road. In terms of social indicators, the number of houses has increased by 93% compared to before and after the opening of all lines, and the number of schools and hospital facilities that accompany them have also increased.

Also, there is a 31% increase in restaurants for economic indicators.

Furthermore, for household indicators, land prices increased by 56% and income per household increased by 104%.

Thus, the socio-economic situation of the roadside area has been developed by the opening of Sindhuli Road.

Furthermore, as shown in Table 14, the population along Sindhuli Road before the opening was smaller than the population along other toll roads, so further development of the roadside area is expected.

Table 13 Remarkable Changes by Major Indicators of the Socio-economic Survey

	unit	BLS, 2012	ELS, 2015	Change
1. Land use within 100m both sides				
a) Social indicator				
Access roads to villages	no.	70	135	93%
House/building	no.	1,938	3,327	72%
School	no.	11	23	109%
Hospital/clinic	no.	1	11	1000%
b) Economic Indicator				
Agro-vet	no.	4	21	425%
Gas store (LPG)	no.	0	11	-
Tea shop/restaurant	no.	284	372	31%
2. Household Indicator				
Land price	Rs. million/ha	12.1	18.9	56%
Income per household	Rs.	119,815	244,308	104%
Share of agriculture to income	%	26.7	39.9	13.2pp
Expenditure per household	Rs.	110,020	154,969	41%
Food sufficiency less than 3 months	%	23.5	12.2	11.3pp
Penetration ratio of mobilephone	%	78	95	17pp
Solar power	%	17	30	13pp
Dish home (parabola antenna)	%	16	32	16pp

Source: JICA Expert Team

Table 14 Population of each District at 2011

District	Population	
Around Sindhuli Road	Kavrepalanchok	381,937
	Ramechhap	202,646
	Dolakha	186,557
	Sindhuli	296,192
	Mahottari	627,580
Around Naubise – Mugling section and Hetauda-Narayanghat section	Makwanpur	420,477
	Chitawan	579,984
	Dhading	336,067

Source: 2017 Statistical Year Book Nepal(Central Bureau of Statistics)

Chapter2 Review on the Toll Road System Proposed by RBN

At the JCC meeting held on April 25, 2019, RBN made the following comments, and it was decided that the toll road system would be introduced for Sindhuli Road.

- The introduction of toll system in the Sindhuli Road was decided by the Nepalese government and toll section including toll rate to be applied for the Sindhuli Road was already described in the official gazette.
- RBN considers that the toll correction system to be applied to the Sindhuli Road is an automatic correction system in the future, However, it will be the manual method instead of the automatic correction system for the time being.

2-1 Toll Collection Section

The toll collection section on Sindhuli Road was announced on April 15, 2019, and it was decided that there will be two sections shown in Figure 6.

- Dhulikhel-Khurkot (87km)
- Khurkot-Bardibas (73km)

When setting the toll collection section, it is desirable that it should be subdivided in consideration of the road usage situation along the roadside as much as possible.

However, there is no particular problem. The reasons are as follows.

- The purpose of introduction is securing the road maintenance cost of the whole Sindhuli Road
- Excessive fragmentation leads to complication of toll collection
- The extension of both sections is 87km and 73km respectively, and there are similar extension cases in other toll sections in Nepal
- It is divided into sections almost in the middle of Sindhuli Road

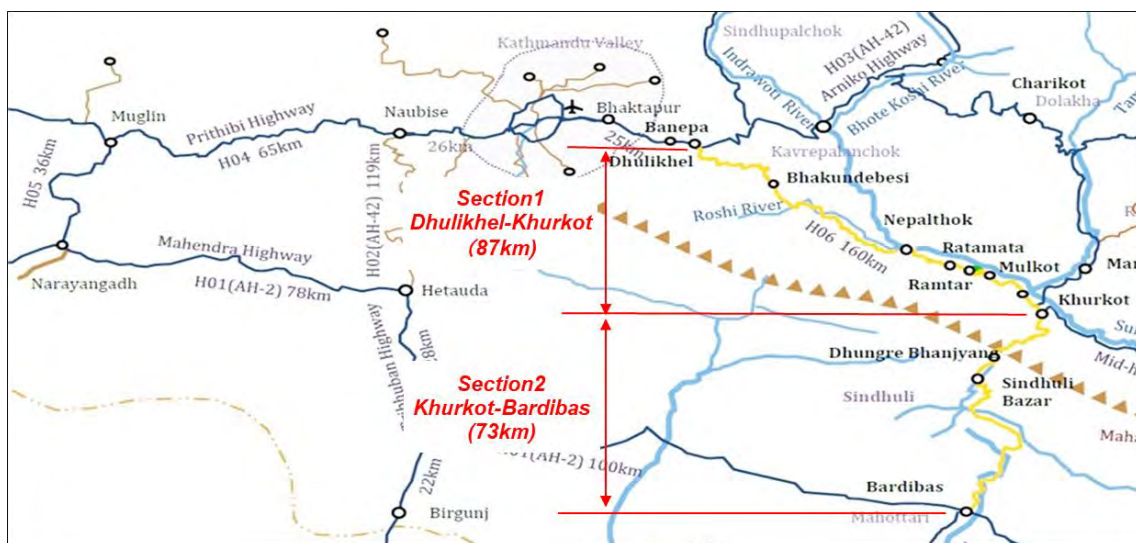


Figure 6 Toll Collection Section in Sindhuli Road

Source: JICA Expert Team

2-2. Toll Road Fee to be Applied for Sindhuli Road

The tolls are publicized on April 15, 2019 in Sindhuli Road, and the system is as shown in Table 15.

Table 15 The Toll in Sindhuli Road

No.	Road Section	Type of Transport and Tax (except Government Transport vehicle)		
		Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment (Rs)	Car, Jeep, Pickup Van and Tractor (Rs)	Three-Wheeler Tempo and Motorcycle L (Rs)
		NRs.	NRs.	NRs.
1.	Dhulikhel-Khurkot	125	50	15
2.	Khurkot-Sundhuli-Bardibas	115	45	15

Source:RBN

2-3. Location of Toll Plaza

So far, the toll collection company has decided the location of the toll plaza. However, in Sindhuli Road, RBN determines the location of the toll plaza.

Figure 7 and Table 16 shows the location and details of the candidate site proposed by RBN.

The candidate site is considered by RBN as follows.

- Avoiding the villages so that local residents do not pay toll road fee in their daily lives.
- Considering the situation of land around Sindhuli Road and the required lane width, it is considered as One side collection.

There are slopes, curves for No1, No2 and No3. There is no problem if there is a facility to slow down the car at the toll booth to ensure traffic safety.

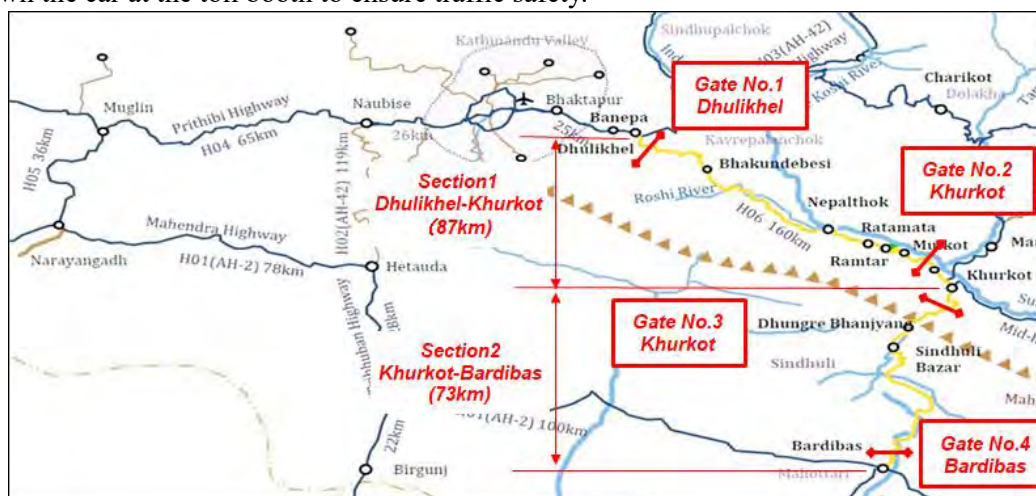


Figure 7 Location of toll plaza

Source: JICA Expert Team

Table 16 Candidate Site For Toll Plaza

No	Section	Place	Photo	Collection direction	Merits and Demerits	
					Merits	Demerits
1	Dhulikhel-Khurkot	About 9km to Khurkot direction from Dhulikhel		One way (Dhulikhel ⇒ Khurkot)	<ul style="list-style-type: none"> • Widenable • Straight • Close to Police box 	<ul style="list-style-type: none"> • Slope • Close to intersection
2		About 9km to Dhulikhel direction from Khurkot		One way (Khurkot ⇒ Dhulikhel)	<ul style="list-style-type: none"> • Widenable 	<ul style="list-style-type: none"> • Curve • Slope • Strong wind blows
3	Khurkot-Bardibas	About 8km to Bardibas direction from Khurkot		One way (Khurkot ⇒ Bardibas)	<ul style="list-style-type: none"> • Widenable 	<ul style="list-style-type: none"> • Curve • Slope
4		About 2.5km to Khurkot direction from Bardibas		One way (Bardibas ⇒ Khurkot)	<ul style="list-style-type: none"> • Straight • Close to Police box 	<ul style="list-style-type: none"> • None

Source: JICA Expert Team

2-4. Number of Lanes

Since there is no proposal from RBN, it is calculated based on traffic volume.

The number of lanes is calculated based on peak hour traffic.

Table 17 shows the number of lanes required based on traffic volume.

Chargeable traffic is half of the total, and peak hour traffic is 10% of the target of toll collection.

Peak hour traffic in 2017 is 463 in Dhulikhel, 145 in Ramtar, 136 in Khurkot, and 389 in Bardibas.

As a result of the field survey, the average processing time per unit is about 10 seconds, and the processing number per hour is 360.

Therefore, the toll booths in Dhulikhel and Bardibas have two lanes and the other toll booths have one lane.

However, 2 lanes of each toll booth will be secured in consideration of future increase in traffic and the introduction of an automatic toll collection system.

Table17 Number of Lanes

Location by Section	Dhulikhel		Khurkot (Ramtar)		Khurkot		Bardibas	
	VPD	%	VPD	%	VPD	%	VPD	%
Type of Vehicle								
a) Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment	1,913	21%	744	26%	747	28%	841	11%
b) Car, Jeep, Pickup Van and Tractor	2,404	26%	932	32%	840	31%	905	12%
c) Three-Wheeler Tempo and Motorcycle L	4,952	53%	1,215	42%	1,127	42%	6,033	78%
Total	9,268	100%	2,890	100%	2,714	100%	7,779	100%
d) Target of Toll collection (50% of c)	4,634		1,445		1,357		3,889	
e) Peak traffic volume per hour (10% of d)	463		145		136		389	
e) Number of Lanes	2		2		2		2	

Source: JICA Expert Team

2-5. Toll Plaza Facilities

2-5-1. The Feasibility Study on Other Toll Road

We review the feasibility study conducted by RBN in May 2018 on the fee collection system at Hetauda-Narayanghat.

In the feasibility study toll plaza facilities are as shown in Table 18.

Most of the facilities listed here could not be identified at the toll booth surveyed on 19 May,

2019.

Table18 Facility Considered by Feasibility Study

Facility considered by feasibility study		Evaluation based on field survey
Office building for whole system	Plaza manager's room、 Pantry、 Medical aid's room、 Toilets、 Electric room、 Server room、 Control room、 In charge room Bedrooms for staffs(conditional)	Although it exists, it does not satisfy the working environment of the staff.
Street lights		It exists.
Traffic lights		It does not exist.
Automatic barrier		It does not exist.
Booth	Ticket counter Money collection	It does not exist.
Booth camera		It does not exist.
Lanes		Except for one place, it is one lane.
Lane cameras(show number plate of vehicle)		It does not exist.
Video camera for record axel		It does not exist.
Underground tunnel for system connections		It does not exist.

Source: JICA Expert Team

2-5-2. Review

In the survey of existing toll roads conducted on May 19, 2019, there were hardly any facilities that could meet traffic safety and staff working conditions.

Based on the facility which was examined in feasibility study, the minimum required toll plaza facilities are shown in Table 19.

Also, an arrangement image is shown in Figure8.

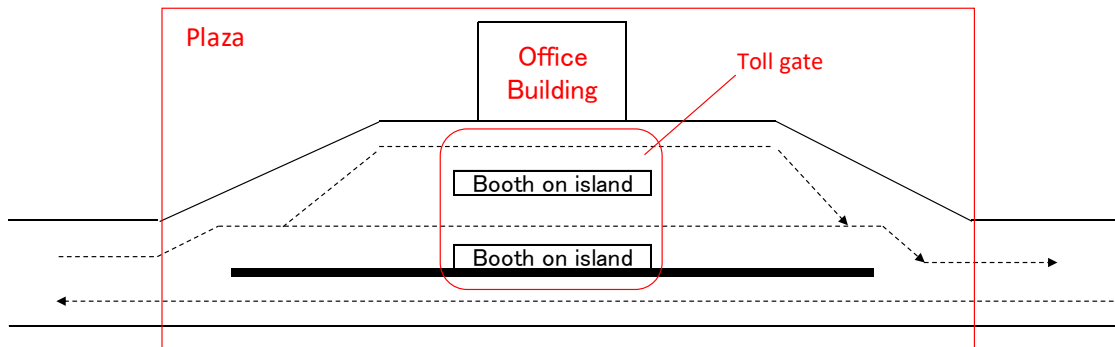


Figure8 The Image of Toll Plaza

Source: JICA Expert Team

Table19 Toll collection facility

Facilities		Description	
Office building	Office space	It is a facility mainly for charge collection management office work and for the staff to take a break.	
	Toilet		
	Lounge		
	AC or fan		
	Power room		
Plaza	Signboard	In order to show that it is a toll plaza, also to show a toll. In addition, it is desirable to set up a signboard at the place before reaching the toll Plaza.	
	Hump or Vibration Line	It is for speed reduction around toll Plaza.	
	Lane mark	It is for ensuring the independence of each lane.	
Toll gate	Island	It is to distinguish the road and the toll booth facility and to install the toll booth facility. It will be a durable reinforced concrete construction.	
		CCTV	Lane surveillance camera is installed on an island to monitor toll collection status and user fraud. Monitoring of the image is performed in the office building.
	Burrier	It is intended to prevent a direct collision of the vehicle to toll booth.	
	Booth	Toll booths are facilities installed on the island for collection workers to perform collection work. It is desirable for the booth to have a size of 1.2 m (W) x 2.4 m (L) x 3.0 m (H), sufficient strength for vehicle collision, and sufficiently fixed to the island.	
			Safe Box
			AC or fan
	Roof	It will be installed to cover the toll booth so that it can be collected without being affected by the weather.	
	Lighting	It is for collecting toll at night.	
Gate bar	It is to prevent the passage of vehicles until driver pays a toll.		

Source: JICA Expert Team

2-6. Toll Collection System



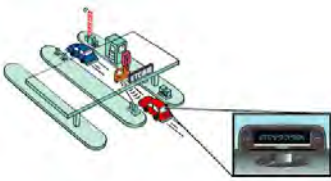
We review the feasibility study conducted by RBN in May 2018 on the fee collection system at Hetauda-Narayanghat.

Toll collection system is as shown in Table 20.

In addition, ETC mainly has the types shown in Table 21.

Of the ETC systems, the DSRC type may be used for other applications. However, the On-Board Unit Cost is expensive. The RFID type is inexpensive for On-Board Unit Cost. However, it cannot be used for other applications.

Table 20 Toll Collection System

manual	semi-automatic	automatic
Collection by staff	Collection by Charge settlement machine	Electronic Toll Collection System (ETC)
		

Source: JICA Expert Team

Table 21 Mainly Types of ETC

		DSRC (Active)	RFID
On-Board Unit (OBU) Type		2 Pieces (OBU + IC Card)	1 Piece
OBU Cost		High (40US\$~)	Low (2US\$~)
Country		Japan、China	India
Merits and Demerits	Merits	<ul style="list-style-type: none"> It is possible to use the IC card for other purposes (shopping etc.) 	<ul style="list-style-type: none"> OBU cost is low
	Demerits	<ul style="list-style-type: none"> OBU cost is high 	<ul style="list-style-type: none"> It is not possible to use the RFID tag for other purposes

Source: JICA Expert Team

2-6-1. Feasibility Study

The feasibility study concludes that it is appropriate to introduce an RFID toll collection system.

2-6-2. Review

The points to be noted in introducing the automatic toll collection system are as follows.

- Domestic standardization of the system

User convenience improves.

- Technology transfer

If ETC vendor's base is in Nepal, appropriate technical support can be received continuously

- Balance between the burden of users and the system to be introduced

In the introduction of the system, there is a burden on the user side, such as installation of on-vehicle equipment. If users find it economically expensive, a policy to improve the penetration rate is necessary.

Considering the small burden on users and compatibility with the neighboring country India, if we pay attention to the domestic standardization and technology transfer of the system, there is no problem in introducing RFID.

2-6-3. The System to be Introduced to Sindhuli Road

At the JCC meeting held on April 25, 2019, it was stated that the introduction of an automatic toll collection system is being considered in the future.

It should initially be manual for the following reasons:

- As the toll road system is introduced for the first time, the spread to the users should be considered.
- The priority should be to establish facilities to satisfy the working environment of staff.

2-7. Road Maintenance Budget

The maintenance budget on Sindhuli Road is divided into the following four.

(1) Routine Maintenance

Routine maintenance is carried out by means of length worker system, whereby one length worker covers a road section of 3 to 5 km. This work consists of cutting grass and bushes, clearing drains, sweeping the road, cleaning road furniture, turf off the embankments etc.

(2) Recurrent Maintenance

Recurrent maintenance is a planned activity such as pothole patching, etc.

(3) Periodic Maintenance

Periodic maintenance is a planned activity comprising mainly of surface resealing and should be carried out at intervals of several years.

(4) Emergency Maintenance

Emergency maintenance is an immediate action to open the blocked road due to landslides, debris flow etc. in order to clean up landslides, debris etc. on the road, heavy equipment such as dozers and graders are often used.

The maintenance budget about Sindhuli Road is as shown in Table 22.

In FY 2018, the periodic maintenance cost for overlay work of pavement accounts for about 60% of the whole.

In order to properly maintain the safety of Sindhuli Road, overlay work of pavement repair with periodical maintenance will be essential, and the budget for the periodic maintenance and management needed for these increasing operations will be required. It will be a key point to maintain the function of Sindhuli Road.

Table22 Maintenance Budget about Sindhuli Road

(Unit:NRs.)

Maintenance Activity	Allocated Budget for FY 2012/2013	Allocated Budget for FY 2013/2014	Allocated Budget for FY 2014/2015	Allocated Budget for FY 2015/2016	Allocated Budget for FY 2016/2017	Allocated Budget for FY 2017/2018	Allocated Budget for FY 2018/2019
Routine Maintenance	8,178,029	8,175,000	10,858,600	12,546,000	14,370,000	14,914,000	18,974,000
Recurrent Maintenance	7,730,000	8,367,000	12,838,000	11,427,000	15,430,000	11,055,000	21,314,000
Periodic Maintenance	22,500,000	0	49,200,000	0	100,000,000		80,000,000
Emergency Maintenance	500,000	10,500,000	0	2,500,000	1,000,000	3,000,000	500,000
Specific Maintenance	4,500,000	9,810,000	10,000,000	6,000,000	10,000,000	15,000,000	10,000,000
Road Traffic Safety	0	0	0	1,000,000	1,000,000	3,000,000	4,000,000
Bridge Maintenance	0	0	0	0	0	0	0
Bio Engineering	0	0	0	500,000	0	0	0
Total	43,408,029	36,852,000	82,896,600	33,973,000	141,800,000	46,969,000	134,788,000

Source:RBN,DOR

2-8. Counterfeit Measures

Since there was no proposal from RBN, we introduce Japan's case.

2-8-1. Overload Vehicles

A person in charge will check for vehicles that may be overloaded near the toll booth and order the driver to remedy the overload.

Since the road maintenance department does not have the police authority, it is generally important to cooperate with the police agency in the crackdown.

The situation of overload confirmation is shown in Figure 8.



Figure8 The situation of Overload confirmation (in Japan)

Source:JICA Expert Team

2-8-2. Unpaid Vehicles

A surveillance camera is used to identify the unpaid vehicle.

If necessary, the road maintenance department will charge additional charges (three times the normal rate) and notify the police agency.

Since the road maintenance department does not have the police authority, it is generally important to cooperate with the police agency in the crackdown.

Chapter3 Proposed the Toll Road System to be Introduced in the Sindhuli Road

3-1. Concept Concerning Toll Road System to Sindhuli Road

The toll road system will be introduced to secure future maintenance costs, especially the pavement repair costs by overlay, and to ensure regular safety and security of user.

However, it does not cover all of the maintenance budget with toll income on current toll roads on the current toll road.

At Sindhuli Road, the periodic maintenance budget for overlay work of pavement accounts for about 60% of the whole in FY2018.

Therefore, at Sindhuli Road, the concept is to secure the periodic maintenance costs with toll road fee.

3-2. Traffic Forecast

Based on the traffic volume of 2017, the future traffic volume after 2019 for each collection point are as shown in Table 23.

The traffic growth rate for each year is 5.9%, which is the GDP growth rate of Nepal.

Since the one-sided collection is assumed at any point, the collected traffic volume is set to half.

Table23 Traffic Forecast

			FY2019/20	FY2023/24	FY2028/29	FY2033/34	FY2038/39
Traffic Forecast (VPY*)	Dhulikhel-Khurkot	Dhulikhel	3,794	4,771	6,355	8,465	11,274
		Khurkot (Ramtar)	1,183	1,488	1,982	2,640	3,516
	Khurkot-Bardibas	Khurkot	1,111	1,397	1,861	2,479	3,302
		Bardibas	3,007	3,782	5,037	6,709	9,463
	Total		9,095	11,438	15,235	20,292	27,555
Target of Toll collection (Half of Traffic Forecast (VPY*))	Dhulikhel-Khurkot	Dhulikhel	1,897	2,386	3,178	4,232	5,637
		Khurkot (Ramtar)	591	744	991	1,320	1,758
	Khurkot-Bardibas	Khurkot	555	699	931	1,239	1,651
		Bardibas	1,503	1,891	2,519	3,354	4,732
	Total		4,547	5,719	7,618	10,146	13,777

* 1 unit is 1,000 VPY (VPY=ADT x 365 days)

Source:JICA Expert Team

3-3. Cost Forecast

3-3-1. Maintenance Cost Forecast

Future maintenance costs are as shown in Table 24.

With regard to the Periodic Maintenance cost, from the first year to the tenth year, the costs necessary for the implementation of 140 km excluding the construction section will be considered. In addition, it will be the cost necessary for the implementation of 80km, which is half of the total extension, in the 11th to 20th years. The total periodic maintenance cost for 20 years is about 60%

of the total maintenance cost.

The other costs were adopted from the 2018 RBN approved budget, and the annual growth rate was 5.9%, which is the GDP growth rate of Nepal.

Table24 Maintenance Cost Forecast

(unit : NRs. million)

	Allocated Budget for (FY)	Routine Maintenance	Recurrent Maintenance	Periodic Maintenance	Emergency Maintenance	Specific Maintenance	Road Traffic Safety etc.	Total
1	2019 / 2020	20.1	22.6	140.0	0.5	10.6	4.2	198.0
2	2020 / 2021	21.3	23.9	148.3	0.6	11.2	4.5	209.7
3	2021 / 2022	22.5	25.3	157.0	0.6	11.9	4.8	222.1
4	2022 / 2023	23.9	26.8	166.3	0.6	12.6	5.0	235.2
5	2023 / 2024	25.3	28.4	176.1	0.7	13.3	5.3	249.1
6	2024 / 2025	26.8	30.1	186.5	0.7	14.1	5.6	263.7
7	2025 / 2026	28.3	31.8	197.5	0.7	14.9	6.0	279.3
8	2026 / 2027	30.0	33.7	209.1	0.8	15.8	6.3	295.8
9	2027 / 2028	31.8	35.7	221.5	0.8	16.8	6.7	313.2
10	2028 / 2029	33.7	37.8	234.5	0.9	17.7	7.1	331.7
11	2029 / 2030	35.6	40.0	244.2	0.9	18.8	7.5	351.0
12	2030 / 2031	37.7	42.4	254.5	1.0	19.9	8.0	371.5
13	2031 / 2032	40.0	44.9	265.3	1.1	21.1	8.4	393.7
14	2032 / 2033	42.3	47.6	276.5	1.1	22.3	8.9	417.6
15	2033 / 2034	44.8	50.4	288.2	1.2	23.6	9.5	443.7
16	2034 / 2035	47.5	53.3	300.4	1.3	25.0	10.0	471.2
17	2035 / 2036	50.3	56.5	313.2	1.3	26.5	10.6	500.3
18	2036 / 2037	53.2	59.8	326.5	1.4	28.1	11.2	531.2
19	2037 / 2038	56.4	63.3	340.4	1.5	29.7	11.9	564.3
20	2038 / 2039	59.7	67.1	354.8	1.6	31.5	12.6	605.7
Total		731.3	821.4	3,465.8	19.3	385.4	154.2	5,577.3

Source:JICA Expert Team

3-3-2. Toll Collection Expense Forecast

The compensation paid by the RBN to the toll collection company is a fixed amount.

Here, it is assumed that it is 30% of annual toll revenue, including toll collection facility maintenance costs and maintenance costs.

3-4. Preconditions of Case Study for Introduction of Toll System

As stated in 2-1 and 2-2, the toll collection section and the charge have been decided. In addition, as stated in 3-2 and 3-3, there is only one case for traffic volume forecast and cost forecast.

Therefore, in the case study, the following two cases are set in consideration of the current situation where almost no charge is collected from motorcycles.

(1) Case1

In this case, all vehicles are charged.

(2) Case2

In this case, no charge will be collected from the local residents based on the fact that almost no charge has been collected from the motorcycle.

3-5. Financial Analysis

Financial analysis is carried out based on the following preconditions.

(1) The financial analysis period is 20 years.

(2) Traffic increase rate; annual increase rate (5.9%*) is applied.

(3) Increasing annual maintenance cost; annual increase rate (5.9%*) is applied.

(4) Toll rate by type of vehicles; the tolls are publicized on April 15, 2019 in Sindhuli Road, and the system is as shown in Table 4. Annual increase rate (5.9%*) is applied.

*According to GDP growth rate at 2018/2019 by World Bank

The said above precondition are summarized in Table 25.

Table 25 Summary of Precondition for Case Study

Precondition	Case-1	Case-2
1) Analysis Period	20 years	
2) Toll Road section	2 section(DhulikheI-Khurkot,Khurkot-Bardibas)	
3) Traffic Volume Forecast	Increase rate 5.9% per annum based on the current traffic volume	
4) Maintenance Cost Forecast	<ul style="list-style-type: none"> • Periodic Maintenance cost Increase rate 5.9% per annum based on overlay pavement construction cost required in 20 years • The other costs Increase rate 5.9% per annum based on the allocated budget 	
5) Toll Rate by Type of Vehicles	The rate determined in the official gazette <ul style="list-style-type: none"> • DhulikheI-Khurkot : Truck125NRs,Car50NRs.,Motorcycle15NRs. • Khurkot-Bardibas : Truck115NRs,Car45NRs.,Motorcycle15NRs. 	
6) Targeted Vehicles	All Vehicles	All Vehicles except local user

Source:JICA Expert Team

Financial analysis sheets by case are shown in Table 26 to Table 27.

In Case 1, the ratio of toll income to maintenance costs for the entire 20 years is 74.8%.

As stated in 3-3-1, the periodic maintenance cost is 60% of the maintenance cost, so it is possible to secure the periodic maintenance cost.

In Case 2, the ratio of toll income to maintenance costs for the entire 20 years is 57.8%.

As stated in 3-3-1, the periodic maintenance cost is 60% of the maintenance cost, so it is impossible to secure the periodic maintenance cost.

Therefore, only Case 1 meets the concept described in 3-1. It is appropriate to adopt Case 1. In addition, toll road fee is appropriate because future maintenance costs, especially overlay pavement maintenance costs, can be secured by toll revenue.

Table 26 Balance Difference(Case1)

Year	(A) Required Maintenance Cost (NRs.million) based on Allocation Budget	(A) 60% of (A)	(B) Toll Fee after Reduction of Operation Cost (NRs.million)	(C) Available Funding after VAT Reduction (NRs.million)	(D) Shortage /Surplus of Maintenance Cost (NRs. million) (C-A)	(E) Toll Fee Share of Maintenance Cost (C/A)	
1	2019	198.0	118.8	134.7	117.2	-1.7	59.2%
2	2020	209.7	125.8	142.6	124.1	-1.8	59.2%
3	2021	222.1	133.2	151.0	131.4	-1.9	59.2%
4	2022	235.2	141.1	159.9	139.1	-2.0	59.2%
5	2023	249.1	149.4	169.4	147.3	-2.1	59.2%
6	2024	263.7	158.2	179.4	156.0	-2.2	59.2%
7	2025	279.3	167.6	189.9	165.2	-2.3	59.2%
8	2026	295.8	177.5	201.1	175.0	-2.5	59.2%
9	2027	313.2	187.9	213.0	185.3	-2.6	59.2%
10	2028	331.7	199.0	225.6	196.3	-2.8	59.2%
11	2029	351.3	210.8	238.9	207.8	-2.9	59.2%
12	2030	240.5	144.3	253.0	220.1	75.8	91.5%
13	2031	254.7	152.8	267.9	233.1	80.3	91.5%
14	2032	269.7	161.8	283.7	246.8	85.0	91.5%
15	2033	285.6	171.4	300.5	261.4	90.0	91.5%
16	2034	302.5	181.5	318.2	276.8	95.3	91.5%
17	2035	320.3	192.2	337.0	293.1	100.9	91.5%
18	2036	339.2	203.5	356.8	310.4	106.9	91.5%
19	2037	359.3	215.6	377.9	328.8	113.2	91.5%
20	2038	380.5	228.3	400.2	348.2	119.9	91.5%
Total		5701.5	3420.9	4900.6	4263.5	842.6	74.8%

Source: JICA Expert Team

Table 27 Balance Difference(Case2)

	(A)	(A)'	(B)	(C)	(D)	(E)	
Year	Maintenance Cost Forecast (NRs.million)	60% of Maintenance Cost Forecast	Toll Fee after Reduction of Operation Cost (NRs.million)	Available Funding after VAT Reduction (NRs.million)	Shortage /Surplus of 60% of Maintenance Cost Forecast (NRs. million) (C-A)	Toll Fee Share of Maintenance Cost (C/A)	
1	2019	198.0	118.8	104.1	90.6	-28.2	45.8%
2	2020	209.7	125.8	110.3	96.0	-29.9	45.8%
3	2021	222.1	133.2	116.8	101.6	-31.6	45.8%
4	2022	235.2	141.1	123.7	107.6	-33.5	45.8%
5	2023	249.1	149.4	131.0	114.0	-35.5	45.8%
6	2024	263.7	158.2	138.7	120.7	-37.6	45.8%
7	2025	279.3	167.6	146.9	127.8	-39.8	45.8%
8	2026	295.8	177.5	155.6	135.3	-42.1	45.8%
9	2027	313.2	187.9	164.7	143.3	-44.6	45.8%
10	2028	331.7	199.0	174.5	151.8	-47.3	45.8%
11	2029	227.1	136.3	184.8	160.7	24.5	70.8%
12	2030	240.5	144.3	195.7	170.2	25.9	70.8%
13	2031	254.7	152.8	207.2	180.3	27.4	70.8%
14	2032	269.7	161.8	219.4	190.9	29.1	70.8%
15	2033	285.6	171.4	232.4	202.2	30.8	70.8%
16	2034	302.5	181.5	246.1	214.1	32.6	70.8%
17	2035	320.3	192.2	260.6	226.7	34.5	70.8%
18	2036	339.2	203.5	276.0	240.1	36.6	70.8%
19	2037	359.3	215.6	292.3	254.3	38.7	70.8%
20	2038	380.5	228.3	309.5	269.3	41.0	70.8%
Total	5577.3	3346.4	3790.1	3297.4	-49.0	59.1%	

Source: JICA Expert Team

3-6. Division of Roles Between RBN and DOR

Based on the discussion between RBN and DOR, the division of roles between RBN and DOR is as shown in Table 28.

Table28 The Division of Roles Between RBN and DOR

RBN	DOR
<ul style="list-style-type: none"> • Study of toll road system • Procurement of contractor for toll collection • Budget allocation for maintenance cost • Construction of toll plaza including land acquisition • Maintenance of toll plaza 	<ul style="list-style-type: none"> • Advice on construction of toll plaza including land acquisition • Advice on maintenance of toll plaza

Source: RBN and DOR

3-7. Implementation Plan (Tentative)

Based on the discussion between RBN and DOR, the schedule is as shown in Table 29.

The toll road system will be introduced after the Acquisition of toll place, Toll booth design, Toll booth construction, Selection of toll collection company, Toll collection system construction by the contractor.

The period until the introduction is assumed to be approximately 2 years.

Table29 Schedule of toll road system introduction

	month																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Select the toll collection place	█	█	█																						
Toll booth design	█	█	█	█	█																				
Toll booth construction						█	█	█	█	█	█	█	█	█	█	█	█	█	█	█					
Selection of toll collection company																	█	█	█						
Toll collection system construction by contractor																				█	█	█	█	█	█
Toll road system start																									█

Source: RBN and DOR

Chapter4 Conclusion and Recommendation

4-1. Conclusion

Based on the historical background, socio-economic conditions of the roadside, and traffic characteristics, we will review the introduction of the toll road system in Sindhuli Road that RBN is trying to introduce. The results are as follows.

(1) Usage Range of Toll Road Fee

As a result of financial analysis, it turned out that it is impossible to cover all maintenance costs with toll road fee. However, considering the balance with other toll roads fee and the income of users, it is not appropriate to raise the toll road fee. Therefore, it is desirable that usage range of toll road fee in the Sindhuli Road covers only the periodic maintenance cost (about 60% of the maintenance cost) and the shortfall is covered by levy.

(2) Toll Road Fee

Under the conditions described in (1), Toll Road Fee is appropriate because future maintenance costs, especially overlay pavement maintenance costs, can be secured by toll revenue.

However, it is required to clarify the rules for toll collection from nearby residents and motorcycle users who rarely pay the toll at present.

Furthermore, for users using two sections, it is desirable to simplify the payment at the toll plaza, such as the introduction of a coupon system, in order to eliminate resistance to being billed twice.

(3) Toll Collection Section

As analyzed in Chapter 2, it is appropriate to divide the section into two sections, Dhulikhel-Khurkot and Khurkot-Bardibas because it was divided almost at the center of Sindhuli Road, and there is a similar case for other toll roads in Nepal about the distance of each section.

(4) Toll Collection System

As analyzed in Chapter 2, manual charge collection is desirable for the time being.

On the other hand, when the automatic toll collection system considered on other routes has spread, it is desirable to prepare for the introduction of an automatic toll collection system in Sindhuli Road.

(5) Improvement of Toll Plaza Facilities

The working environment of the collection staff at the existing toll plaza is poor. It is necessary to greatly improve the toll plaza facilities to ensure the working environment of the collection staff, such as establishment of the toll booth and rest space.

In addition, although there is a problem of securing financial resources and sharing of responsibility with DOR, in order to ensure the safety of road users, it should aim to install simple facilities such as public toilets near the toll plaza.

(6) Improvement of Toll Collection Method

The major problem with the current toll road system is that the tolls corresponding to the traffic volume are not collected. The main causes may be ambiguous rules about toll collection, missed collection, fraud, and lack of enforcement measures.

It is necessary to improve the toll collection method, such as clarifying the toll collection rules, installing a gate bar, installing a camera, and ensuring cooperation with the police.

4-2. Recommendation

In addition to the conclusions stated in 4-1, the following points are recommended.

(1) Examination of the Toll Road System Introduction Postponement to Sindhuli Road

Since Sindhuli Road is an important arterial road that forms part of Mid Hill Highway, the project of widening to two-lane road is planned over the whole line. This plan may be implemented in the near future.

When construction is started, it is assumed that there will be traffic regulation implementation and road condition deterioration for a long time. If the toll road system is introduced along with such a situation, it is doubtful whether road users and local residents accept it without problem. Therefore, as an alternative opinion, it would be better to induce the toll road system to Sindhuli Road may be performed after completion of the widening project.

Although it may be difficult because it has already announced the introduction of the toll road system by gazette, it is recommended to consider postponing introducing the toll road system on Sindhuli Road.

(2) Improvement of the Toll Road System

Toll revenue is only 0.5% of RBN's total resources in FY2017. Furthermore, compared to the toll revenue if the toll is reliably collected based on the traffic volume, the actual toll revenue ratio is less than 30%. This indicates how inefficient the current toll road system is.

Therefore, it is recommended to reconsider the toll road system itself.

Appendix

Introduce Japan's case for the toll road toll system.



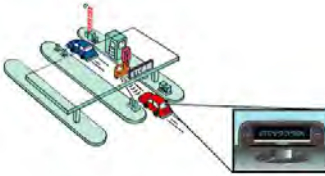
1 Toll collection system

Toll collection system is as shown in Table 30.

In addition, ETC mainly has the types shown in Table 31.

Of the ETC systems, the DSRC type may be used for other applications. However, the On-Board Unit Cost is expensive. The RFID type is inexpensive for On-Board Unit Cost. However, it cannot be used for other applications.

Table 30 Toll collection system

manual	semi-automatic	automatic
Collection by staff	Collection by Charge settlement machine	Electronic Toll Collection System (ETC)
		

Source: JICA Expert Team

Table 31 Mainly types of ETC

		DSRC (Active)	RFID
On-Board Unit (OBU) Type		2 Pieces (OBU + IC Card)	1 Piece
OBU Cost		High (40US\$~)	Low (2US\$~)
Country		Japan、China	India
Merits and Demerits	Merits	<ul style="list-style-type: none"> It is possible to use the IC card for other purposes (shopping etc.) 	<ul style="list-style-type: none"> OBU cost is low
	Demerits	<ul style="list-style-type: none"> OBU cost is high 	<ul style="list-style-type: none"> It is not possible to use the RFID tag for other purposes

Source: JICA Expert Team

2 Counterfeit measures

2-1. Overload vehicles

A person in charge will check for vehicles that may be overloaded near the toll booth and order the driver to remedy the overload.

Since the road maintenance department does not have the police authority, it is generally important to cooperate with the police agency in the crackdown.

The situation of overload confirmation is shown in Figure 8.



Figure9 The situation of Overload confirmation (in Japan)

Source:JICA Expert Team

2-2. Unpaid vehicles

A surveillance camera is used to identify the unpaid vehicle.

If necessary, the road maintenance department will charge additional charges (three times the normal rate) and notify the police agency.

Since the road maintenance department does not have the police authority, it is generally important to cooperate with the police agency in the crackdown.

**The Project for
Operation and Maintenance of
The Sindhuli Road Phase 2**

Technical Report

On

**Major Improvement Items
Required for Overlay Pavement**

July 2019

JICA Expert Team

- Table of Contents -

- 1	Current Pavement Situations of the Sindhuli Road	1
1.1	Pavement of the Sindhuli Road.....	1
1.2	General Observation of Current Pavement Conditions of Each Section	3
1.3	Current Pavement Improvement Plan by DOR for Sec. IV	5
- 2	Damages and Repair Method for DBST Pavement	10
2.1	Basic Understandings	10
2.2	Major Surface Treatment Methods for Damaged DBST	11
2.3	General Criteria for DBST Treatment.....	13
2.4	Damage and Repair Method of DBST Pavement	16
2.5	Damage and Repair of Granular Layers and Subgrade	19
- 3	Consideration of Asphalt Overlay Design	20
3.1	Pavement Material	20
3.2	Proposal of Overlay Pavement Type in Sindhuli Road	25
- 4	Solutions and Proposals Related to Overlay Work of Sindhuli Road	30
4.1	Preparation of Appropriate Documents.....	30
4.2	Site Inspection Before the Start of Work	30
4.3	Inspection Related to Quality Control During Construction	30
4.4	Necessity and Method of Inspection After Completion of Construction.....	33
4.5	Other Suggestions.....	33
- 5	Recommendations for Further Road Pavement Maintenance.....	35

1 Current Pavement Situations of the Sindhuli Road

1.1 Pavement of the Sindhuli Road

1.1.1 Outline of the Sindhuli Road

The Sindhuli Road was constructed under Japan's grant aid as a trunk road (National Highway No.6) connecting the southern Terai Plain and Kathmandu, the capital city of Nepal as shown in the location map (Figure 1.1) and the whole section from Dhulikhel to Bardibas of about 160 km was opened in March 2015. The overall alignment from Bardibas to Dhulikhel is divided in four sections.



Figure 1.1 Location map

1.1.2 Pavement Type of the Sindhuli Road

The Sindhuli road is a mountainous road that passes through steep terrain with an altitude difference of 1,000 m and huge construction costs had been expected for its construction. From this background, a simple pavement called DBST has been adopted instead of asphalt concrete pavement to reduce the initial cost and provide regular maintenance after the construction. The typical pavement structure of the Sindhuli Road is shown in the figure below. It comprises of a double bituminous surface treatment over 150 mm thick granular base course. The subbase layer is 150 mm thick over the subgrade.



DBST structure applied in the Sindhuli Road

Asphalt Concrete Pavement

Figure 1.2 Pavement Type

Table 1.1 Definitions of DBST Pavement Components

DBST	Double bituminous surface treatment is a term describing a common type of pavement construction which involves two applications of bituminous binder material and mineral aggregate placed on a prepared surface. Its main function is to provide an all-weather, water-resistant, skid-resistant wearing surface. DBST is not a structural unit of pavement.
Prime Coat	Prime coat is a thin layer of low viscosity bituminous binder applied to an absorbent non-bituminous surface. It provides proper bonding between base course and surface course, bind the loose materials and also prevents water to percolate underneath.
Base course	Base course is the layer of granular material immediately beneath the surface course, it facilitates additional load distribution.
Subbase course	Sub-base course is the layer of material beneath the base course and the primary function is to provide structural support.
Subgrade	Sub grade is layer of natural soil prepared to receive the stresses from the layers above.

Apart from typical DBST section, the Sindhuli road has hairpin curved sections which was constructed with concrete pavement and asphalt concrete pavement.



Concrete Pavement



Asphalt Concrete Pavement

Figure 1.3 Concrete and Asphalt Concrete Pavements

1.1.3 Pavement Construction Year by Section

The Sec.I of the Sindhuli Road stretches from Bardibas to Sindhuli Bazar with length 37 km. The DBST construction period of this section was from 2009 to 2015. The Sec.II begins at Sindhuli Bazar and ends at Khurkot. The DBST construction of this 36 km long section was done from 2006 to 2011. The Sec.III which extends from Khurkot to Nepalthok is 37 km long and DBST was constructed from 2014 to 2015. The Sec.IV is the longest section from Nepalthok to Dhulikhel whose DBST construction period was from 2003 to 2006.

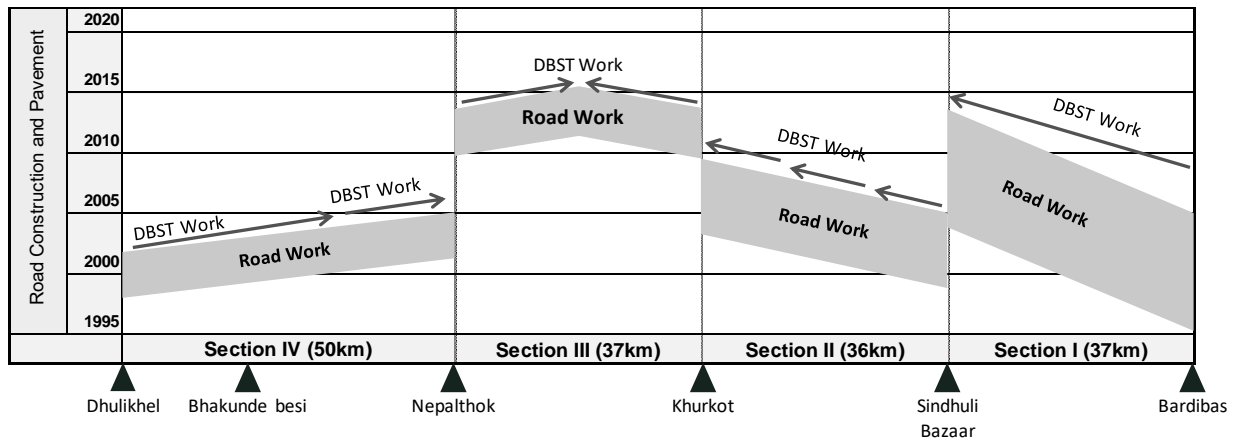


Figure 1.4 Construction history of DBST pavement in Sindhuli Road

1.2 General Observation of Current Pavement Conditions of Each Section

1.2.1 Sec.I (Bardibas – Sindhuli Bazar: 37km)

It has been 4 to 10 years since the construction of DBST. Maintenance is well done mainly to repair the pothole. The DBST condition was good.



Figure 1.5 Pavement Conditions in Sec.I

1.2.2 Section II (Sindhuli Bazar – Khurkot: 38km)

It has been 8 to 13 years since the construction of DBST. Maintenance is well done mainly to repair the pothole. However, peeling of DBST was observed in the steep gradient part.



Good condition of DBST



Patching work done on DBST

Figure 1.6 Pavement Conditions in Sec.II

1.2.3 Sec.III (Khurkot – Nepalthok:37km)

It has been 4 to 5 years since the construction of DBST. The DBST of Sec.III is in better condition than in other sections. The pavement performance can be maintained with regular and proper repair of existing DBST. However, rutting was observed in the asphalt pavement in the hairpin curve section.



Fair Condition of DBST



Peeled Surface at Road Center



Rutting on Asphalt Concrete at Hairpin Curve at Mulkot

Figure 1.7 Pavement Conditions in Sec.III

1.2.4 Sec.IV (Nepalthok – Dhulikhel: 50km)

It has been 13 to 16 years since the construction of DBST. Due to the deterioration of DBST and increasing traffic volume, various damages such as pot holes, alligator cracks, linear cracks and rutting are observed in various places. Thus, proper maintenance is required. In this section where the asphalt overlay construction was done about one year ago, damage has already occurred in few portions which needs to be repaired.



Alligator Crack on DBST



Pothole on Asphalt Overlay



Rutting on Asphalt Overlay

Figure 1.8 Pavement Conditions in Sec.IV

1.3 Current Pavement Improvement Plan by DOR for Sec. IV

As mentioned above, the Sindhuli Road has been made as a simple pavement in DBST. For an appropriate maintenance plan, a long-term perspective is necessary. It has been over ten years since the DBST construction of Sec IV and the rapid increase in traffic and the damage is noticeable.

DOR has planned mainly Overlay works as a Periodic Maintenance for the repair.

1.3.1 Outline of the Contracts

The following is outline of the periodic maintenance construction contracts of Sec.IV as of the 1st week of July 2019.

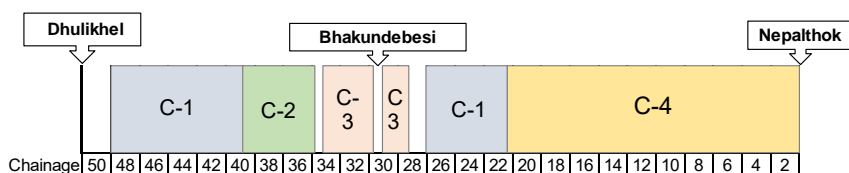
- (1) The 1st contract was awarded in year 2017. It is divided into 9 km (Ch.48+000 - Ch.39+000) and 5.75km (Ch.26+150 – Ch.20+400) section. The 9km section is asphalt overlay work and the 5.75 km section is SBST work.
- (2) The 2nd contract was signed in May 2019. It is a 4.75km (Ch.39+000 - Ch.34+250) section. The scope of the 2nd contract is: scarify the existing DBST, scarifying and mixing

existing road base material and the new road base material and laying the asphalt overlay of 6 cm thick. Currently scarification and overlay on remaining portion of the 1st contract has been completed as a part of the 2nd contract.

- (3) For the 3rd contract, the tender process has been finalized. The construction section is divided into a 3.97 km (Ch.33+625 - Ch.29+654) section and 1 km (Ch.29+070 – Ch.28+041) section. The scope of this contract is scarifying the entire DBST pavement, in about 3km length, there will be replacement of the existing road base. The bituminous binder course of 60 mm and asphalt wearing course of 50 mm will be done as overlay.
- (4) The 4th contract was signed in May 2019. Construction section is 20.4km (Ch.20+400 - Ch.0+000). The outline of the construction is to lay the SBST after the base repair. Currently existing DBST is being repaired.
- (5) Near Dhulikhel and Bhakundebesi, asphalt overlay work was done in 2017. The vicinity of Dhulikhel is 2km (Ch.50+000 - Ch.48+000) and the vicinity of Bhakundebesi is about 0.6km (Ch.29+650 - Ch.29+070). The thickness of overlay work was 40 mm.

The above mentioned contracts are summarised in the Table 1.2 below.

Table 1.2 Periodic Maintenance Situation of Sec.IV



Contract	Chainage		Length m	Lane No.	Surface Type	Progress (As of July 2019)	Remarks
	From	To					
-	50+000	48+000	2,000	2+2	Overlay T=40mm	Completed	Widen Section near Dhulikhel
Contract 1	48+000	39+000	9,000	1.5	Overlay T=40mm	Completed	
Contract 2	39+000	34+250	4,750	1.5	Overlay T=60mm	On going	
-	34+250	33+625	625	1.5	-	Planning	
Contract 3	33+625	29+654	3,971	1.5	Overlay T=110mm	Selection of Contractor	
-	29+654	29+070	584	2+2	Overlay T=40mm	Completed	Widen Section near Bhakundebeshi
Contract 3	29+070	28+041	1,029	1.5	Overlay T=110mm	Selection of Contractor	
-	28+041	26+150	1,891	1.5	-	Planning	
Contract 1	26+150	20+400	5,750	1.5	SBST	On going	
Contract 4	20+400	0+000	20,400	1.5	SBST (Partially Concrete)	On going	
TOTAL			50,000	*Overlay thickness is based on breakdown of the cost estimate			

1.3.2 Findings in the Contract Documents

- (1) Estimated quantity in the BOQ is not accurate. For example, it does not contain the quantity that covers the actual road length required. Existing DBST treatment techniques to be performed before overlay work and the construction quantity is not accurately indicated.
- (2) The minimum thickness of overlay is not mentioned in the contract document and the quantity unit is only in cubic meter. Therefore, there is risk that pavement thickness could be changed according to convenience of the contractor and required design thickness is not maintained.

1.3.3 Findings in the Site Work Situations

- (1) There was no traffic control and safety measure taken by contractor which is a dangerous case for road users and even more during night.
- (2) The overlay has been done without repairing side drain which will hamper the life of the pavement
- (3) In Ch.48+000 - Ch.39+000, 9km section of the 1st contract and near Dhulikhel and Bhakundebeshi section, damages like cracks, ruts and potholes have already occurred in various portions.



Figure 1.9 Site works with no traffic/safety control



Damage of Side Drain



Unrepaired Side Drain After Overlay

Figure 1.10 Damage of Side drain



Rutting on Overlay



Rutting on Overlay



Alligator Crack Near Dhulikhel



Alligator Crack Near Dhulikhel



Pot Hole Near Bhakundebsi



Alligator Crack Near Bhakundebsi

Figure 1.11 Damages on New Asphalt Overlay Pavement

1.3.4 Mechanism of Cracking Occurring in the Overlay Section

The cause of the damage occurring on the surface of the overlay is due to reflection cracks. The cause of this reflection crack is construction of asphalt overlay without removing or repairing underlying damaged DBST surface. The alligator cracks in the existing DBST appear due to loss of interlock between crushed stone. The cracks propagate from the lower part of the overlay toward the upper part. The cracking mechanism of asphalt overlay is illustrated in Fig 1.12

For the countermeasure, it is necessary to properly assess the damage of DBST. The method of judging is explained in Item 2.3 General Criteria of DBST repair.

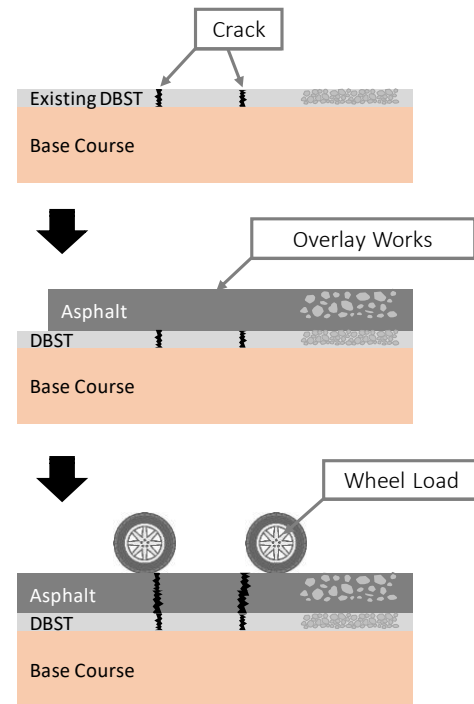


Figure 1.12 Cracking Mechanism of Asphalt Overlay

2 Damages and Repair Method for DBST Pavement

2.1 Basic Understandings

2.1.1 Service Life of Pavement

The DBST pavement requires a functional recovery plan that can maintain its long-term service function because it is a simple pavement and life is short. It is necessary to do regular and periodic maintenance of the components of the pavements to maintain its desired function. If left until the loss of function, large-scale repair work is required and the cost increases. In the figure 2.1, the red curve 'A' shows the deterioration of the DBST performance as the time progresses, the repair cost at the end of curve 'A' is very high. The blue curve 'B' shows the restoration of pavement after maintenance in a short regular interval and although periodic spending of cost is needed, but it is quite less than the cost for the full restoration without maintenance.

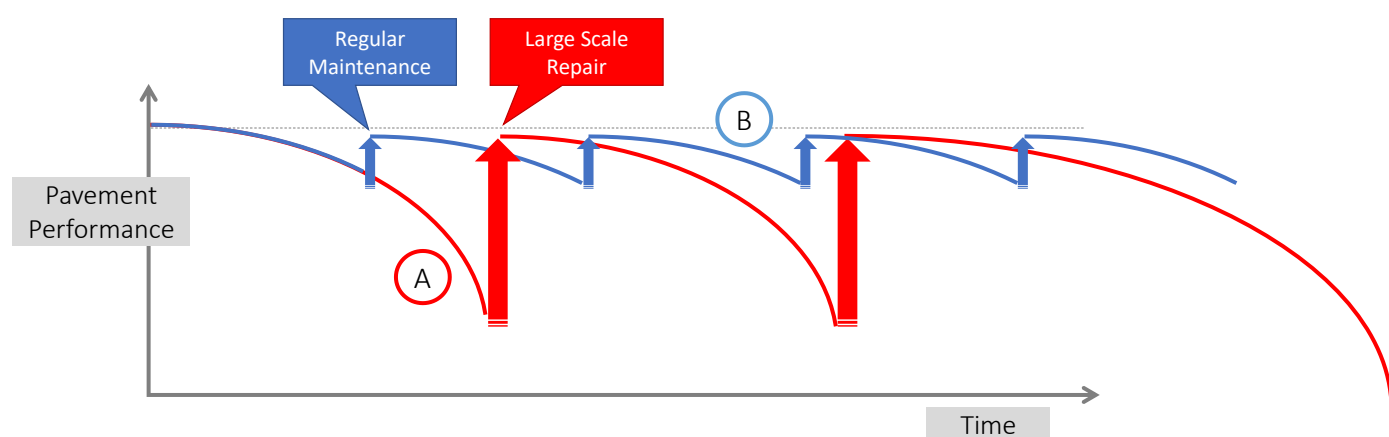
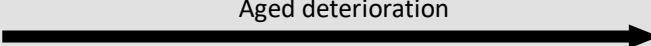



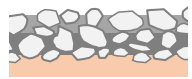
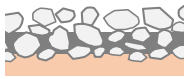
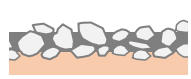


Figure 2.1 Deterioration of DBST with Time and Comparative Costs for Its Regular or Full Repair

2.1.2 Progressive Damage in DBST Pavement

The life of DBST is short and it undergoes progressive deterioration. The stages of damages are illustrated in the Table 2.1.

Table 2.1 Progressive Damage in DBST Pavement

Damaging stage of DBST surface	1	2	3
	Aged deterioration 		
Photo			
Surface situations	Good Condition	First layer bitumen worn out	First layer worn out (Left side half)
Necessary treatment	Regular observations of surface conditions	Fill with bitumen (Spray slurry seal)	Restore the original state by reconstruction of SBST
			

2.2 Major Surface Treatment Methods for Damaged DBST

For repair of damaged DBST, the typical methods are described below:

(1) Single Bituminous Surface Treatment (SBST)

SBST is used when the first layer of the existing DBST is peeled off or to improve the durability of existing DBST. SBST is suitable only for maintenance works and not applicable for new construction. The primary purpose is to seal the surface and/or provide an improved riding surface and skid resistance. The appropriate amount of emulsion spray rate is 80~100 liter per 100m², size of the aggregate used is 2.5mm~5mm and spray rate is 500 liter per 100m² depending on existing surface condition.

(2) Double Bituminous Surface Treatment (DBST)

DBST is used when the existing both layers are peeled off or DBST pavement is to be reconstructed due to severe damage. DBST differ from the single version in a way that two applications of bitumen and cover aggregate are made. The first application of bitumen is usually less than that would be used for the same cover stone in a single surface treatment. They are slightly thicker and considerably more durable than single bituminous surface treatments.




The appropriate 1st layer of the amount of emulsion spray rate is 80~100 liter per 100m², size of the aggregate used is 5mm~13mm and spray rate is 1000 liter per 100m².

2nd layer of the amount of emulsion spray rate is 120~140 liter per 100m², size of the aggregate used is 2.5mm~5mm and spray rate is 600 liter per 100m².

(3) Slurry Seal

Slurry seal is done to prevent the scattering of surface chips by loss of bitumen. Slurry seal material consists of a well graded sand, water, quick-set emulsified bitumen and, in some cases, a setting agent. Proportion of aggregate, water, and bitumen must be very carefully done to provide the desired result. Slurry provides a thin, gritty surface layer that is reasonably effective in resisting wear and in sealing cracks. Slurry is prepared by mixing fine aggregate, filler, bitumen emulsion (MK2 or MK3) and water. It is spread as a thin layer (approximately 3 to 5mm thick) over existing pavement. Rate of application is 430kg ~ 650kg per 100m².

Table 2.2 Types of Surface Treatment

	Single Bituminous Surface Treatment (SBST)	Double Bituminous Surface Treatment (DBST)	Slurry Seal
Image			
Rate of application	-	-	430KG - 650KG per 100m ²
Type asphalt emulsion	PK-1, PK-2, PKRS-1, PKRS-2	PK-1, PK-2, PKRS-1, PKRS-2	MK2, MK3
Rate of application for emulsion	80 - 100L per 100m ²	1st layer 80 - 100L per 100m ² 2nd layer 120 - 140L per 100m ²	-
Rate of application for Aggregate	500L per 100m ²	1st layer 1000L per 100m ² 2nd layer 600L per 100m ²	-

2.3 General Criteria for DBST Treatment

In Sindhuli Road, it is important to apply one of the surface treatment method as described above depending upon the extent of damage. The treatment method depends on following types of cracks.

- (1) Crack width less than 2mm
- (2) Crack width 2mm to 7mm
- (3) Crack width greater than 7 mm
- (4) Peeled DBST Surface

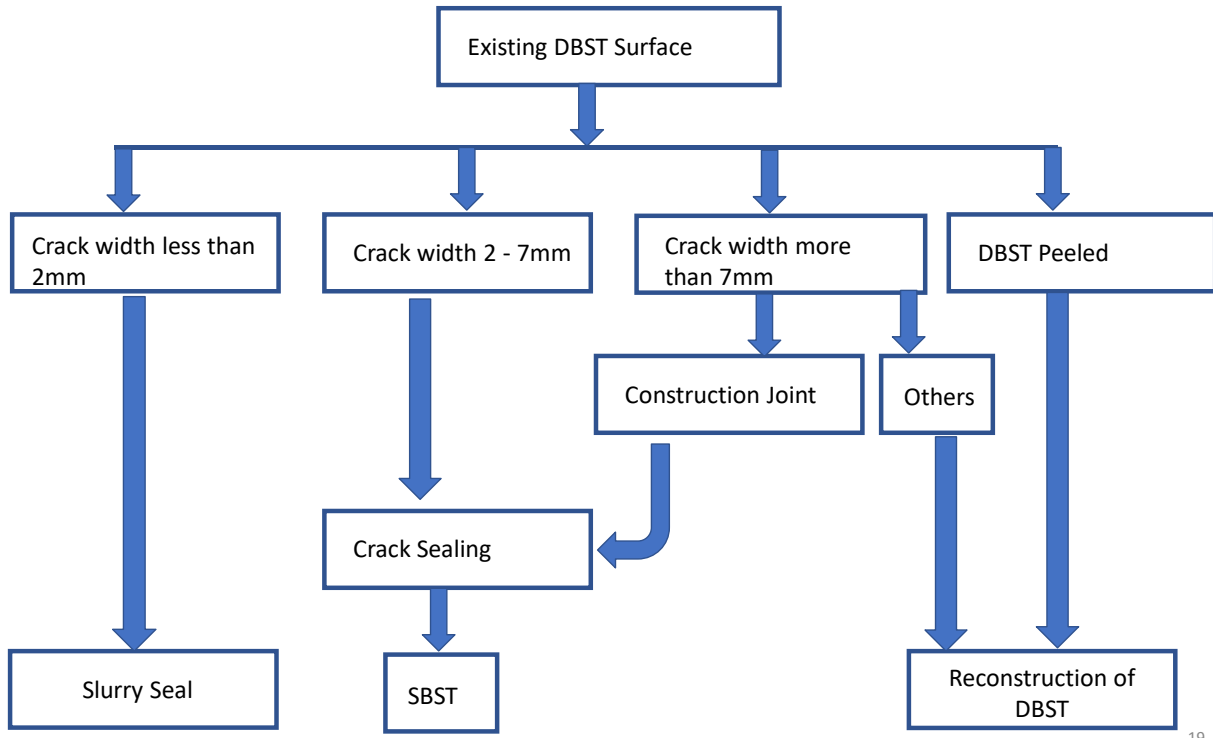


Figure 2.2 General Criteria for DBST Treatment

(1) Crack width less than 2mm

Cracks of width less than 2mm are minor and can be sealed by direct slurry seal.



Minor Cracks on DBST



After Applying Slurry Seal

Figure 2.3 Crack width less than 2mm

(2) Crack width 2 to 7mm

For Cracks with width 2 to 7 mm, first of all, the bitumen is penetrated into the cracks. Then the single bituminous surface treatment is laid and compacted. The important thing is to properly penetrate the bitumen into the crack before doing the SBST.



Cracks with 2 to 7 mm width



Image of Bitumen Penetration on Cracks

Figure 2.4 Crack width 2 to 7mm

(3) Crack width greater than 7 mm

If the crack width is more than 7 mm, the portion should be removed because the damage is severe and SBST method is not sufficient. In case of such cracks in construction joint, bitumen should be penetrated in the crack portion. If the cracks advance to alligator pattern, DBST will be no longer works as a functional surface, then it should be removed and reconstructed.



Cracks more than 7 mm wide



Advanced Alligator Cracks

Figure 2.5 Crack width greater than 7 mm

(4) Peeled DBST Surface

If there is peeling of DBST surface, for repair the surface should be dry and proper cleaning should be done. Then the reconstruction of DBST should be done.



Close View of Peeled DBST



Total View of Peeled DBST

Figure 2.6 Peeled DBST Surface

2.4 Damage and Repair Method of DBST Pavement

The DBST state of Sindhuli Road differs in the type of cracks due to the cause of the damage. The main cause of these cracks are i) those that occur from the repetition of the tensile strain acting on the DBST pavement by the traffic load, ii) from the construction joint (Crack) and iii) Road base and Sub grade deterioration. Damage in the curve portion is further added due to the lateral load of the traffic and the crack evolves faster than in the straight part. It is important to prevent degradation of DBST before the damage is developed on a large scale. The major damage observed in the Sindhuli Road are categorized as shown below.

(1) Linear Cracks on Surface

It is the occurrence of linear crack in the longitudinal direction. The cause of this crack is caused by repeated pulling strain in DBST due to traffic load. The degree of damage is initial stage. If the linear cracks are left untreated, the crack width progresses and there is a risk of evolution to alligator crack. It is recommended for early treatment by surface treatment by slurry seal or SBST.

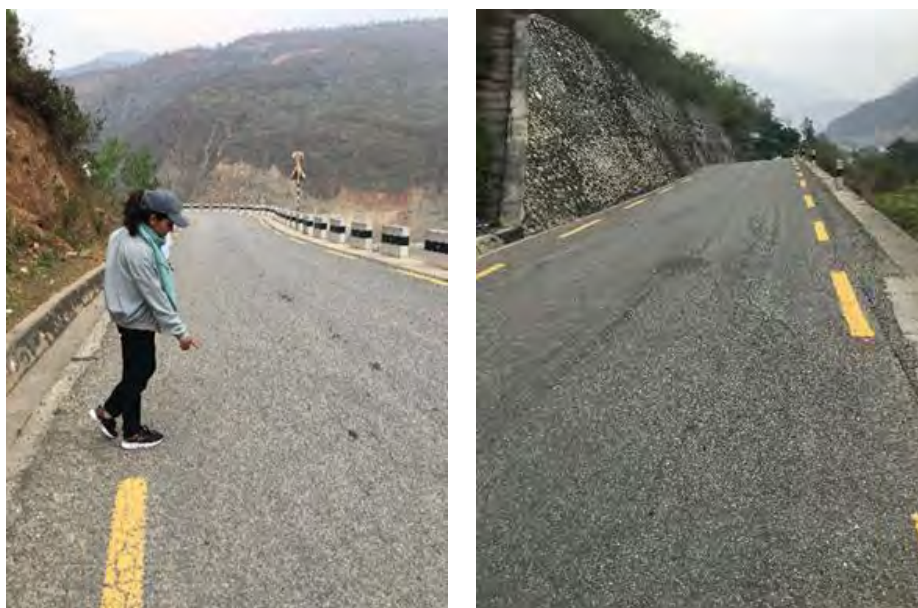


Figure 2.7 Linear Cracks on Surface

(2) Alligator Cracks on Surface

The alligator crack occurs in the DBST due to repetition of large vehicle loads. The linear cracks gradually increase to form the alligator cracks if they are not treated in time. The larger the width of the cracks, the greater the damage of DBST.

The repair method is to remove the crack portion of DBST, after conforming the quality of the existing road base material, it is supplemented with the new road base material. The watering,

trimming and compaction is followed by application of the prime coat and finally construction of the DBST.



Figure 2.8 Alligator Cracks on Surface

(3) Alligator Cracks with Depression

The severe case of alligator crack is followed by depression on the surface. Cause is the repetition of traffic load in the alligator crack surface section and percolation of rain water.

The damage initiates from the DBST surface then is transferred to underlying base course. It is necessary to repair it early and to apply SBST on pavement because the influence extends to sub base and sub grade material if left as it is.

Repair method is to remove the alligator crack portion of DBST, after confirming the quality of the existing road base material, to determine the repair method. The existing road base material and new road base material is replenished followed by mixing, trimming, watering, compacting and spraying prime coat then finally constructing DBST. However, it is desirable to remove unserviceable soil if there is a problem (water content or grading of aggregate) in the existing road base and sub base material.



Figure 2.9 Alligator Cracks with Depression

(4) Entire Pavement Damage

It is a situation where the road base material is peeled off and the pothole is enlarged. The cause of such damage is due to leaving the alligator crack and entering of rainwater into the lower layer of DBST pavement. As a result, road base, subbase and sub grade is deteriorated. This is a major cause of weakening of the pavement. Early repair needs to be done to prevent total damage of the pavement.

To repair this type of damage, the cracked portion of the DBST should be removed. The quality of existing road base and subbase material should be confirmed. If there is a problem with the existing subbase, the existing road base and subbase should be replaced with the new road base and sub base material followed by laying the DBST after applying the prime coat. However, if there is a problem on the subgrade (CBR decrease due to rainwater) then it is necessary to replace the subgrade.



Figure 2.10 Entire Pavement Damage

2.5 Damage and Repair of Granular Layers and Subgrade

The main cause of damage of the DBST pavement structure is the repetitive impact of rain water and traffic load. If the damage occurs, it is necessary to rebuild the pavement layers (road base, subbase or the subgrade). If water is accumulated on any part of the pavement layer, it shall be removed and be replaced by new material. To confirm the cause, it is necessary to perform grading and CBR tests of pavement layers. The Dynamic Cone Penetration (DCP) test can be used to determine the strength of the subgrade and granular layers. The equipment is easy to transport and economical to operate.



Visual site inspection at Sec. IV of Sindhuli Road



Pavement thickness and subgrade condition



DCP test

Source: Office of Material and Road Research
Minnesota Department of Transportation, USA

Figure 2.11 Inspection of Granular Layers and Subgrade Conditions

3 Consideration of Asphalt Overlay Design

From the situation of the existing simple pavement of Sindhuli Road, the most important things to keep in mind when repairing overlay portions are the following two :

- a. The damage of existing DBST must be repaired before applying overlay.
- b. Suitable method and type of overlay must be determined according to characteristics of road section.

3.1 Pavement Material

3.1.1 General

Most of the roads in Nepal are bituminous pavement. Mix designs for DBM and asphalt concrete are based on guideline given by Standard Specifications For Road and Bridge Works hereinafter called 'The Nepalese Specification'. The bituminous mix design aims to determine the proportion of bitumen, filler, fine aggregate, and coarse aggregate to produce a mix which is workable, strong, durable and economical. The Marshall mix design method is used for the asphalt mix design as per Nepalese specification.

Two things are of primary concern in asphalt mix, namely the aggregate gradation and the mix design requirements. Various mixes have various gradation. The acceptable volumetric parameters and Marshall stability requirements are different for different mixes. Thus, for various individual mixes, a separate Marshall mix design needs to be carried out to find out the OBC (Optimum bitumen content) value.

3.1.2 Characteristics of Material Specification of Nepal

The " Standard Specifications for Road and Bridge Works" in Nepal includes asphalt concrete and DBM. These are mainly used as surface course and binder course of the road pavement work. Comparison of standard mixture aggregate grading range of DBM in Nepal and the criteria of Dense-graded asphalt concrete(20) specified in Japan as shown in Table 3.1.

As a result, the specifications of Nepal are relatively rougher in the gradation range of aggregate. Such type of gradation provide flow resistance. On the Sindhuli Road, cracks and ruts due to repeated tensile loads on the pavement have occurred. It is reasonable to apply the Nepali specification with a particle size distribution that is easy to respond to fluidity.

Table 3.1 Standard Proportion of Mixture (Nepal and Japan)

Grading	A	B
Type of Mixture	(Nepal) Bituminous Concrete pavement	(Japan) Dense-graded asphalt concrete (20)
Sieve size (mm)	Cumulative %by weight of total aggregate passing	
45		
37.5		
26.5		
19	90 - 100	95 - 100
13.2	59 - 79	75 - 90
9.5	52 - 72	-
4.75	35 - 55	45 - 65
2.36	28 - 44	35 - 50
1.18	20 - 34	-
0.6	15 - 27	18 - 30
0.3	10 - 20	10 - 21
0.15	5 - 13	6 - 16
0.075	2 - 8	4 - 8
Bitumen content(%)by mass of total Mix	Min.5.2	5~7
Layer thickness	50mm	30-50mm
Nominal aggregate size	19mm	19mm

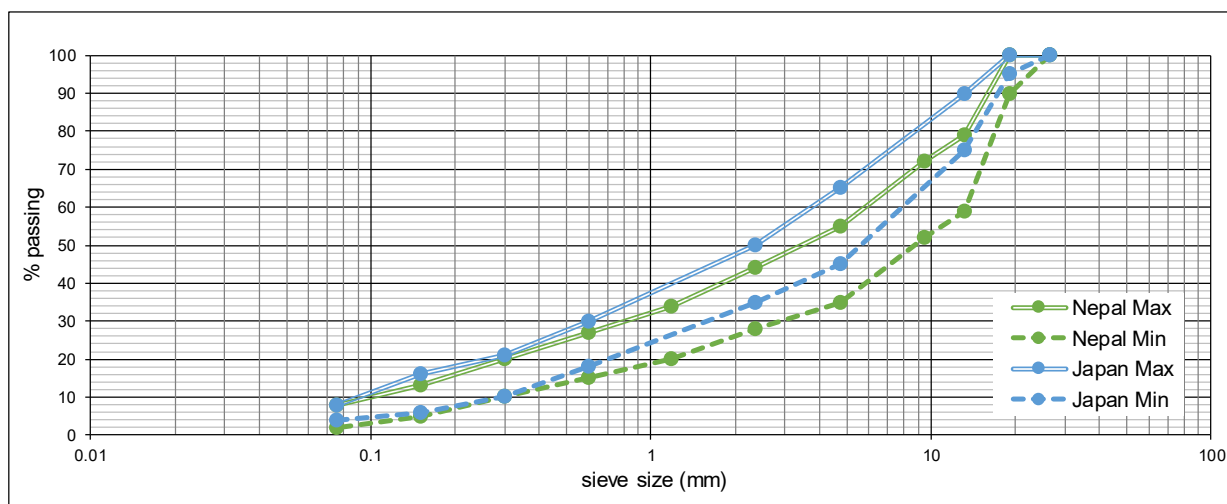


Figure 3.1 Gradation Curves of Nepalese and Japanese Specification

3.1.3 Bituminous Pavement

For the overlay of the Sindhuli Road, the Nepalese Specification Section1308; DBM and Section1309; Asphalt / Bituminous Concrete specifications are referred. The grading range of DBM and Asphalt / Bituminous Concrete are shown in Table 3.2.

Table 3.2 Particle Size Range of DBM and Asphalt Concrete

Grading	1	2	3	4
Type of Mixture	Dense Bituminous Macadam (DBM)		Asphalt Concrete (AC)	
Sive size (mm)	Cumulative %by weight of total aggregate passing			
45	100			
37.5	95 - 100	100		
26.5	63 - 93	90 - 100	100	
19	-	71 - 95	90 - 100	100
13.2	55 - 75	56 - 80	59 - 79	90 - 100
9.5	-	-	52 - 72	70 - 88
4.75	38 - 54	38 - 54	35 - 55	53 - 71
2.36	28 - 42	28 - 42	28 - 44	42 - 58
1.18	-	-	20 - 34	34 - 48
0.6	-	-	15 - 27	26 - 38
0.3	7 - 21	7 - 21	10 - 20	18 - 28
0.15	-	-	5 - 13	12 - 20
0.075	2 - 8	2 - 8	2 - 8	4 - 10
Bitumen content(%)by mass of total Mix	Min.4.0	Min.4.5	Min.5.2	Min.5.4
Layer thickness	75-100mm	50-75mm	50mm	30~40mm
Nominal aggregate size	37.5mm	26.5mm	19mm	13.2mm

(1) Dense Bituminous Macadam

DBM mix is mainly used for the binder course. It consists of two gradations; Grading-1 and Grading-2. Grading-1 has 37.5mm as the nominal maximum aggregate size while Grading-2 has nominal maximum aggregate size of 26.5mm. The fine aggregate percentages in both the grading are same in a range of 28 to 42%. The main criteria that differ both the grading is that the grading-1 consist of large size grading 26.5mm to 45mm. The grade-1 has the advantage of rutting resistance compared to the grading-2. For the overlay of the Sindhuli Road, grading -2 with paving thickness 60mm is used as shown in above Table 3.2. The bituminous design mix requirement is show in the Table 3.3.

Table 3.3 Bituminous Mix Design

Properties	Viscosity grade paving Bitumen	Modified bitumen		Test Method
		Hot climate	Cold climate	
Number of blows	75 blows on each face of the specimen			
Minimum stability (kN at 60°C)	9	12	10	AASHTO T245
Mashall flow (mm)	2~4	2.5~4	3.5~5	AASHTO T245
Marshall Quotient	2~5	2.5~5	2.5~5	MS-2 and ASTM 02041
Air Voids (%)	3~5			
Voids Filled with Bitumen (VFB)	65~75			
Coating of aggregate particle	95% Minimum			IS:6241

(2) Asphalt Concrete

The Section 1309 of the specification covers specification for Asphalt/ Bituminous Concrete. The bituminous concrete mix is used in two forms: Grading-3 and Grading-4. Grade-3 with the nominal maximum aggregate size of 19mm and Grade-4 with 13.2 mm as the nominal maximum aggregate size. The Grade-3 bituminous concrete can be used as both binder as well as wearing course. For the overlay of Sindhuli road, Grade-3 asphalt/ bituminous concrete with 50mm thickness is adopted. The provisions for the bituminous concrete mix design are the same as DBM and there is no change.

3.1.4 Grading Arrangement for Asphalt Mix

The Figure 3.2 shows the grading range of the DBM mixture. The graph also shows the composite granularity of “Grading A” using the granularity range of DBM grading-2. “Grading A” is a grading range close to the lower limit of the aggregate size that is as coarse as possible within the grading range. The coarser grading of the grading range is less liable to flow and less likely to fail in rut.

During the actual mix design, it is necessary to select the optimum bitumen content (OBC) in order to come to the lower limit side of the grading range.

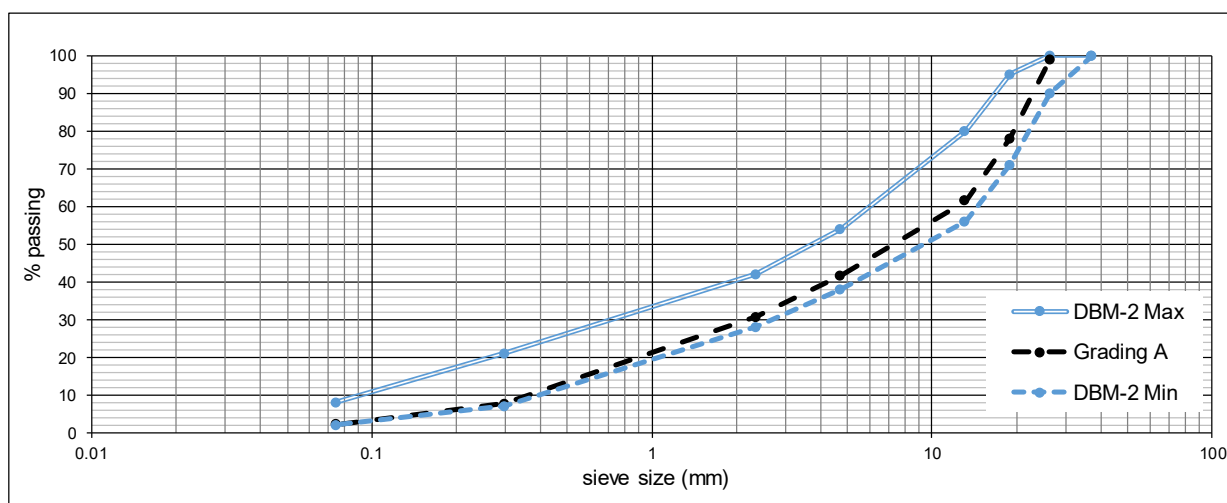


Figure 3.2 Grading Range of DBM Mix

3.2 Proposal of Overlay Pavement Type in Sindhuli Road

(1) Consideration of Overlay Pavement Types

As a type of asphalt pavement for overlay, single layer structure and two layer structure are examined. DBST method is excluded from the examination because it is a simple pavement. The single-layer structure was examined with two types of asphalt concrete (t = 5 cm) and DBM (t = 6 cm), and the following two types were selected for the two-layer structure. The first one is a structure in which the wearing course is asphalt concrete (t = 5 cm), the binder course is DBM (t = 6 cm), and secondly, the wearing course is DBM (t = 5 cm) and the binder course is DBM (t = 6 cm). It is noted that the Nepalese specification doesn't mention the applicability of DBM as the surface layer. The considered pavement type is illustrated in Figure 3.3 as shown below.

The grading range comparison of asphalt concrete and DBM is shown in the graph of figure 3.4. For DBM mixture where mixing rate of 13.2 mm or more coarse aggregate is increased, it has excellent durability than the grading range of asphalt concrete. Therefore, the DBM grading range is more suitable than the asphalt concrete grading range for the Sindhuli Road.

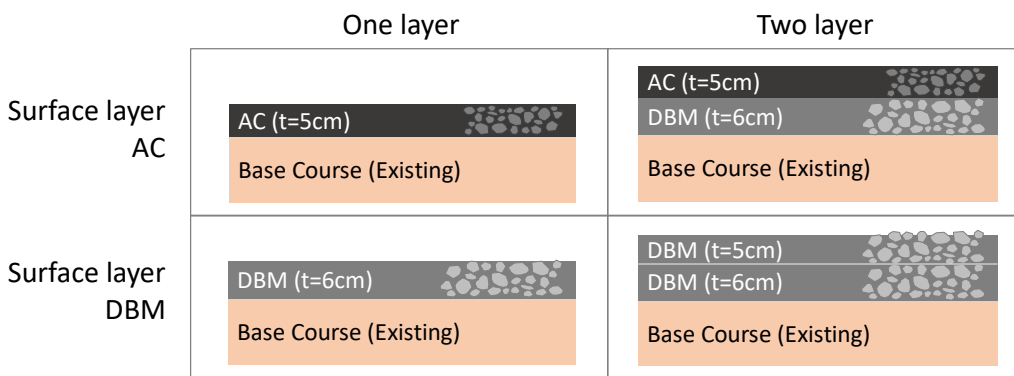


Figure 3.3 Proposed Overlay Pavement Types

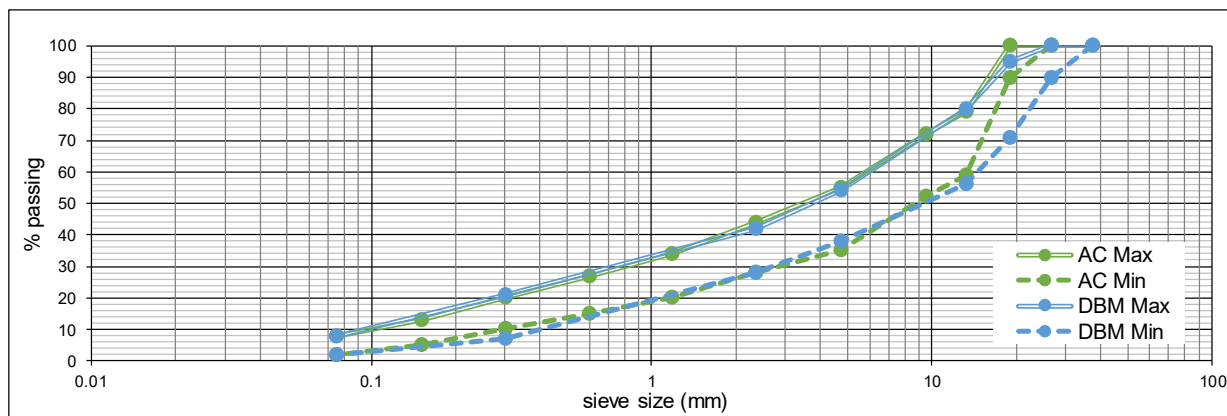


Figure 3.4 Grading Range of Asphalt Concrete and DBM

(2) Study on Application of DBM to Surface Course Mixture

Although DBM is used for binder course construction, as it was described above that it is a mixture which is excellent in flow resistance and is particularly applied to pavement area where there is rutting. From this aspect, it shall be examined whether this DBM grading-2 is able to be applied to the surface.

The comparison of coarse aggregate in DBM as base course material and asphalt concrete as surface course material is summarized in the following table. In strength, Los Angeles value for DBM is maximum 35 % for base course and for asphalt concrete, the value is maximum 30 % which is stronger value for surface course. Aggregate Impact Value for DBM is maximum 27 % while for asphalt concrete is maximum 24 %. Polished stone value for DBM is not specified but for asphalt concrete, it should be minimum 55 %. From the consideration above, it was concluded that DBM is able to be applied as wearing course on the premise of conforming required specifications which is equivalent to that of asphalt concrete, as shown in the table below.

Table 3.4 Physical Requirements of Coarse Aggregate for AC and DBM

Property	Test	Specification			Method of Test
		DBM	Asphalt Concrete	ex) Malaysia	
Cleanliness (dust)	Grain size analysis	Max 5 % passing 0.075 mm sieve	Max 5 % passing 0.075 mm sieve		IS:2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max 35 %	Max 35 %	< 30	IS:2386 Part I
Strength	Los Angeles	Max 35 %	Max 30 %	< 25	IS:2386 Part IV
	Abrasion value or Aggregate Impact Value	Max 27 %	Max 24 %	< 25	
Durability	Soundness either: Sodium Sulphate	Max 12 %	Max 12 %	<12	IS:2386 Part V
	Magnesium Sulphate	Max 18 %	Max 18 %		
Polishing	Polished Stone Value	N/A	Min 55	< 40 (for ACWC)	BS:812-114
Water Absorption	Water Absorption	Max 2 %	Max 2 %	< 2%	IS*2386.Part III
Stripping	Coating and Stripping of Bitumen Aggregate Mix	Minimum retained coating 95 %	Minimum retained coating 95 %	< 95%	IS:6241
Water Sensitivity	Retained Tensile Strength	Min 80 %	Min 80 %		AASHTO283

The specification for wearing course material of Nepal is compared to that of Malaysia which is shown in Table 3.5. Below 2.36 mm of sieve size, grain range shows the same in the specifications of both countries. For gradings of 2.36 mm or more, it can be said that Malaysia has a slightly coarser particle size range and Nepal has slightly smoother particle size range.

Table 3.5 Standard Proportion of Mixture for Nepal and Malaysia

Type of Mixture of Dense Bituminous Macadam (NEPAL)		Type of Mixture of Bituminous Macadam (20) (MALAYSIA)	
Sive size (mm)	Cumulative % by weight of total aggregate passing	Sive size (mm)	Cumulative % by weight of total aggregate passing
37.5	100	28	100
26.5	90 - 100	20	95 - 100
19	71 - 95	14	65 - 85
13.2	56 - 80	10	52 - 72
4.75	38 - 54	6.3	39 - 55
2.36	28 - 42	3.35	32 - 46
0.3	7 - 21	0.3	7 - 21
0.075	2 - 8	0.075	2 - 8
Bitumen content (%) by mass of total mix	Min.4.5	Bitumen content (%) by mass of total mix	4.9±0.5%
Layer thicness	50-75mm	Layer thicness	-
Nominal aggregate size	26.5mm	Nominal aggregate size	28mm

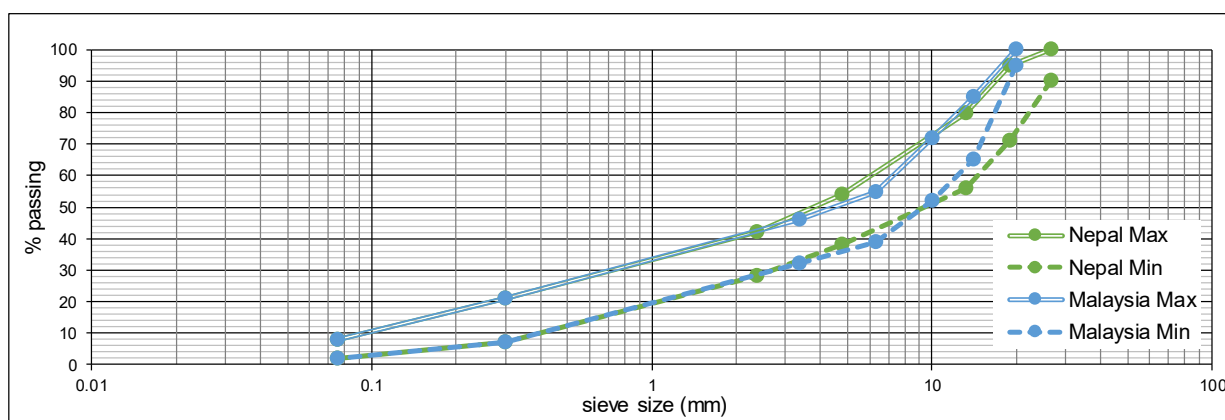


Figure 3.5 Grading Curve in Nepalese and Malaysian Specifications

Next, since there is provision of coarse aggregate in both countries, the comparison is summarized in the following Table 3.6. Major difference is found in the provision of coarse aggregate in the surface pavement material in strength and polishing value. In Malaysian specification, maximum value of Los Angeles Abrasion test is 25 % while that of Nepal is maximum 30 %. The polishing value requirement in Malaysian Specification is 40 while that in Nepal is 55 which is very strict standard. Apart from these criteria, other specifications are either equal or higher in Nepal. It can be said that Nepal has stricter management rules and the selection of high quality aggregates has led to production of high quality mixtures.

Table 3.6 Design Requirement of Coarse Aggregate

Properties	Viscosity grade paving Bitumen	Modified bitumen			Test Method
		Hot climate	Cold climate	Ex) Malaysia	
Number of blows	75 blows on each face of the specimen				
Minimum stability (kN at 60°C)	9	12	10	> 8	AASHTO T245
Marshall flow (mm)	2~4	2.5~4	3.5~5	2 - 4	AASHTO T245
Marshall Quotient	2~5	2.5~5	2.5~5	N/A	MS-2 and ASTM 02041
Air Voids (%)	3~5			3 - 5	
Voids Filled with Bitumen (VFB)	65~75			70 - 80	
Coating of aggregate particle	95% Minimum			N/A	IS:6241
Nominal Maximum Particle Size (mm)	Related to design percentage of air void				
26.5	11	12	13		
37.5	10	11	12		

The number of blows required in both the country's specification is 75. The minimum stability requirement for viscosity grade is 9 for Nepalese specification and 8 for Malaysian specification. Marshall flow and air voids requirement are same in both country's specifications. The VFB value is 65-75 in Nepal and it is not compared with that of Malaysia because bitumen grade used is 60-70 in Nepal and 80-100 in Malaysia due to difference in climatic conditions.

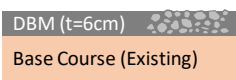
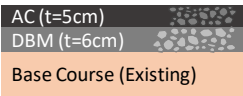
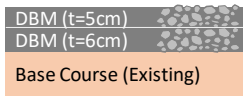
Thus, although the comparison of specification of each country was made, the standard value of Nepal is appropriate on the side of prudence and it can be said that DBM mixture can be applied to the prescribed range of wearing course. For this design consideration, selection of material that can pass the specified Los Angeles test, Aggregate impact value test and Polished Stone value test of the

material for the wearing course, and in the grading range of DBM as the wearing course material should be done. The compounding design results in a more durable mixture.

(3) Recommended Overlay Structure

In principle, the following three types of structures are proposed as standard structures for overlaying of paving work for maintenance of the Sindhuli Road, assuming that materials specified in Nepal specifications are applied.

Table 3.7 Recommended Overlay Structure

		One layer (DBM)	Two layer (AC + DBM)	Two layer (DBM + DBM)
				
Applicability	Road alignment	Gentle alignment	Relatively gentle alignment	Winding alignment
	Necessity of Durability	Low durability required	Regular durability required	High durability required

(4) Proposed Concept for Application of Overlay in the Sindhuli Road

Three types of standard overlay were defined in above section. And here's how the three types will be distinguished from the existing Sindhuli road and then concept of application will be illustrated. It is noted that actual application shall be determined based on the detailed observations.

Table 3.8 Concept of Application of Overlay in the Sindhuli Road

		Features of the section	Paving- type
Section I		Gentle terrain with few sharp curve	One layer (DBM)
Section II		Hilly steep terrain and many curves including hairpin bend	Two layer (DBM+DBM)
Section III	Khurkot-Mulkot	Mountainside terrain, continuous various curves including hairpin bend	Two layer (DBM+DBM)
	Mulkot-Nepalthok	Riverside gentle terrain with comparatively few number of curves	Two layer (AC+DBM)
Section IV	Ch.0 – Ch.30	Riverside gentle terrain with comparatively few number of curves	Two layer (AC+DBM)
	Ch.30 – Ch.50	Mountainside terrain and continuous various curves	Two layer (DBM+DBM)

4 Solutions and Proposals Related to Overlay Work of Sindhuli Road

4.1 Preparation of Appropriate Documents

In order to prepare an appropriate contract document for Periodic Maintenance Works, it is necessary to accurately grasp the actual road condition by detailed site survey prior to tender and reflect it on the document, and to clearly define the BOQ items of the construction that the contractor should perform.

In the contract work currently being implemented, there were cases where the type and quantity of work to be actually performed at the site were significantly different from the contents and quantity of work prescribed by the contract. These cases not only have the potential to develop disputes between client and contractor, but also lead directly to delays in construction period and issues of quality assurance. In order to prevent this, it should be insured that the ordered contents of work to should be accurately determined and BOQ should be prepared with the accuracy of quantity.

In case of asphalt pavement works, which are the most important in overlay construction, it is necessary to clarify the layer thickness and composition based on the design, and be careful not to make a difference in interpretation of construction quantity.

4.2 Site Inspection Before the Start of Work

After finalization of contract, the client and the contractor should jointly carry out site inspection for confirmation before the start of the work as per standard specifications Sec 100, and both the parties should recognize the scope of the work. This joint inspection prior to commencement of work helps in preparation of realistic construction plan, avoid dispute regarding the content of the work and variation in cost estimate.

For example, if some defect in pavement is still observed after the completion of work, it is possible to identify the cause of it and whether it was present prior to the repair work or after completion of work. By the help of additional coring and test-pit, it is possible to investigate the cause and determine if it is contractor's liability or not.

4.3 Inspection Related to Quality Control During Construction

In case of any defect in the post-construction inspection, a great deal of manpower and time is required to carry out the reconstruction due to the nature of paving work. During the construction period, it is important to conduct inspections at each process to minimize variations in quality and prevent construction defects, and to make the pavement in acceptable finished shape and quality that meets the design criteria.

Nepal's "Standard Specification for Road and Bridge Works" and "Manual of Standard Tests" describe the quality control items required during construction. In accordance with this, it is necessary to thoroughly implement the quality control and report the performance of the contractor. The contractor must submit the results of tests for quality control.

The contractor is responsible for 'Basic Standard Test', 'Acceptable Finished Shape Control', and 'Quality Control'. The basic standard test includes test results of the pavement material like bitumen, aggregate, etc. used by contractor. For example, it should include bitumen test results from bitumen manufactures like 'Basic Bitumen Test Results Sheet'. Regarding 'Acceptable Finished Shape Control', the contractor should carry out in accordance with the construction process, to measure the construction width and thickness required and submit in standard form.

Regarding quality control, especially in asphalt paving work, it is important to carry out trial construction and proceed with construction after conformation by inspection. At the time of construction, it is necessary to manage the temperature control of the asphalt mixture and the prescribed paving method and number of compaction based on the construction plan.

Table 4.1 Sample of Inspection of Finished Pavement Components

Type of works	Item	Frequency	Control Limits
Sub-grade	Design Level	Every 40 m	Within ± 5 cm
	Width	Every 40 m	Morethan - 10 cm
Sub base	Design Level	Every 40 m	Within ± 4 cm
	Thicness	Every 40 m	Morethan - 4.5 cm
	Width	Every 20 m	Morethan - 5 cm
Road base	Thickness	Every 20 m	Morethan - 2.5 cm
	Width	Every 100 m	Morethan - 5 cm
Binder couese	Thickness	Every 1000 m ²	Morethan - 0.9 cm
	Width	Every 100m	Morethan - 2.5 cm
Waring course	Thickness	Every 1000 m ²	Morethan - 0.7 cm
	Width	Every 100 m	Morethan - 2.5 cm
	Flatness	Per lane, toal length	Less than 2.4 mm

Source: Japan Road Association

Table 4.2 Sample of Quality Control Items

	Type of works	By Scale of works implement or not		Frequency to implement	Standard management limits
		Medium or Large	Small		
Subbase	Water content ratio	Depends	-	When an abnormality is observed	
	Plastic index	-	-		
	Grading	-	-		
	Degree of Compaction	✓	Depends	1 No. per 1000 m ²	Morethan 93% (MDD)
	Proof rolling	✓	-	time to time	
Road base	Water content ratio	Depends	Depends	When an abnormality is observed	
	Plastic index	-	-		
	Grading (2.36 mm)	✓	-	1~2 time per day	Within ± 15%
	Grading(75 μ mm)	Depends	-	1~2 time per day	Within ± 6%
	Degree of Compaction	✓	Depends	1 No. per 1000 m ²	Morethan 93% (MDD)
Wearing course/ Binder course	Appearance	✓	✓	time to time	
	Temperature	✓	✓	time to time	
	Grading (2.36 mm)	✓	-	1~2 time per day	Within ± 15%
	Grading(75 μ mm)	Depends	-	1~2 time per day	Within ± 6%
	Asphalt content	✓	Depends	1~2 time per day	Within - 9%
	Degree of Compaction	✓	Depends	1 No. per 1000 m ²	Morethan 94% (MDD)

* ✓; Regularly or Time to time is Desirable

Source : Japan Road Association

Besides, the following points must be considered for inspection works done by client.

(1) Conducting Road Base Inspection

Visually inspect the condition of the roadbase before overlay work or after prime coating, and confirm that the road base is not damaged. If the road base is not completed properly, problems such as damage on the overlay surface, poor flatness, insufficient overlay thickness etc. may occur.

If there is suspicion of damage, the proof rolling test should be done for deflection check.

(2) Inspection of Bituminous Mix Design Results for Asphalt Mixture

The grading test must be done to check whether the combined grading is within the specified range or not. In addition, in order to confirm whether the contractor has calculated and determined the optimum bitumen content (OBC) according to the degree of stability, flow value, etc. according to the particle size actually used, the combined mixed result is inspected.

In addition, based on the results of the combined mix, at the mixing station in the asphalt plant,

the asphalt mixture being produced is taken from the dump truck to asphalt laboratory and subjected to the grading test and the bitumen content test to check whether it is within the specified range.

(3) Confirmation of Compaction Factor in Trial Lay

Trial laying of asphalt mixture should be done based on paving method and number of compaction as specified in the construction plan. The result of the compaction thickness is inspected comparing with various method of paving and number of compaction.

(4) Confirmation by Core Sampling of New Overlay Section

Core sample must be taken immediately after completion of new overlay work to carry out the thickness and density test of the pavement. Density test is intended to confirm whether the density obtained by the paving method proposed by contractor is satisfactory or not.

4.4 Necessity and Method of Inspection After Completion of Construction

After completion of construction work, the final inspection should be done and recorded in the inspection sheet and as-built drawing should be prepared. Confirmation of the quality of the pavement works and method of repairing with asphalt overlay is specially more important. For example, if crack appears immediately after paving works, it can be determined by inspection sheet, the quality and method of repairing with asphalt overlay at that time. In addition, if additional coring or open cutting is performed, the cause of the occurrence of the crack can be analyzed in detail, and the contractor's responsibility can be clarified.

Also from a long-term perspective, it is important to keep the inspection record so that it can be useful in future for reconstruction purpose.

4.5 Other Suggestions

- a. If road side drainage is damaged or blocked, it will not function properly and flooding on the road surface will occur, which will also adversely affect road pavement structure. Since it was observed that the existing road drainage was left damaged after the overlay completion, it is proposed that repair of drainage should also be included in BOQ as a part of the Periodic Maintenance Work.
- b. The width of the Sindhuli Road is narrow with only 1.5 lanes and traffic volume is rapidly increasing, the traffic management during construction is extremely important.
- c. It is necessary to consider construction schedule time to avoid construction during the rainy season like July and August as much as possible. If it is inevitable that the construction takes

- place in rainy season, it is necessary to check the contractor's construction schedule firmly.
- d. In the current construction contract, there is no designation that “Contractor's engineers must be on site during construction period”, and it seems that there is no engineer at the construction site. In this case, site work control, safety control and quality control cannot be performed. It is desirable to include "provision of site engineer" in the clause of construction contract.
 - e. Nepal's “Standard Specification for Road and Bridge Works” and “Manual of Standard Tests” describe items related to quality but in particular the specification of the design thickness of asphalt pavement. However, it is not written clearly about the implementation of thickness and density inspection after completion. This part is proposed to be clarified in the special condition of contract.
 - f. Rutting has occurred in the hairpin curved portions of Section II and Section III. Although it is desirable to provide concrete pavement in such portion, the necessity of long curing and traffic stoppage is not practicable in the Sindhuli Road. Therefore, it is recommended to provide paving blocks in hairpin portions. It is like small precast concrete plate which doesn't take much time to pave. However, it should be rigidly fixed in the both ends to the concrete kerbs.



Source: Sunway Paving Solutions Sdn Bhd

Figure 4.1 Example of Paving Blocks

5 Recommendations for Further Road Pavement Maintenance

(1) Long-term Plan Considering the Entire Sindhuli Road

Since the Sindhuli Road is a long route with total length of 160 km and it is made up of simple DBST pavement, it is quite possible that a large-scale repair will be required in many portions in a short period from now on. In such case, it becomes difficult to carry out multiple contract management and budget allocation within a limited period of time. In order to maintain all sections efficiently and effectively, a long-term maintenance plan should be formulated.

(2) Initial Diagnosis and Treatment to Reduce Total Cost

It is important to actively conduct diagnosis and treatment from the time when the degree of damage in pavement is in initial stage, to prevent the damage to advance. Specific examples include surface restoration work by slurry seal, SBST and DBST. By implementing these regular and proper repair, it is possible to prolong the period until the overlay works required and save total cost of long-term maintenance and management.

(3) Traffic Control / Regulation of Overloaded Vehicles

The overloaded vehicles have severe impact on the life of pavement. For proper functioning and longer life of pavement, proper traffic regulation and restriction for the overloaded vehicles by the governing authorities should be given to in the Sindhuli Road.

(4) Need of Construction Record

In the portion where overlay by periodic maintenance works is completed, the road surface survey immediately after the construction should be conducted to record the work status and conditions so that it can be looked back to assess what kind of road surface construction was performed. For this purpose, it is proposed to hire a consultant to investigate the current pavement situation to prepare a restoration plan.

(5) Coordination with Two-lane Widening Plan for the Sindhuli Road

Since DOR is planning two lane widening of the Sindhuli Road, the coordination between periodic maintenance plan and the widening plan is necessary to avoid overlapping of the scopes of the works in order to maintain the existing durable road structure.

The Project for the Operation and Maintenance of
the Sindhuli Road Phase 2

Preliminary Survey for Introduction of ETC
on Sindhuli Road

December 2022

JICA Expert Team

Contents

- **1. Summary of Survey..... 1**
 - 1.1 Background..... 1
 - 1.2 Purpose of Survey..... 1
 - 1.3 Survey Schedule 1
 - 1.3.1 Before the First Business Trip 1
 - 1.3.2 First Business Trip..... 2
 - 1.3.3 Second Business Trip..... 2
 - 1.4 List of Key Interviewees..... 3

- **2. Analysis of the Current Situation and Issues related to the Introduction of ETC.... 3**
 - 2.1 Organisational Structure 3
 - 2.1.1 RBN..... 3
 - 2.1.2 Relationship diagram between relevant organisations and RBNs 5
 - 2.2 Information on the Current Toll Road System..... 6
 - 2.2.1 Policies and System..... 6
 - 2.2.2 Toll Facilities and Operations..... 8
 - 2.3 Basic information required for ETC introduction..... 11
 - 2.3.1 Standardization of license plates and vehicle information`s databaseization..... 11
 - 2.3.2 Penetration of the cashless system..... 14
 - 2.4 Trends for introduction of ETC. 15
 - 2.4.1 Perspectives on the necessity of ETC by RBN..... 15
 - 2.4.2 Site checks of potential ETC installation sites. 15
 - 2.4.3 Estimated average daily traffic volume at cross sections 17
 - 2.5 Procurement status review and confirmation..... 18
 - 2.5.1 Toll-collecting section 18
 - 2.5.2 Bidding Units..... 18
 - 2.5.3 Method of toll collection 19
 - 2.5.4 Status of Contractor Procurement..... 20

2.6	Identification of issues on introduction of ETC.....	20
2.6.1	Establishment of a system for collecting and storing actual traffic volumes	20
2.6.2	Clear distinction between exempt and non-exempt.....	20
2.6.3	Establishment of a fee collection enforcement system.....	20
2.6.4	Subdivision of vehicle classification	21
- 3.	Recommendations for the introduction of ETC	22
3.1	Consideration of the system to be introduced.....	23
3.1.1	Issues and countermeasures on introducing ETC	23
3.1.2	Prospective ETC	24
3.1.3	Proposed ETC	26
- 4.	Appendix	32
4.1	Roadmap for ETC development in Nepal.....	32

List of tables

Table 1.3.1	Online Meetings before the First Business Trip	2
Table 1.3.2	Results of the First Business Trip.....	2
Table 1.3.3	Results of the Second Business Trip	3
Table 1.4.1	List of Key Interviewees	3
Table 2.2.1	Strategies related to ETC	7
Table 2.2.2	Toll revenues in the Past Five Years.....	9
Table 2.5.1	Tender subject and description.....	18
Table 3.1.1	Advantages and disadvantages of various ETC	25

List of figures

Figure 2.1.1	Organisational Structure of RBN.....	4
Figure 2.1.2	Relationship between RBN and other Organisations Focusing on the Flow of Funds.....	5
Figure 2.2.1	Eight sectors and 80 strategies (Digital Initiatives).....	6
Figure 2.2.2	Toll roads and Toll road Fees in Nepal	8
Figure 2.2.3	Location map of toll plazas in Sindhuli Road.....	8
Figure 2.2.4	Bhiman Toll Plaza.....	9

Figure 2.2.5	Receipts issued at toll booths in September 2019.....	10
Figure 2.2.6	Toll collection at Bhiman toll plazas, November 2021.....	10
Figure 2.2.7	Toll collection at Naubise toll Plaza (outside Sindhuli Road), May 2019.....	11
Figure 2.3.1	Photos related to the new number plate.....	12
Figure 2.3.2	RFID tag on the windscreen of a vehicle.....	13
Figure 2.3.3	10 locations for a plan of installation of RFID antennas on highways.....	13
Figure 2.3.4	Trends of broadband internet penetration (2016-2021).....	14
Figure 2.4.1	Candidate locations for ETC installation.....	16
Figure 2.4.2	Estimated average daily traffic volume at candidate locations for ETC	17
Figure 2.5.1	HETC toll plaza	18
Figure 2.5.2	Bidding Units.....	19
Figure 2.5.3	Image of HETC toll booths.....	19
Figure 2.6.1	Reference of vehicle classifications for toll roads (Italy, Autostrade)	21
Figure 3.1.1	Identification of issues on introduction of ETC	23
Figure 3.1.2	Proposed ETC concept.....	26
Figure 3.1.3	Flows when passing through the proposed ETC.....	27
Figure 3.1.4	Image of the layout of each toll lane.....	29
Figure 4.1.1	Roadmap for Development of Unified ETC in Nepal	32

Abbreviations

Abbreviation	Official Name
ALB	Automatic Lane Barrier
ANPR	Automatic Number Plate Recognition
AVC	Automatic Vehicle Classification
DOR	Department of Roads
DOTM	Department of Transport Management
DSRC	Dedicated Short Range Communication
EDL-VRS	Electronic Driving License and Vehicle Registration System
ETC	Electronic Toll Collection System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HETC	Hybrid Electronic Toll Collection System
ITS	Intelligent Transport System
JCC	Joint Coordination Committee
JET	Jica Expert Team
LRN	Local Road Network
LSD	Lane Side Display
MCIT	Ministry of Communications and Information Technology
MLFF	Multilane Free Flow
MOF	Ministry of Finance
MoPIT	Ministry of Physical Infrastructure and Transport
NRB	Nepal Rastra Bank
NTA	Nepal Telecommunications Authority
OCR	Optical Character Recognition
POS	Point of Sales
RBN	Road Board Nepal
RFID	Radio Frequency Identification
SDDSBP	Suryabinayak-Dhulikhel, Dhulikhel Sindhuli Bardibas Project
SRN	Strategy Road Network
SROM2	Operation and Maintenance of Sindhuli Roads Phase2
SSP	Superintendents of Police
T&G	Touch and Go
VD	Vehicle Detector
VRS	Vehicle Registration System

1. Summary of Survey

1.1 Background

In 2019, RBN, Roads Board Nepal decided to introduce a toll system to 11 major highways across the country for the purpose of expanding the maintenance budget. BP Highway, also known as the Sindhuli Road is one of them. In September 2019, the manual toll collection system was introduced to Sindhuli Road, where the road was divided into two sections: Bardibas to Khurkot (90km) and Khurkot to Dhulikhel (70km). The toll collection was initially planned to be implemented by procured private companies. However, since the system introduction, only the section between Bardibas to Khurkot has been covered by a private company and the other section has been handled by DOR staff on its behalf. In addition, RBN planned to procure a contractor to introduce the Hybrid Electric Toll Collection System (HETC), however the bid was unsuccessful.

JICA Expert Team (hereinafter referred to as JET) of “The Project for the Operation and Maintenance of the Sindhuli Road Phase 2 (SRM2)”, has been collecting information and providing technical support regarding the introduction of a toll collection system. In the 6th JCC meeting held in March 2, 2022, RBN requested support for the introduction of ETC.

In order for the Nepal government to popularize and promote ETC in the future, it is essential to have a systematic perspective on the development of the system not only on Sindhuli Road but also on all toll roads across Nepal. For this reason, it is necessary to first consider an introduction support program taking Sindhuli Road as a pilot model while collecting and organizing basic information necessary for future nationwide expansion and unified standardization of the ETC.

1.2 Purpose of Survey

The survey is conducted as an initial step to collect materials for examining how JICA supports RBN in the introduction of the ETC. Based on the survey results, JICA considers the most effective supporting method through discussion with RBN. The JET survey team considers the introduction of the ETC to the Sindhuli Road as a pilot model toward future nationwide expansion and unified standardization of the system.

1.3 Survey Schedule

1.3.1 Before the First Business Trip

Several online meetings were held with RBN to understand the current situation and issues prior to the first business trip. The attendees of the meeting include Executive Director, Senior Engineer, and other staff of RBN.

Themes and results of each meeting are shown in Table 1.3.1 to Table 1.3.3.

Table 1.3.1 Online Meetings before the First Business Trip

Date	Themes	Results
16 June	<ul style="list-style-type: none"> Brief description of the survey. Overview of ETC Question and Answer Session 	<p>JET explained the survey overview and basic principles of ETC.</p> <p>RBN asked for a detailed explanation of each type of ETC.</p>
13 July	<ul style="list-style-type: none"> Detailed description of ETC. Comparison of different ETC Question and Answer Session 	JET explained the details and advantages and disadvantages of each type of ETC.
2 August	<ul style="list-style-type: none"> Schedule of First Business trip Necessity of Introduction of ETC Decision-making Process in the Introduction of ETC 	Based on the need for ETC explained by RBN, RBN and JET shared key points for consideration, and shared the schedule for the first business trip.

Source: JICA Expert Team

1.3.2 First Business Trip

JET stayed in Nepal from August 17 to 31, 2022 to collect basic information related to the introduction of the ETC.

The results of activities in the business trip are shown in Table 1.3.2.

Table 1.3.2 Results of the First Business Trip

Date	Counterpart, etc.	Summary
18 August	RBN	Explanation of the survey overview, Distribution of questionnaires, Discussion
18 August	DOR SDDSBP	Explanation of the survey overview
18 August	JICA Nepal office	Briefing on the survey, discussion of the questionnaire
21 August	RBN	Explanation of basic principles, Q&A session
24 August	RBN and relevant agencies (MoPIT, DOR, DOTM, Kathmandu Valley Traffic Police)	Explanation of the survey outline and basic principles, Distribution of questionnaires.
25 August	7th JCC Meeting	Report on the overview and progress of the survey.
27-28 August	Sindhuli Road site	Site visit of potential location of toll booths

Source: JICA expert team.

1.3.3 Second Business Trip

JET drafted the proposal for the introduction of the ETC based on the basic information collected on the first business trip. After that, JET went on the second trip to Nepal from December 17 to 24, 2022, to explain the proposal.

The results of activities in the business trip are shown in Table 1.3.3.

Table 1.3.3 Results of the Second Business Trip

Date	Counterpart, etc.	Summary
19 December	RBN and relevant agencies (MoPIT, DOR, DOTM, Kathmandu Valley Traffic Police)	JET explained the result of the survey. The purpose of RFID and T & G system was accepted concept to begin with.
21 December	MoPIT (Joint Secretary)	JET explained the result of the survey. The purpose of RFID and T & G system was accepted concept to begin with. MoPIT suggested that a stakeholder consulting meeting should be held as soon as possible.

Source: JICA expert team.

1.4 List of Key Interviewees

List of key interviewees is shown in Table 1.4.1.

Table 1.4.1 List of Key Interviewees

Organisation	Interviewee
RBN	Mr. Ganesh Bahadur KC (Executive Director) Mr Sagar Gnawali (Technical Director) Mrs Chetna Thapa (Director, Administration) Mr Sanu Babu Prajapati (Senior Engineer) Mr Dharma Raj Upadhyay (Engineer)
MoPIT	Mr Prabhat Kumar Jha (Joint Secretary)
DOR	Mr Ashish Nebal (Engineer)
DOR SDDSBP	Mr Rabindra Lal Das (Project Manager) Mr Shambu Prasad Acharya (Senior Divisional Engineer)
DOTM	Mr Ishwori Datt Paaneru (Director) Mr Abinash Aryal (Engineer)
Kathmandu Valley Traffic Police	Mr Rayendra Pd.Bhatta (Superintendents of Police (SSP))

Source: JICA expert team.

2. Analysis of the Current Situation and Issues related to the Introduction of ETC

2.1 Organisational Structure

2.1.1 RBN

RBN was established under the Roads Board Act, 2002 with the objective of providing sustainable funds for planned maintenance of roads. The objectives of planned maintenance are to maintain existing serviceable roads in a serviceable condition, to reduce vehicle operating costs and to provide comfort to road users. The major function of RBN is to collect, manage and allocate fund for road maintenance to the Road Agencies (RAs). RBN is funded by tolls, fuel levies, and vehicle registration fees, therefore the organization is fully dedicated to providing better road services to drivers.

According to Section six (6) of Roads Board Act, the sources of Road Fund to be accured for Roads Board Nepal as follows:

Government of Nepal may by a notification published in the Nepal Gazzette levy as such toll may be prescribed in such a notification on the motor vehicle making use of road prescribed in the said notification.

- The Board shall collect or cause to collect the toll prescribed by Government of Nepal by notification published in the Nepal Gazzette.

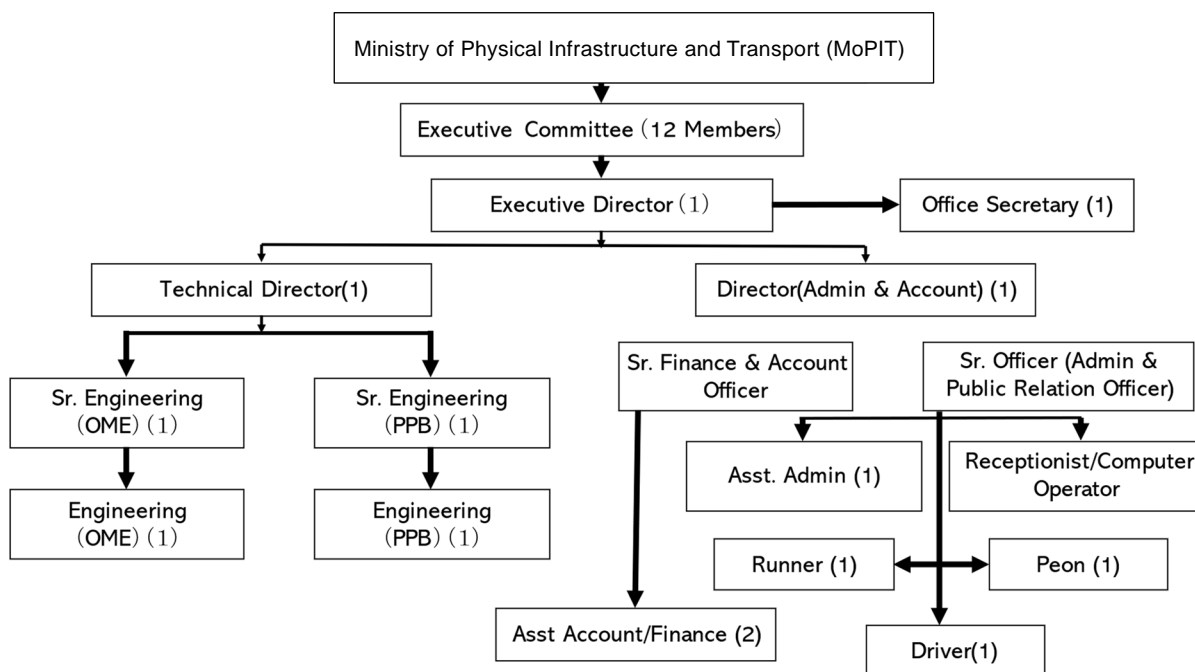
Currently RBN has been availing the following resources:

- Fuel levy on diesel and petrol for vehicles
- Road Users Fee
- Vehicle registration fee

Other possible resources that are yet to be tapped are:

- Fee for vehicle registrered aborad but used in Nepal
- Subsidies and grant from Government of Nepal and support from donors and internationals , if any

The organisational structure is shown in Figure 2.1.1.



Source: RBN.

Figure 2.1.1 Organisational Structure of RBN

2.1.2 Relationship diagram between relevant organisations and RBNs

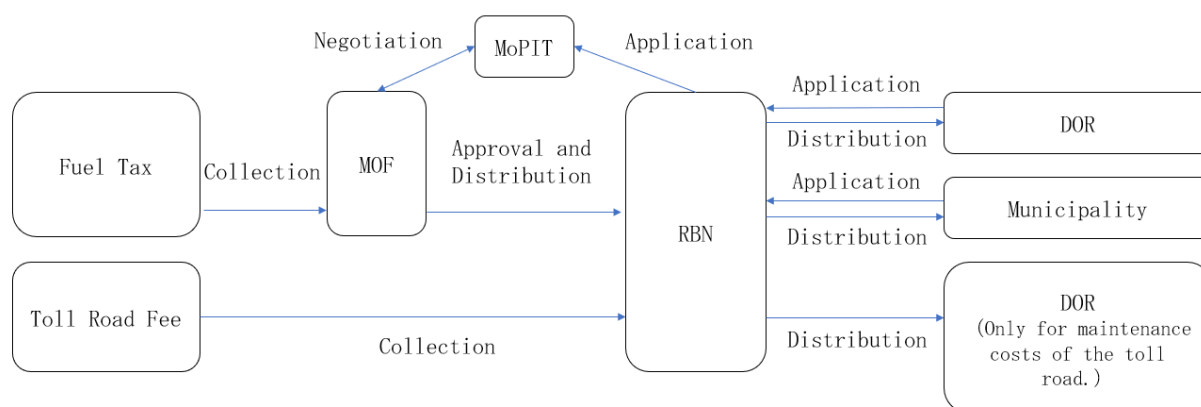
The Sindhuli road maintenance budget is made up of two sources of funds: the maintenance budget from RBN and the project budget which is the government's general fund budget (for recurrent costs such as DOR staff costs and office operating costs).

RBN fund is provided as per the Roads Board Act, and the Government of Nepal may, by notification published in the Nepal Gazette, levy tolls prescribed in the notification on motor vehicles that use the roads specified in the notification.

Toll collection system was introduced by RBN and toll collection is outsourced to private companies. The revenue generated from toll collection is used for maintenance of road of the same section on which tolls are being collected.

The relationship between RBN and relevant organisations with a focus on the flow of funds is shown in Figure 2.1.2.

DOR maintains and manages the Strategic Road Network (SRN, accounting for 70% of the total), which is one of the two road types. The other road type, the Local Road Network (LRN, accounting for 30% of the total) is managed by the Metropolitan, Submetropolitan Municipalities and Rural Municipalities. The RBN's budget is distributed mainly from revenues from tolls, fuel tax and vehicle registration fees. The toll road users fee directly comes to the account of RBN which is used for maintenance of toll roads. Whereas fuel tax is collected by the Nepal Oil Corporation will go to basket of Ministry of Finance (MoF) and regular road maintenance fund has been reflected in Red Book from MoF. Regarding the budget allocation from the RBN to the DOR, Metropolitan, Submetropolitan Municipalities and Rural Municipalities, the DOR and municipalities submit budget requests to the RBN, and then RBN determines the allocation of budget as per Annual Road Maintenance Plan.



Source: JICA expert team made based on material provided by RBN.

Figure 2.1.2 Relationship between RBN and other Organisations Focusing on the Flow of Funds

2.2 Information on the Current Toll Road System

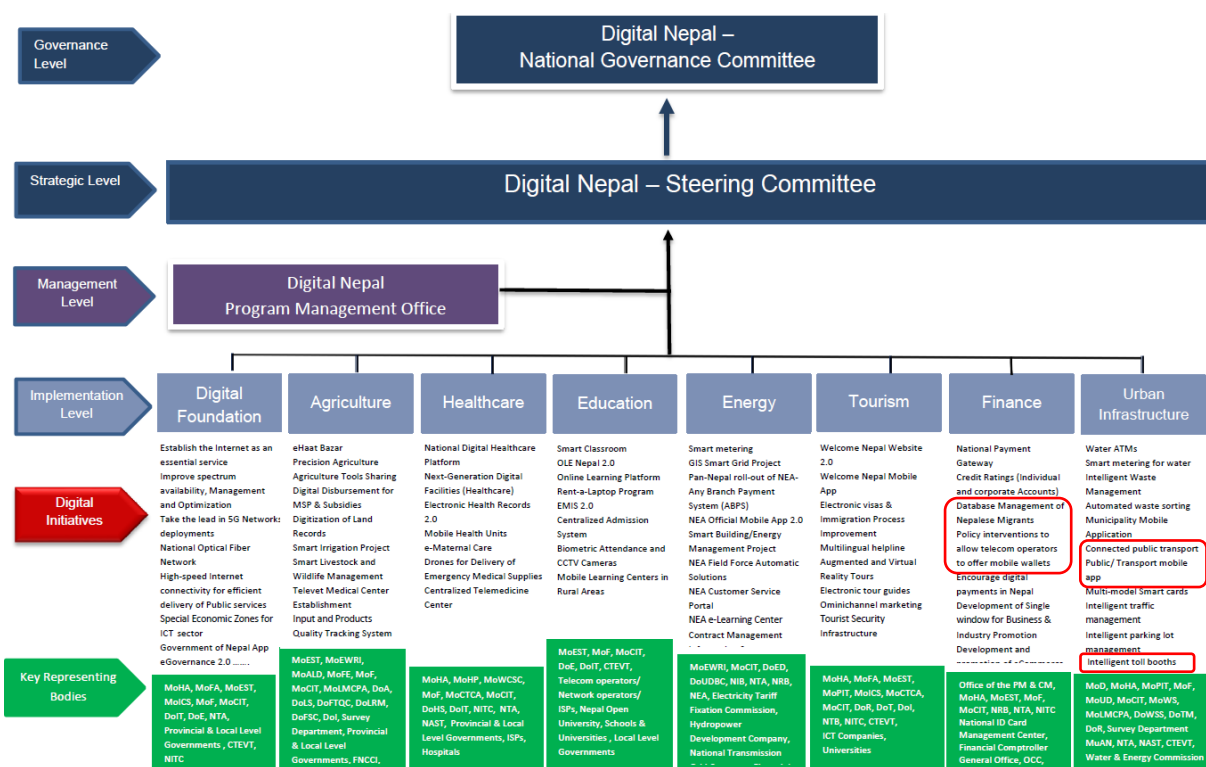
2.2.1 Policies and System

(1) National Strategy in relation to ETC (2019 Digital Nepal Framework)

In 2018, Ministry of Communications and Information Technology (MCIT) developed the 2019 Digital Nepal Framework, which sets out a roadmap for Nepal to become a digital nation, with the following vision and mission

- Vision: Digital-based socio-economic wealth
- Mission: To transform government, society and the economy through digital technology

In addition, 80 strategies (Digital Initiatives) in eight sectors have been set out to achieve the above vision and mission. Among the 80 strategies, those relevant to ETC are listed in Figure 2.2.1. The strategies include the use of RFID tags for a non-stop toll collection system and traffic management for buses and other vehicles, as well as the development of digital financial services using e-wallets.



Source: 2019 Digital Nepal Framework.

Figure 2.2.1 Eight sectors and 80 strategies (Digital Initiatives)

Table 2.2.1 Strategies related to ETC

Sector	Strategies (Digital Initiatives)	Contents of Strategy (Digital Initiatives)	Expected benefits	Timeline (Year)
Urban Infrastructure	Strategy 78: Intelligent Toll Booths.	<ul style="list-style-type: none"> • Install RFID tag readers (for high frequency users) at toll booths on national roads to enable automatic debiting of fees. • This reduces congestion as vehicles can pass smoothly without the need to stop for cash payments. 	<ul style="list-style-type: none"> • Increased revenues for road infrastructure development • Improved vehicle transit speeds, reduced traffic flow and congestion on national roads • Improved satisfaction and comfort of road users • Savings in fuel consumption due to stops at toll booths 	Medium-Term (3 years)
Urban Infrastructure	Strategy 75: Connected Public Transport / Public Transport Mobile App	<ul style="list-style-type: none"> • Install RFID and GPS systems in public transport (buses, taxis, etc.) and connect them to the central system of the Department of Transport (DOT). • This enables monitoring of operational status, frequency, etc. • Develop an official mobile app for the Department of Transport to provide information on the status of various public transport services, journey times, fares, route guidance and payment. 	<ul style="list-style-type: none"> • Public Improved convenience for transport users (real-time information, mobile ticket use, access to timetables and route maps) 	Medium-Term (3 years)
Finance	Strategy 65: Mobile Wallet Services.	<ul style="list-style-type: none"> • The National Bank of Nepal (NRB) and Nepal Telecommunications Authority (NTA) should work together to draft a policy framework that allows the involvement of telecom operators and IT companies in promoting financial inclusion in Nepal. • Telecom operators can be given the licenses to operate e-wallet/digital financial services using existing telco KYC for authentication purposes. 	<ul style="list-style-type: none"> • This will enable telecom operators to leverage their existing nationwide network of retailers to increase the reach of financial services in remote/ rural areas. • Help in achieving SDGs related to the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all (SDG Target 8.10) 	Immediate (3 years)

Source: JICA expert team made based on 2019 Digital Nepal Framework.

(2) Toll roads and Toll Road Fees

RBN have already introduced toll road system into some sections of three routes, including National Highway 1 and the East-West Highway, which lead to Kathmandu. On 15 April 2019, RBN decided to introduce toll road system to further 11 major routes across the country, aiming to expand its maintenance budget. The list of toll roads are shown in Figure 2.2.2 below. Sindhuli Road is one of these roads. In

September 2019, toll road system was introduced to Sindhuli Road, where the road was divided into two sections for tolling: Dhulikhel to Khurkot (approximately 90 km) and Khurkot to Bardibas (approximately 70 km).

	Type of Transport and Tax (except Government Transport vehicle)		
	Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment	Car, Jeep, Pickup Van and Tractor	Three-Wheeler Tempo and Motorcycle
	NRs.	NRs.	NRs.
Hetauda-Narayanghat	100	40	10
Narayanghat-Butwal	130	60	10
Naubise-Muglin	120	50	10
Bhairahawa-Bhumai	30	20	10
Kakarvitta-Damak	75	30	10
Damak-Itahari	125	50	10
Biratnagar-Dharan	70	25	10
Koshi-Chaiharwa	140	55	10
Chaiharwa-Pathlaiya	125	85	10
Hetauda-Birgunj	85	35	10
Birgunj-Pathlaiya	50	20	10
Dhulikhel-Khurkot	125	50	15
Khurkot-Sundhuli-Bardibas	115	45	15
Pachkhal-Melamchi	50	15	5

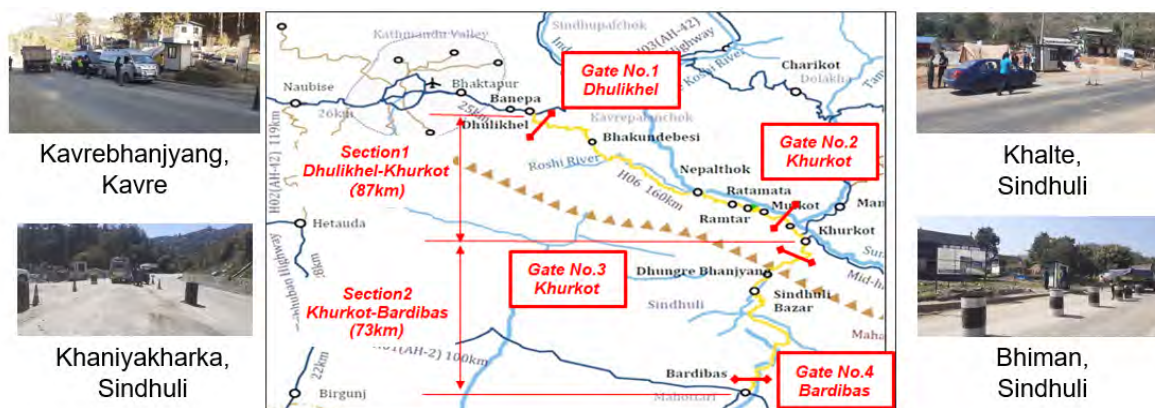
Source: JICA expert team made based on the Official Gazette dated 15 April 2019.

Figure 2.2.2 Toll roads and Toll road Fees in Nepal

2.2.2 Toll Facilities and Operations

(1) Location of Toll Plaza

Location of four toll plazas is shown in Figure 2.2.3.



Source: JICA Expert Team.

Figure 2.2.3 Location map of toll plazas in Sindhuli Road

(2) Toll Facilities

The status of a toll plaza is shown as below in Figure 2.2.4 It consists only of signage, a toll booth and simple median strip.



Source: photo by JICA expert team.

Figure 2.2.4 Bhiman Toll Plaza

(3) Toll Collection System

Toll fees are collected only in cash.

For the toll collection, RBN conducted a public bidding process to procure private companies. In the bidding conducted in 2019, only the Khurkot-Bardibas section was awarded by a private company, whereas the bid was unsuccessful for the Dhurikhel-Khurkot section. RBN requested DOR to collect tolls in the section by their own.

According to the ANNUAL PROGRESS REPORT issued by the RBN, toll revenue in 2019/2020 from Sindhuli Road was 29,133 thousand NRs. in Dhurikhel-Khurkot section and was 21,561 thousand NRs. in Khurkot- Bardibas section. Toll revenues in past five years, including other toll roads, are shown as below in Table 2.2.2.

Table 2.2.2 Toll revenues in the Past Five Years

Unit: Thousand NRs.

Toll roads	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
Naubise-Mugling.	38,431.88	40,385.08	43,791.67	60,954.17	155,251.05
Hetauda-Nayaranghat.	22,438.60	22,979.41	27,168.62	51,071.95	90,377.15
Narayanghat-Butawal.	28,314.95	29,070.09	30,837.66	36,778.05	46,703.10
Bhairahawa-Bhumachi.	1,680.00	2,928.64	5,607.69	8,903.93	10,146.16
Pachkhal-Melamchi	-	-	-	-	6,751.20
Dhurikhel-Khurkot.	-	-	-	-	29,133.88
Khurkot-Sindhuli-Bardibas	-	-	-	-	21,561.80
Total	90,865.43	95,235.04	104,531.36	139,261.08	271,848.88

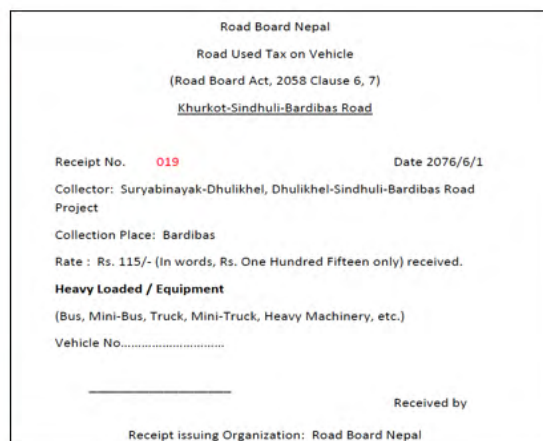
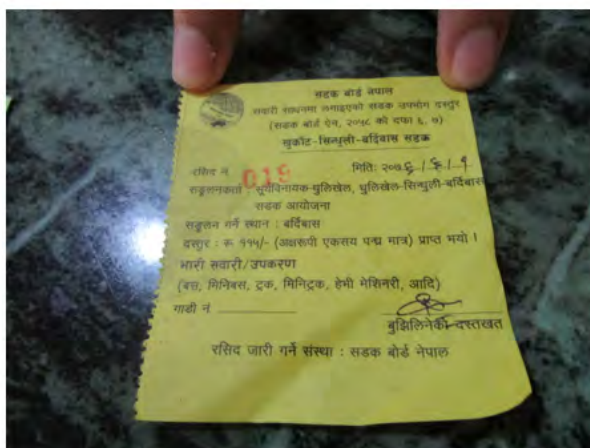
Source: RBN.

(4) Problems with the current toll collection system

The current toll collection system has the following problems.

- The number of vehicles that have passed through toll plazas is not counted.

As shown below in Figure 2.2.5, a toll receipt is issued on paper. On the other hand, RBN does not have a system to track the volume of traffic passing through toll plazas. As a result, RBN has no way to verify that the number of receipts matches the actual traffic volume.



Source: photo by JICA expert team.

Figure 2.2.5 Receipts issued at toll booths in September 2019

- Toll collectors' safety is not secured

As shown in Figure 2.2.6, there are no toll collection booth in the median, and a toll collector stands in the median to collect tolls without wearing helmets. This means that no safety measure has been taken.

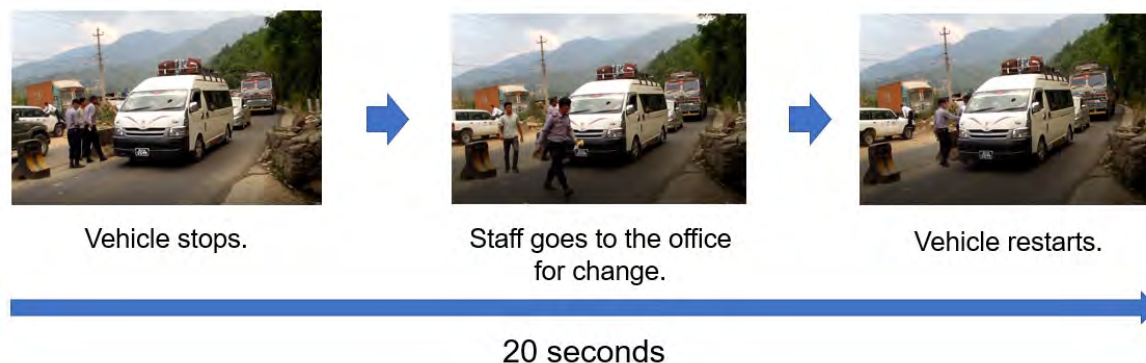


Source: photo by JICA expert team.

Figure 2.2.6 Toll collection at Bhiman toll plazas, November 2021

- Toll collections can be time-consuming

As shown in Figure 2.2.7, a toll booth does not stand in the median, but on the roadside. This means that if a driver needs change, a collector has to return to the roadside booth, requiring a lot of time to collect tolls.



Source: JICA Expert Team.

Figure 2.2.7 Toll collection at Naubise toll Plaza (outside Sindhuli Road), May 2019

2.3 Basic information required for ETC introduction

2.3.1 Standardization of license plates and vehicle information's databaseization

(1) Standardisation of number plates

According to DOTM, the number of registered vehicles in Nepal is about 4 million as of 2022. The number of registered motorbikes occupies 70-80% (about 3 million) of them. DOTM is proceeding the standardization of license plates (standardization of size, unifying numbers into Arabic numerals). According to a contract in 2016 between DECATUR (American company) and JV of TIGERIT (Bangladesh), a project is conducted by DOTM for manufacturing embossed license plates and for attaching them to vehicles. The project is on process although the contract period was to be from 2016 to 2021. Based on the project, the type and size of embossed license plates are standardized and classified into 4 types (Public, Private, Government, Diplomatic) with Arabic numbers from 7 types (Public, Private Government, Diplomatic, Tourism, Public service, VIP).

The new embossed number plates are mandatory for the following three types of vehicles. However, majority of vehicles in Kathmandu are still using the old version of license plates. DOTM referred to the reason for the low achievement is brought from timid attitudes of citizens. According to DOTM's plan, the current 34,500 units (about 0.9%) as of December 2022 are expected to increase to 2.5 million units (about 62%) within the next 1.5 years, and 4 million units (100%) within four years.

- i. Newly purchased vehicles after November 17, 2021
- ii. Vehicles with new ownership transfers after February 13, 2022
- iii. Vehicles renewing registration certificates in Nepal, after May 15, 2022.



A manufacturing factory for new licence plate



Inside the manufacturing factory



Samples of embossed licence plate



Comparison of number plates
Old version (Left) , New version (Right)

Source: JICA expert team.

Figure 2.3.1 Photos related to the new number plate

(2) RFID tag

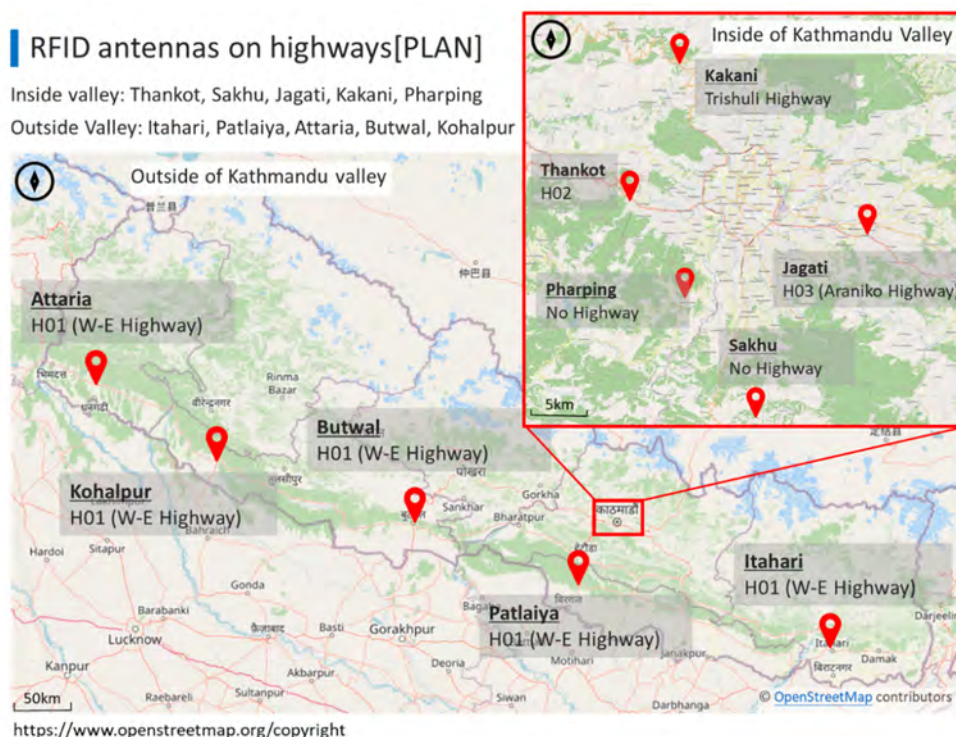
All four wheelers and three wheelers with embossed number plates have RFID sticker on their front windscreen and the two wheelers have RFID tag affixed on their real number plates. The internal chip embedded in RFID sticker/tag contains a unique serial number assigned to each vehicle. The RFID gates that will be built at important locations along the national highways will scan the RFID sticker/tag and communicate with the server maintained at the DoTM. All information about the vehicle including its model, year, type, engine, owner-details etc can be retrieved from the server based on the serial number extracted by the RFID gates from the RFID sticker/tag. The serial number in the sticker/tag of a vehicle can be linked to the bank account of the concerned owner and can be used a means of collection of toll charge in highways. Such system of levying toll charge through electronic means can be implemented in collaboration with commercial banks and national clearing house service center.

In the project implemented by DECATUR and TIGERIT, DOTM plans to manage traffic by installing gates that read RFID tags at five locations inside of the Kathmandu Valley (Thankot, Sakhu, Jagati, Kakani, Pharping) and five outside the Kathmandu Valley (Itahari, Patlaiya, Attaria, Butwal, Kohalpur) on highways. Currently, DOTM is on the process of coordinating with DOR for the installation of RFID gates at Thankot inside of the Kathmandu Valley.



Source: JICA Survey Team

Figure 2.3.2 RFID tag on the windscreen of a vehicle



Source: prepared by JICA expert team based on information from DOTM.

Figure 2.3.3 10 locations for a plan of installation of RFID antennas on highways

(3) National database of vehicle information

According to DOTM, the vehicle information database for managing license plate information and for operating RFID tags will be prepared within one year. Although there is a database system known as the VRS (Vehicle Registration System) and the updated version called EDL-VRS (Electronic Driving License and Vehicle Registration System), DOTM points out that the number of data registered in the system is insufficient. This is because data such as vehicle information is still managed in a paper-based record book.

In addition, the vehicle information database is accessible only to DOTM and the transport offices of respective states. Therefore, traffic police need to get permission from DOTM to access the database.

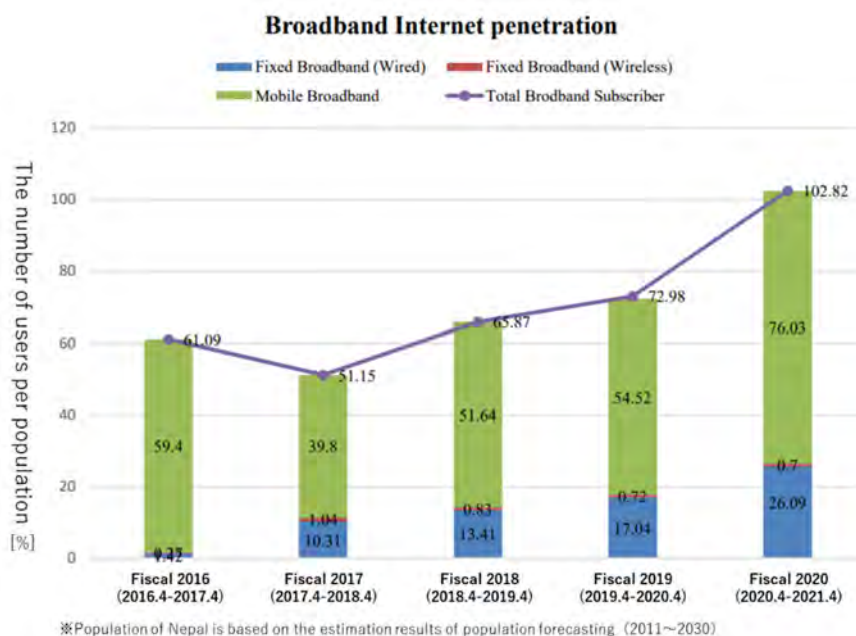
Regarding the accessibility, DOTM mentioned that traffic police and RBN should also be able to access the database because they need to access the vehicle database to check and enforce illegal traffic for operating the ETC.

2.3.2 Penetration of the cashless system.

(1) Internet Penetration rate

In order to confirm the spread of cashless payment in Nepal, the penetration of internet and bank account and credit card are important to consider the feasibility. According to the 2020 Annual Report of the Nepal Telecommunications Authority (NTA) ¹, the internet penetration rate in Nepal has reached 102% of the country's population based on population estimates (2011-2030). According to the estimates, the population as of 2021 is assumed to be 29.87 million. The mobile internet access significantly contribute to the high internet penetration rate. Mobile internet occupied 76% (22.71 million) of the total internet penetration, especially more than 12.89 million people are able to access to 3G internet service. Nepal Telecom has 10.04 million users, and Ncell has 2.46 million users. The total number of 4G users is under 10 million. Telecom occupies 4.74 million of that.

On the other hand, according to a report by Nepal Rastra Bank², smartphone penetration rate was 65% in 2020 and the number of contracted mobile phone accounted for 131% of the total population.



Source: 2019 Digital Nepal Framework.

Figure 2.3.4 Trends of broadband internet penetration (2016-2021)

¹ <https://nta.gov.np/wp-content/uploads/2021/10/NTA-Annual-Report-207778.pdf>

² Financial Access in Nepal, Nepal Rastra Bank, 2021.8

(2) Ownership rate of bank accounts and credit cards

According to a 2017 World Bank report³, 45% of the population owns bank accounts in Nepal. The ownership rate of bank accounts was updated

Besides, the bank account ownership rate trends to increase from 61% as of July 2019 to 67.3% as of June 2020 show according to a report published later by Nepal Rastra Bank. 30% of the population still does not have a bank account.

In addition, according to the World Bank's report, credit card ownership in Nepal is 1% and debit cards are 9%. The situation of card ownership rate means cash payments are still common in Nepal.

2.4 Trends for introduction of ETC.

2.4.1 Perspectives on the necessity of ETC by RBN

RBN recognized the following five points as the necessity of ETC or expected effects of introduction of ETC. expected benefits of introducing ETC, as follows.

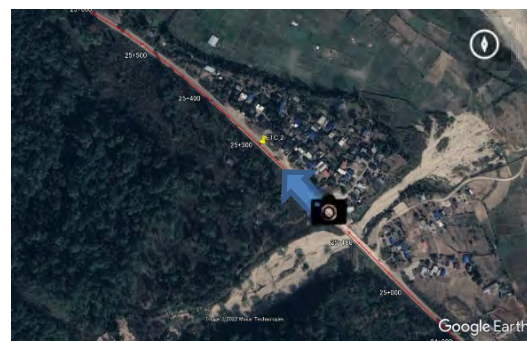
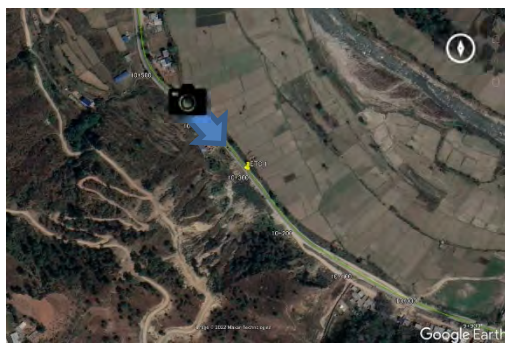
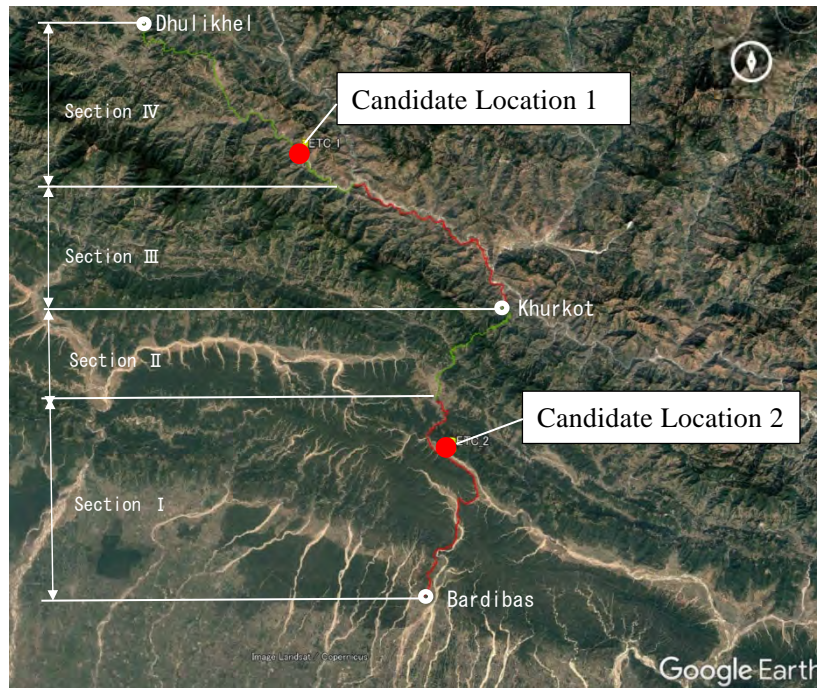
- Establishment of a continuous traffic data recording system
- Efficient collection of toll fares
- Avoidance of traffic congestions at toll collection points
- Conserve operational costs required by manual methods
- Improving convenience for drivers in paying toll fares

2.4.2 Site checks of potential ETC installation sites.

JICA survey team visited the candidate locations for ETC on the Sindhuli Road (Dhulikhel-Bardibas) from 27th to 28th in 2022 for checking the actual situation focusing the points below The road extends over about 150 m.

- ✓ Width: within ROW (15+15=30m)
- ✓ Incline: Less than 2% and never more than 3%
- ✓ Required Length : more than 150m
- ✓ No trees around need to be protected for environmental conservation.
- ✓ Areas with low population density
- ✓ Securing altanative route during construction
- ✓ Areas that are unlikely to be damaged by debris

³ 2019 Digital Nepal Framework.



Dhulikhel – Khurkot (Candidate 1)

Khurkot – Bardibas (Candidate 2)

Ch. 120+200~120+400 (Sec. IV)

Ch. 25+200~25+400 (Sec.I)

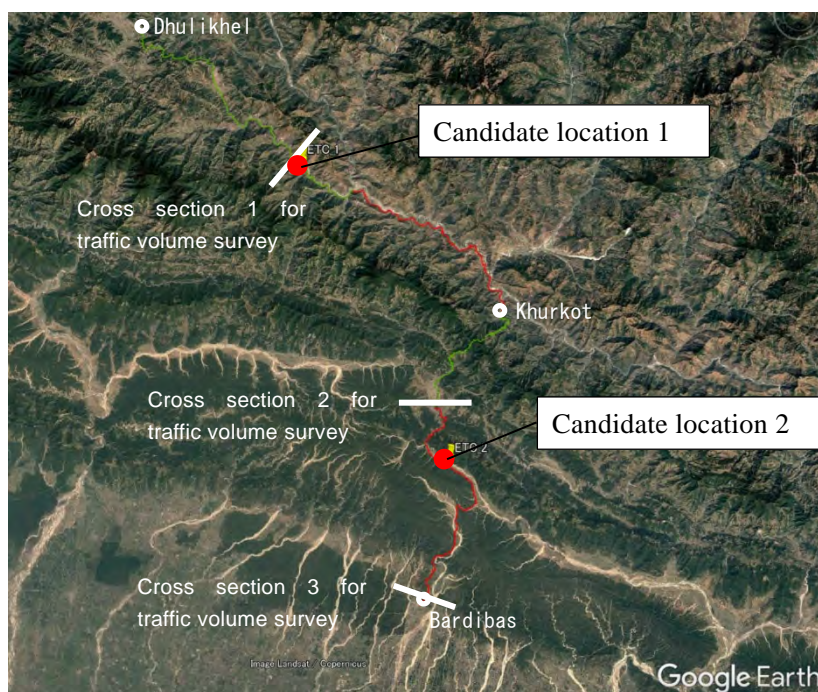
Source: JICA Expert Team.

Figure 2.4.1 Candidate locations for ETC installation

2.4.3 Estimated average daily traffic volume at cross sections

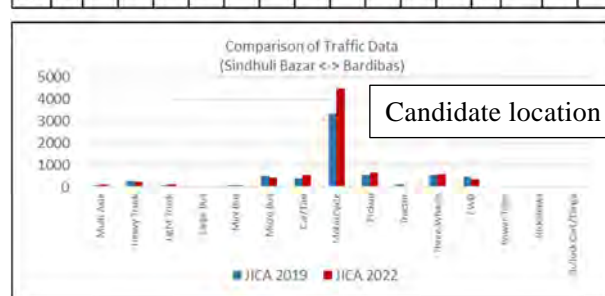
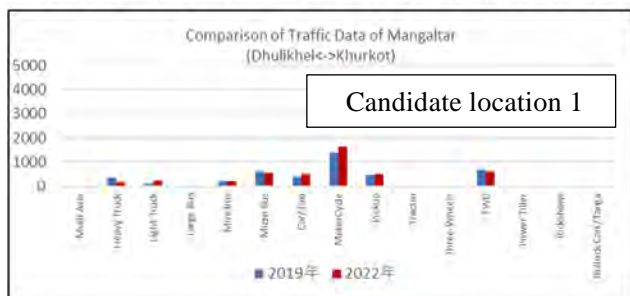
Based on the existing traffic survey results, average daily traffic volume at each cross section were estimated in the candidate locations for installing ETC. The targeted crosssection for the estimation and the estimated average daily traffic are shown in Figure 2.4.2. The estimated traffic volume at the targeted cross section 1 in the figure is used as the estimated traffic volume at candidate 1. On the other hand, The estimated traffic volume at candidate 2 is used as the average values calculated from traffic volume at candidate 2 and 3. Each estimated traffic volume is shown in Figure 2.4.2.

The result of estimation show that average daily traffic volume at the cross section increased in 2022 compared to 2019. In 2022, the average daily traffic generated at the candidate 1 is about 7,700 vehicles, and of the candidate 2 it is about 4,400 vehicles. Among them, Motorcycle accounts for a large proportion, accounting for about 52% in the candidate 1 and about 22% in the candidate 2.



Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Van/Mini	Micro Bus	Car/Truck	Motor Cycle	Pickup	Tractor	Three-wheeler	Two-wheeler	Power Tiller	Other	Auto Rickshaw	Auto Cycle/Taxi	Other
JICA 2019	2	355	91	1	219	593	400	1378	475	2	11	697	0	0	0	0	8224
JICA 2022	0	155	298	11	201	520	487	1630	505	5	3	817	1	0	0	0	4371

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Van/Mini	Micro Bus	Car/Truck	Motor Cycle	Pickup	Tractor	Three-wheeler	Two-wheeler	Power Tiller	Other	Auto Rickshaw	Auto Cycle/Taxi	Other
JICA 2019	97	279	73	1	101	519	379	3323	528	114	528	463	2	1	0	0	6408
JICA 2022	113	230	128	27	90	425	537	4485	679	59	595	368	0	7	0	0	7743



Source: JICA expert team.

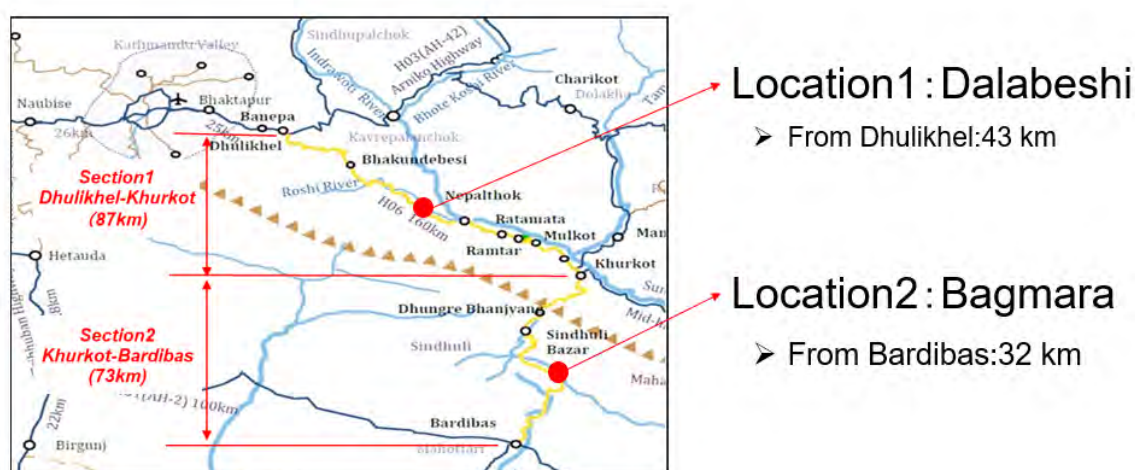
Figure 2.4.2 Estimated average daily traffic volume at candidate locations for ETC

2.5 Procurement status review and confirmation

On 16 September 2020, RBN published a tender for an ETC named Hybrid Electronic Toll Collection System(HETC).

2.5.1 Toll-collecting section

The HETC was to be installed into two sections where tolls have already been collected by cash: Dhurikhel-Khurkot and Khurkot-Bardibas. The location of the toll plazas is near the midpoint of each section, as shown below in Figure 2.5.1.



Source: JICA expert team.

Figure 2.5.1 HETC toll plaza

2.5.2 Bidding Units

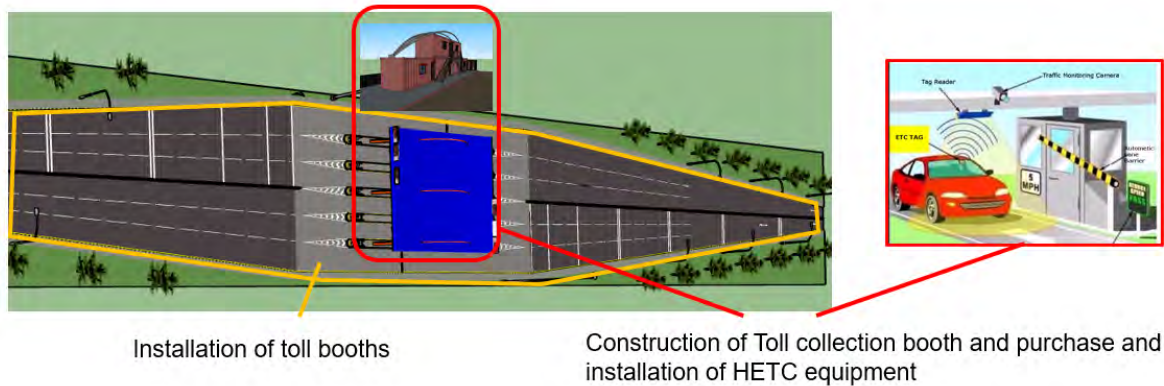
As shown in Table 2.5.1 and Figure 2.5.2, the order was divided into two units. One was for the Installation of toll booths and the other for Construction of Toll collection booth and purchase and installation of HETC equipment.

Table 2.5.1 Tender subject and description

Subject	Items	Contract Period
Installation of toll booths	Construction of toll islands Construction of toll collection lanes Construction of pedestrian lanes Concrete Asphalt pavement Demolition of existing structures	15 months
Construction of Toll collection booth and purchase and installation of HETC equipment	Construction of administrative buildings Installation of HETC equipment Establishing roofs, signage of toll collection booth Establishing a manual of operation and Maintenance	15 months

	Training of RBN engineers On-site technical support Maintenance support(for 3 years)	
--	--	--

Source: JICA expert team made based on material provided by RBN.

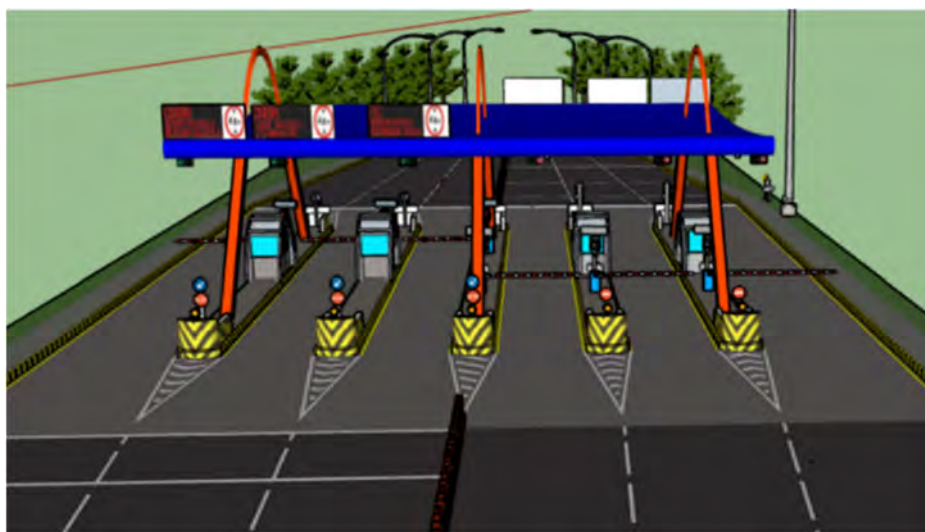


Source: JICA expert team made based on material provided by RBN.

Figure 2.5.2 Bidding Units

2.5.3 Method of toll collection

It was planned to use both automatic and manual collection system. For the automatic toll collection, road users purchase an ETC tag at toll booth, affix it to the windscreen of their vehicles and pay a toll with the tag which communicates via radio waves with a tag reader installed at each toll booth. For the manual collection, staff is stationed at toll booths to visually identify the type of vehicles entering a toll booth before collecting a toll. Although the tender documents clearly indicated the equipment and specifications required as a list of procured equipment, they did not specify the method of operation.



Source: RBN.

Figure 2.5.3 Image of HETC toll booths

2.5.4 Status of Contractor Procurement

RBN started a public announcement on 16 September 2020, but they cancelled the tender on 1 July 2022 after failing to select the successful bidder.

2.6 Identification of issues on introduction of ETC

2.6.1 Establishment of a system for collecting and storing actual traffic volumes

The existing fee collection system is a manual system and the actual work is carried out by private operators under contract. The amount paid by private operators to the RBN is a fixed fee based on the contract with the RBN, which does not match the actual amount of collected toll fee. In case that the traffic volume is lower than expected, the private operator sometimes do a lawsuit against RBN to reduce the amount paid. RBN sometimes lost the lawsuit because RBN could not verify the appeal from the private operator.

Given this situation, it is necessary for the RBN to establish a system to store and manage data on actual traffic volume and toll revenues in order to ensure reliable toll collection.

2.6.2 Clear distinction between exempt and non-exempt

As composition of the vehicles passing through a Sindhuliroad road, motorcycle consists 40~60%. Although toll fee for motorcycle are regulated in the Official Gazette, there is no statement in the contract between the private business operator and RBN. Regarding toll collection of motorcycle, there is a gap between the current system and the actual situation.

Besides, "Residents" are also excluded from the target of toll collection, so that the private business operator is collecting toll under the condition where it is unclear whether the passing vehicle is a "resident" or "the others". Although RBN plans not to change the policy of collection targets, clarifying the targets is to be needed when implementing the ETC.

2.6.3 Establishment of a fee collection enforcement system

For operation and maintenance of ETC, engineers for information systems, equipment maintenance, traffic data management, etc. will also be required. Since it is not easy for current RBN members to operate the system continuously, an issue regarding how RBN operates the ETC such as improving organizational capacity of RBN (including cooperation with external organizations) becomes crucial.

2.6.4 Subdivision of vehicle classification

Currently, number of vehicle classification for imposing toll fare is 3types as per the Gazette dated 15 April 2019, which are “Three-Wheeler Tempo and Motorcycle”, “Car, Jeep, Pick up Van and Tracker” and “Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment”.

According to the Gazette, road operators charge the same toll fare for both Mini-Buse and Multi-Axle Trailers. However, from the point of view of maintenance works such as damage to the pavement, this categorization causes unfairness. Therefore, it is highly recommended to consider subdividing vehicle classifications based on dimensions or number of axles or combination of both.

The following tables are oversea references of vehicle classifications for toll roads.

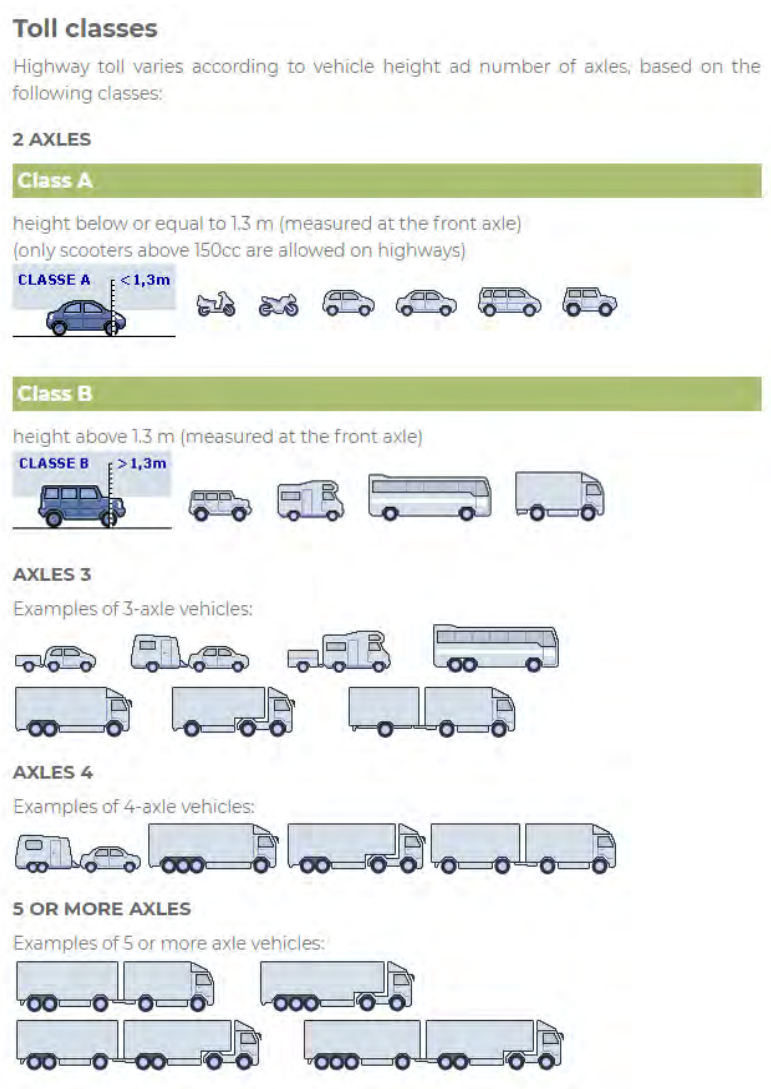






Figure 2.6.1 Reference of vehicle classifications for toll roads (Italy, Autostrade)

3. Recommendations for the introduction of ETC

VEHICLE CLASS APPLICABLE TO CONVENTIONAL TOLL PLAZAS		
CLASS 1	All light vehicles	
HEAVY VEHICLES		
CLASS 2	2 AXLE	
CLASS 3	3 and 4 AXLE	
CLASS 4	5 or more AXLE	

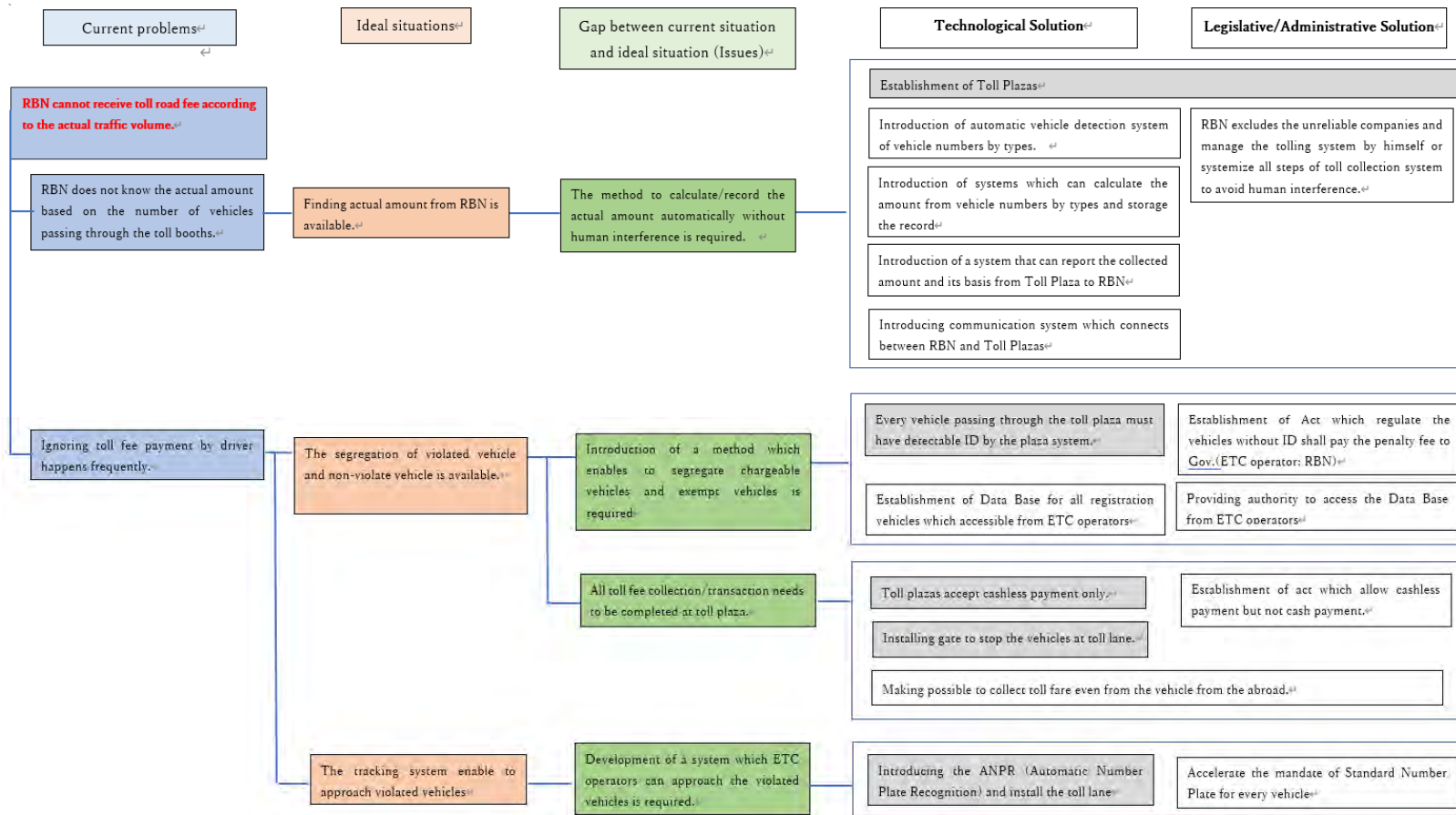
Source : 2020-sanral-toll-tariff-booklet_1

Figure 2.6.2 Reference of vehicle classifications for toll roads (South Africa)

3.1 Consideration of the system to be introduced

3.1.1 Issues and countermeasures on introducing ETC

An analysis of the issues based on the current problems for toll collection and proposed countermeasures are shown in Figure 3.1.1



Source: JICA Expert Team.

Figure 3.1.1 Identification of issues on introduction of ETC

3.1.2 Prospective ETC

There are five ETC types below.

(1) Touch & Go

It is a prepaid IC card system similar to Suica and PASMO widely used in Japan. The users stop at a toll booth and touches their cards to pay tolls.

(2) DSRC

Dedicated Short Range Communication (DSRC) is a communication method used for roadside unit-to-vehicle communication in narrow areas. The method can be broadly classified into two types: the active method used for the ETC in Japan, in which its OBU also has a transmitter function, and the passive method commonly used in Europe, in which its OBU does not have a transmitter function but reflects radio waves from roadside equipment to communicate.

(3) RFID

Radio Frequency Identifier (RFID) is a system that exchanges information by transmitting and receiving radio waves between an IC tag put on a vehicle and an RFID antenna on the road side. The IC tag(vehicle- mounted equipment) contains an IC chip with ID information and an antenna. In addition, the tag is compact and inexpensive because it does not need a power source in the car, getting the power necessary for its operation from radio waves transmitted from the roadside unit.

(4) GNSS

Global Navigation Satellite System (GNSS) is a method that uses positioning information from satellites to determine the position and route of vehicles equipped with on-board equipment, and does not require roadside equipment infrastructure.

(5) ANPR

Automatic Number Plate Recognition (ANPR) is a system that detects vehicle number plates from images taken on the road, reads numbers on a plate using OCR (Optical Character Recognition), and identifies and charges the vehicle owner by checking the number with the database.

In countries where number plates are not standardised, or in road environments where number plates are difficult to read, such as snow-covered or unpaved roads, it will be difficult to maintain the ETC using only the ANPR system, requiring the use of other systems, such as RFID in combination.

(6) ETC to be installed on Sindhuli road.

The advantages and disadvantages of each ETC type are shown in Table 3.1.1.

For the ETC to be introduced into the Sindhuli road, it is recommended to focus on Touch&Go and RFID from the following perspectives

- Low rate of bank account and credit card ownership required for cashless payments
- Failure to complete number plate standardisation.
- Adoption of RFID in number plate standardisation.
- Desirability of reducing the burden on users.
- Less developed OBU market in Nepal.

Table 3.1.1 Advantages and disadvantages of various ETC

	Touch & Go	DSRC	RFID	GNSS	ANPR
Overview	<ul style="list-style-type: none"> • A system by touching an IC card to a card reader with one stop at a toll booth • Popular in Indonesia etc. 	<ul style="list-style-type: none"> • A system that On-board units(OBU) and Roadside Units exchange information by radio waves • Popular in Europe, Japan, etc. 	<ul style="list-style-type: none"> • A system that exchanges information by transmitting and receiving radio waves between tags on the vehicle and RFID antennas on the roadside. • Popular in many countries such as the United States and India 	<ul style="list-style-type: none"> • A system that detects the position and travel route of a vehicle equipped with an OBU by using positioning information from satellites • Popular in Eastern Europe for heavy-duty vehicles 	<ul style="list-style-type: none"> • A system that identifies vehicle owners and charges fares by reading the vehicle number plates with OCR and compare that with the database
Advantages	<ul style="list-style-type: none"> • On-board Units are not necessary 	<ul style="list-style-type: none"> • High communication Accuracy 	<ul style="list-style-type: none"> • OBU are not required, only inexpensive tags are needed 	<ul style="list-style-type: none"> • OBU can be substituted with smartphone with GPS • Roadside Units are not needed 	<ul style="list-style-type: none"> • OBU are not required
Disadvantages	<ul style="list-style-type: none"> • Low handling capacity compare with other system 	<ul style="list-style-type: none"> • OBU Price is relatively high 	<ul style="list-style-type: none"> Communication accuracy is relatively low 	<ul style="list-style-type: none"> • Substitution of OBU is relatively expensive • There is a risk of spoofing 	<ul style="list-style-type: none"> • Accuracy is affected by weather • Standardization of license plates should be preceded

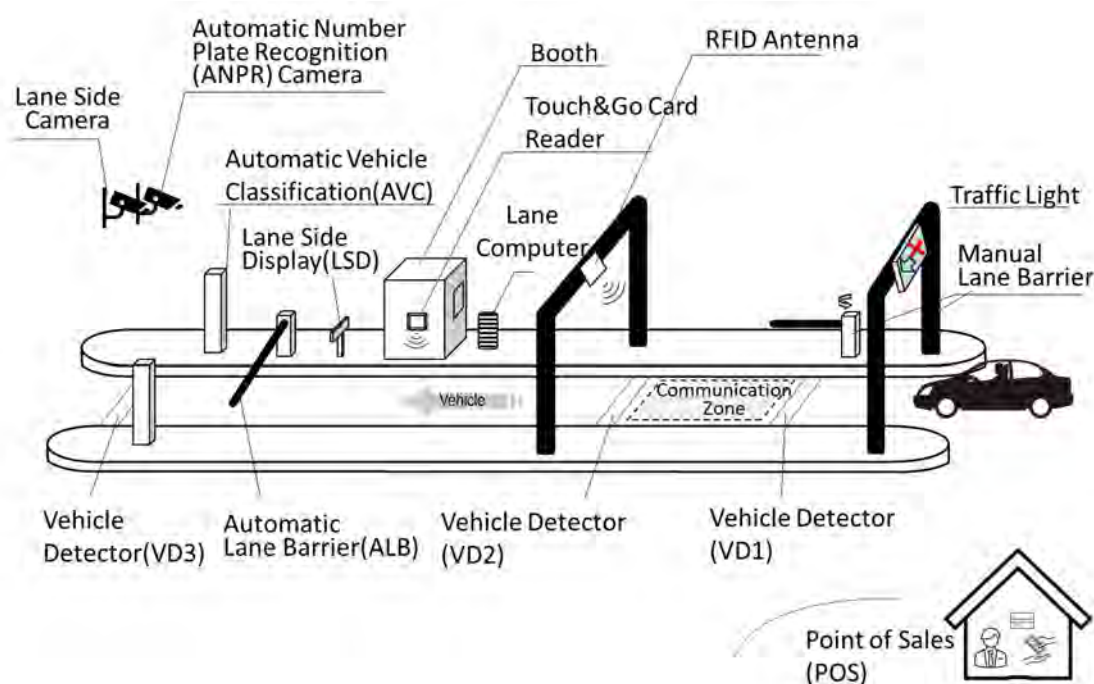
3.1.3 Proposed ETC

(1) Overview of proposed system

Based on the review in 3.1.1 and 3.1.2, the following three points is required for the proposed ETC.

Based on the considerations in 3.1.1 and 3.1.2, the following three main points were identified for the introduction of ETC. Figure 3.1.2 shows overview of the proposed ETC.

- Establishing a complete cashless system
- Development of equipment that can deal with the cashless automobiles
- Introducing a system that can be implemented on all toll roads in Nepal

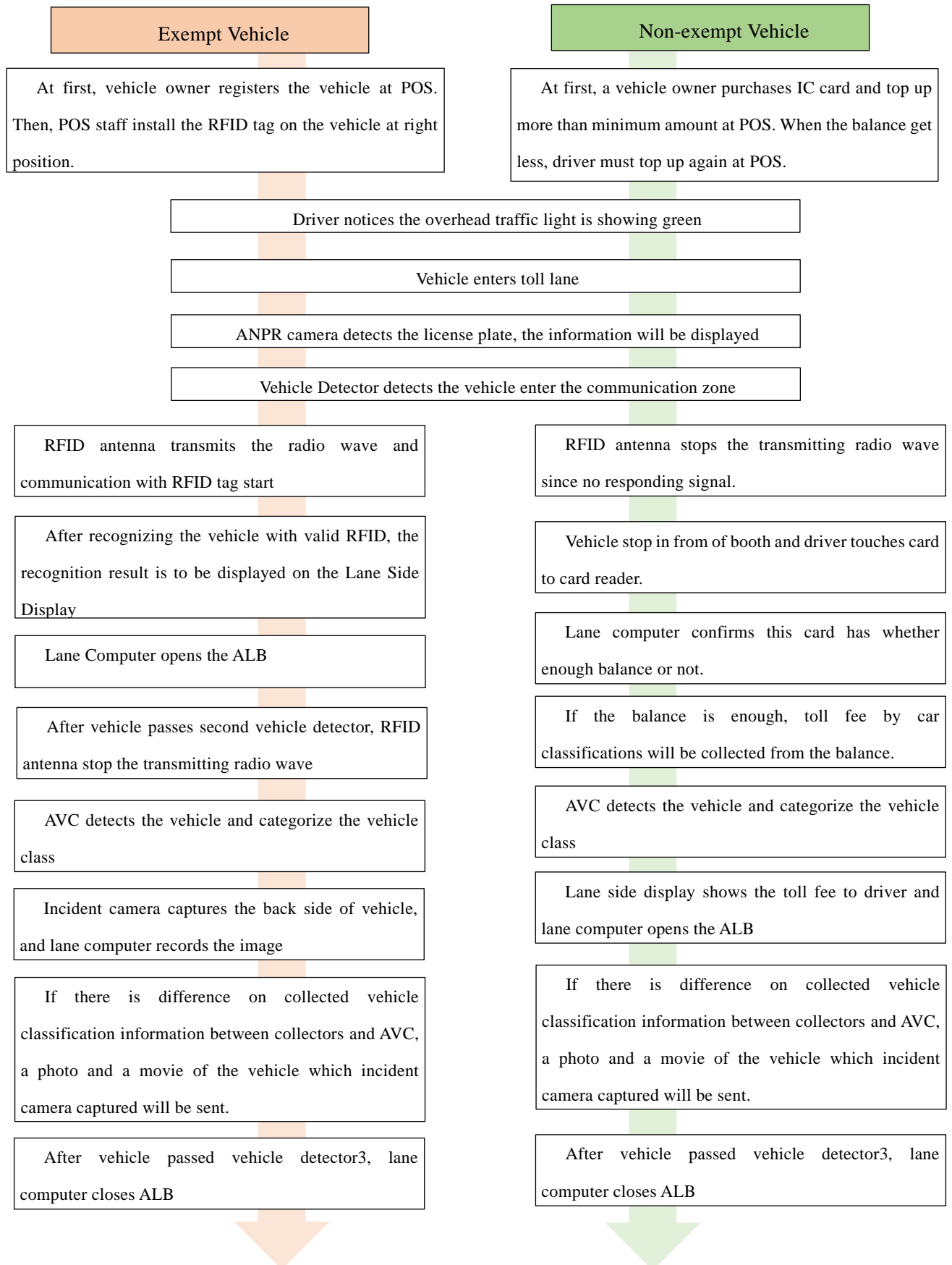


Source: JICA Expert Team.

Figure 3.1.2 Proposed ETC concept

The proposed ETC consists of two passing methods for exempt and non exempt vehicles. RFID method is adopted for exempt vehicles. RBN distributes RFID tags for free in advance to owners of exempt vehicles and the vehicle owners shall affix RFID tags to the inside of the windshield. After the vehicle enter the toll lane, RFID antenna transmits the radio wave and communication with RFID tag on the vehicle. Then, a bar opens to pass through without stop.

Touch and Go method is adopted for non exempt vehicles. The car owner buys a prepaid card at the POS in advance and charges a certain amount. At the toll booth, touch the prepaid card over the reader and pay the fee.



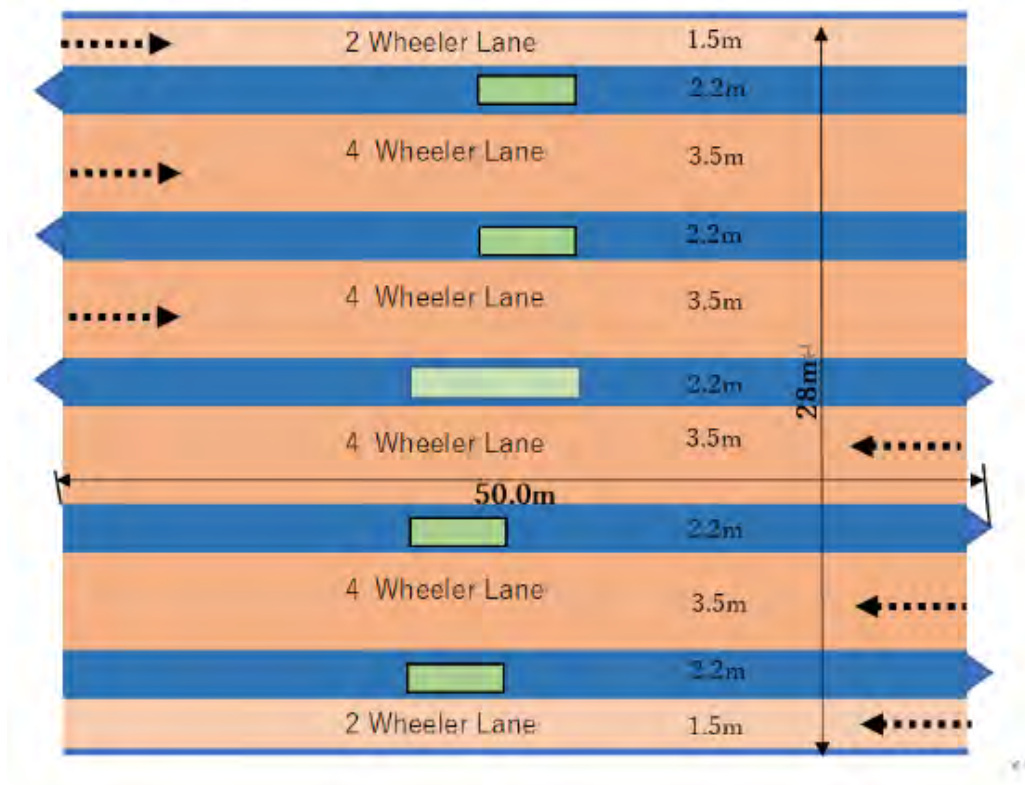
Source: JICA Expert Team.

Figure 3.1.3 Flows when passing through the proposed ETC

(2) Layout of each toll lane.

The layout of each toll lane is shown in Figure 3.1.4.

- ✓ The toll plaza will have three lanes in one direction, two normal lanes and one dedicated lane for two-wheeled vehicles. The cross-sectional traffic volumes for the proposed toll plaza are 7,700 vehicles/day and 4,400 vehicles/day, but 3,700 vehicles/day and 3,000 vehicles/day, excluding two-wheeled vehicles. Even with a 20% concentration of traffic during peak hours, 740 vehicles/day and 600 vehicles/day, the throughput per lane of 1,200 vehicles/hour with full ETC conversion and 400 vehicles/hour for T&G is not a problem. However, if the RFID Tag or antenna (reader) is a low-end product or if the Tag is attached to the vehicle in the wrong way, a stop is made and a human check is required, which reduces the throughput at once.
- ✓ Two toll lanes for regular vehicles should be reserved. This is to allow for maintenance and to deal with damage caused by vehicles crashing into each other. In addition, due to the large number of two-wheeled vehicles, a dedicated lane for two-wheeled vehicles will be provided.
- ✓ The width of the toll lanes shall be 3.5 m for regular vehicles and 1.5 m for two-wheelers. The width of the lanes for regular vehicles is the width used worldwide, while the width of the lanes for two-wheeled vehicles adopts the Indian case, which has introduced dedicated lanes for two-wheeled vehicles. The Sinzli road will not have lanes for heavy vehicles, as multi-axle vehicles cannot operate on the narrow width and steep gradients of the mountain road.
- ✓ The total width of the toll plaza shall be 28 m and the length of the island shall be 50 m from the bullnose end. The middle island, with bullnose grounded on both sides, will be one bullnose longer.



Source: JICA expert team.

Figure 3.1.4 Image of the layout of each toll lane

(3) Organizational Structure

As shown in Table 3.1.2, the operation of the ETC requires about 100 people, including those working for the RBN and for the toll booths.

It is recommended that all positions should be directly managed by the RBN staff at the beginning of implementation to improve RBN staff's management skill regarding the system.

After improving RBN staff's management skill regarding the system, some of the positions at toll booth 1 and toll booth 2 could be outsourced to private companies. However, Area Manager, Equipment Maintenance and Finance should remain directly managed by the RBN staff because it is an important position in the toll collection operation.

Table 3.1.2 Organizational Structure

Place	Position	Duty	The number of staff	Work Style
RBN	General Manager	Overall management	1	Day shift
	Engineer (Traffic Data Management)	Overall management of traffic data	1	Day shift
	System Engineer	Overall management of system	1	Day shift
	Overall Finance Management	Overall management of fee revenue	1	Day shift
	Admin Wrap-up	General manager of administrative affairs	1	Day shift
Toll booth 1	Area Manager(RBN Staff)	Manage the entire toll booth	1	Day shift
	T&G salesperson (in POS)	Selling T&G cards	4	Three-shift system
	Toll lane Warden	Dealing with passers-by in each lane	24	Three-shift system (4 people x 6 lanes)
	Equipment Maintenance	Troubleshooting ETC equipment	4	Three-shift system
	Finance	Fee revenue management	4	Three-shift system
	Admin	Miscellaneous affairs	4	Three-shift system
	Guard	Toll gate crime management	4	Three-shift system
Toll booth 2	Area Manager(RBN Staff)	Manage the entire toll booth	1	Day shift
	T&G salesperson (in POS)	Selling T&G cards	4	Three-shift system
	Toll lane Warden	Dealing with passers-by in each lane	24	Three-shift system (4 people x 6 lanes)
	Equipment Maintenance	Troubleshooting of ETC equipment	4	Three-shift system
	Finance	Fee revenue management	4	Three-shift system
	Admin	Miscellaneous affairs	4	Three-shift system
	Guard	Toll gate crime management	4	Three-shift system
total amount			95	45 people at each toll booth.

Source: JICA Expert Team.

(4) Estimated Cost

Installation costs are calculated with reference to the costs of similar ETC in India, etc. It is shown in Table 3.1.3.

Table 3.1.3 Estimated Cost of the proposed ETC

No.	Items	volume	INR	NPR
1	ETC installation			
1.1	Lane-level system	12 lanes (8 for regular vehicles + 4 for two-wheeled vehicles)	20,804,580	33,287,328
1.2	Plaza-level system	2 Toll Plazas (including POS system)	22,092,196	35,347,513
1.3	System placed in RBN	Toll station monitoring in RBN office , Real-time toll collection by vehicle type and traffic volume, Daily reports, Data storage period of at least 90 days	3,000,000	4,800,000
1.4	RFID Tag	150 NPR x 3,000 sheets	450,000	720,000
1.5	IC Card (Mifare)	100 NPR x 5,000 sheets	500,000	800,000
1 Total				74,954,841
2	Civil engineering works (Road Widening Costs)			200,000,000
3	Toll station construction works			30,000,000
1-3 Total				304,954,841

Source: JICA Expert Team

Note 1: The estimation includes Indian GST (Goods and Services Tax) and does not include import duty from India to Nepal.

Note 2: With reference to the data provided by RBN, the cost of civil engineering works was estimated to be approximately twice as the cost of installing the ETC, while the cost of building toll booths was estimated to be approximately 0.3 times the cost of installing the ETC.

Note 3: It is expected that 3,000 RFID Tags are distributed for residents and 5,000 IC Cards for non-residents.

Note 4: Calculated as 1 INR = 1.6 NPR (Rate dated 17 October 2022).

4. Appendix

4.1 Roadmap for ETC development in Nepal

Roadmap for development of unified ETC in Nepal is shown in Figure 4.1.1.

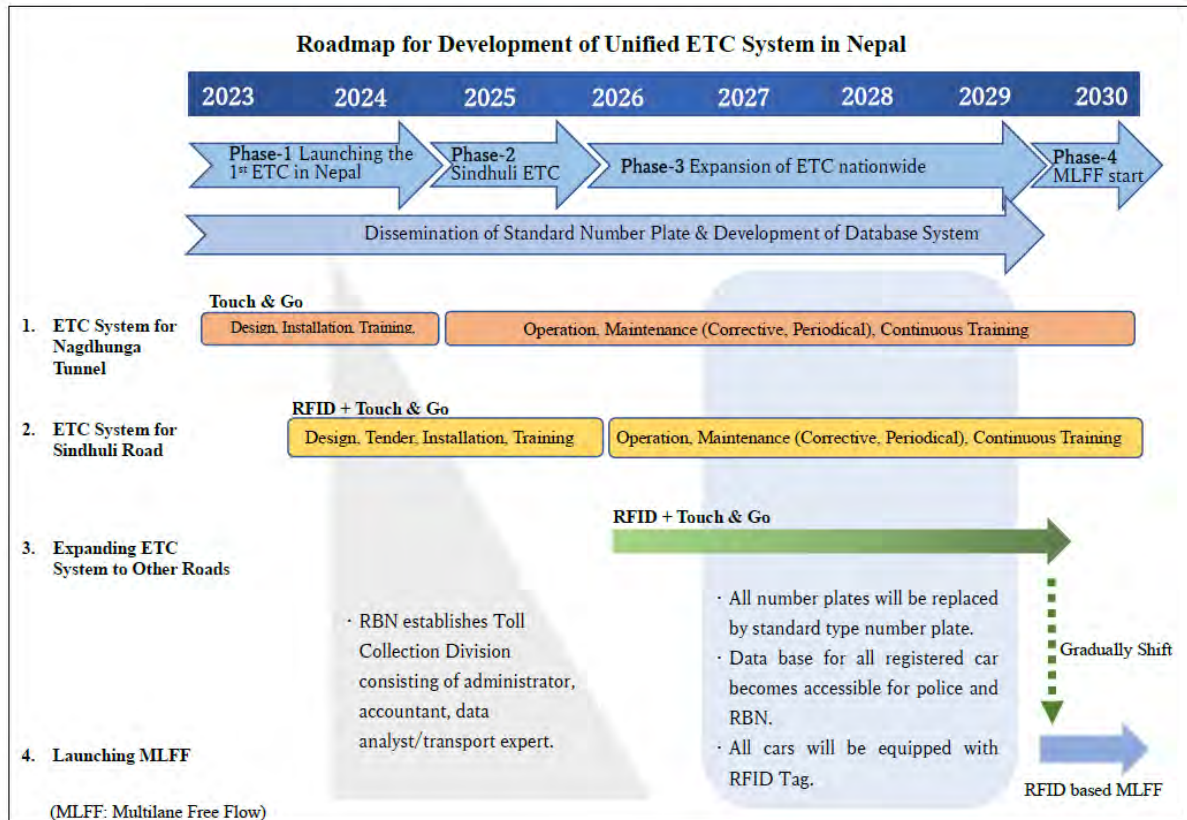


Figure 4.1.1 Roadmap for Development of Unified ETC in Nepal

**The Project for
Operation and Maintenance of
The Sindhuli Road Phase 2**

**Mid/Long term
Operation and Maintenance
Plan**

February 2023

JICA Expert Team

- Table of Contents -

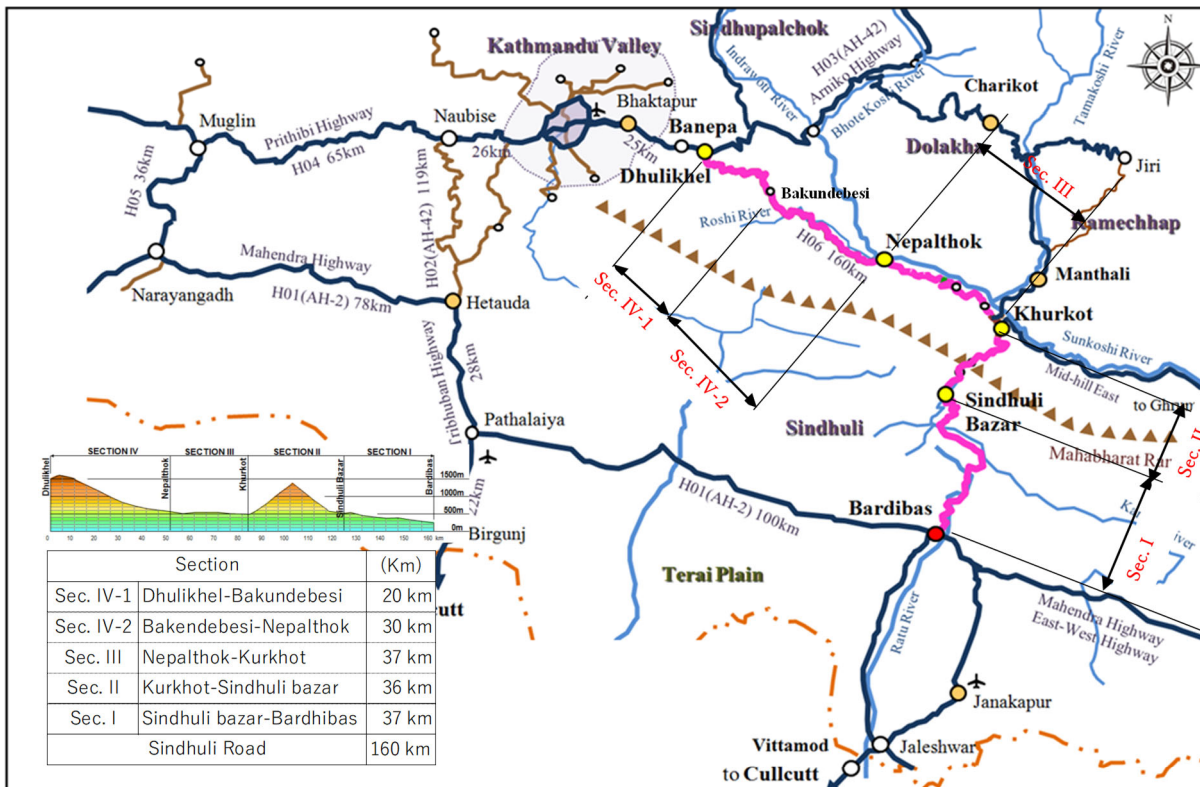
1	Background.....	2
2	Future Transport Network between Kathmandu and Terai.....	2
3	Future Traffic Demand Forecast in 2032.....	3
4	Assumed Role and Function of the Sindhuli Road.....	4
5	Proposed Traffic Capacity Enhancement Measures.....	4
6	Traffic Characteristic of the Sindhuli Road.....	6
7	Proposed Road Maintenance Plan (Mid-term Plan and Long-term Plan).....	7
8	Proposed Implementation Plan.....	7
9	Maintenance Budget for the Sindhuli Road.....	8
10	Recommendations.....	9
11	Some Selected Photographs.....	10

List of Tables

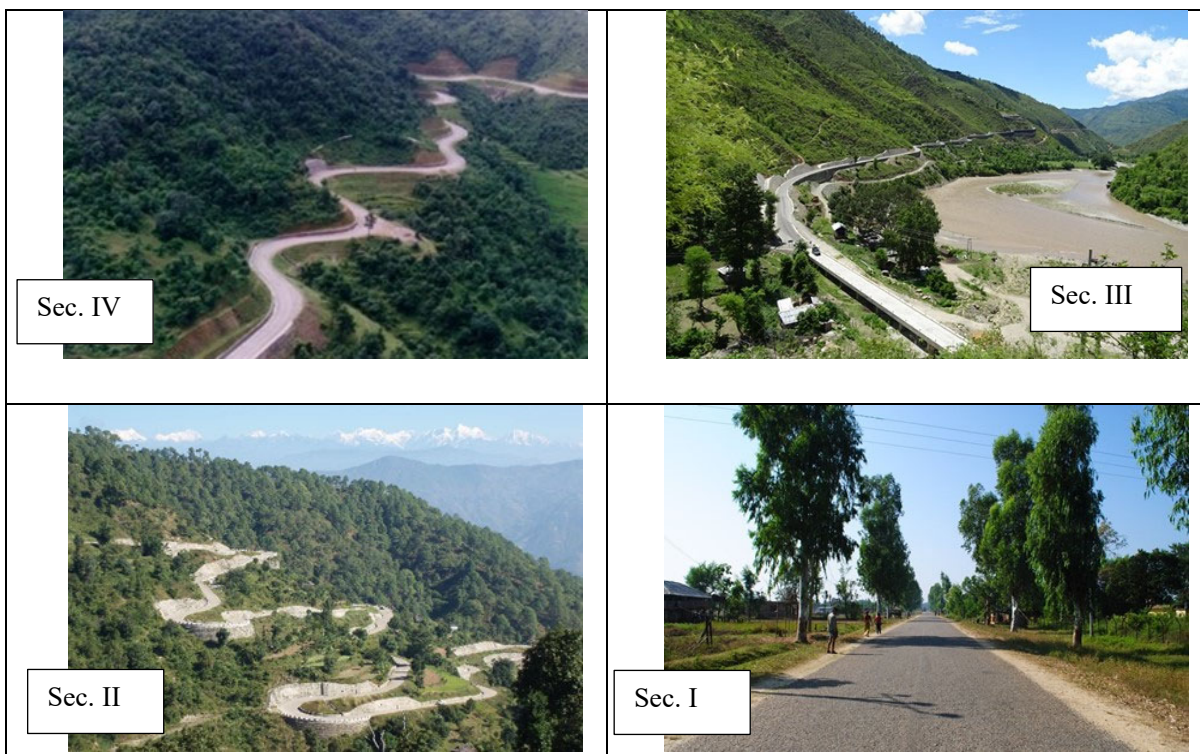
Table 1	Proposed Traffic Capacity Enhancement Measures	5
Table 2	Proposed Implementation Plan	8
Table 3	Maintenance Budgets allocated to the Sindhuli Road	9

List of Figures

Figure 1	Future Transport Network between Kathmandu and Terai	2
Figure 2	Future Traffic Demand Forecast in 2032	3
Figure 3	Traffic Accidents and Traffic Volume on the Sindhuli Road.....	6



Location Map of the Sindhuli Road



Photos

1 Background

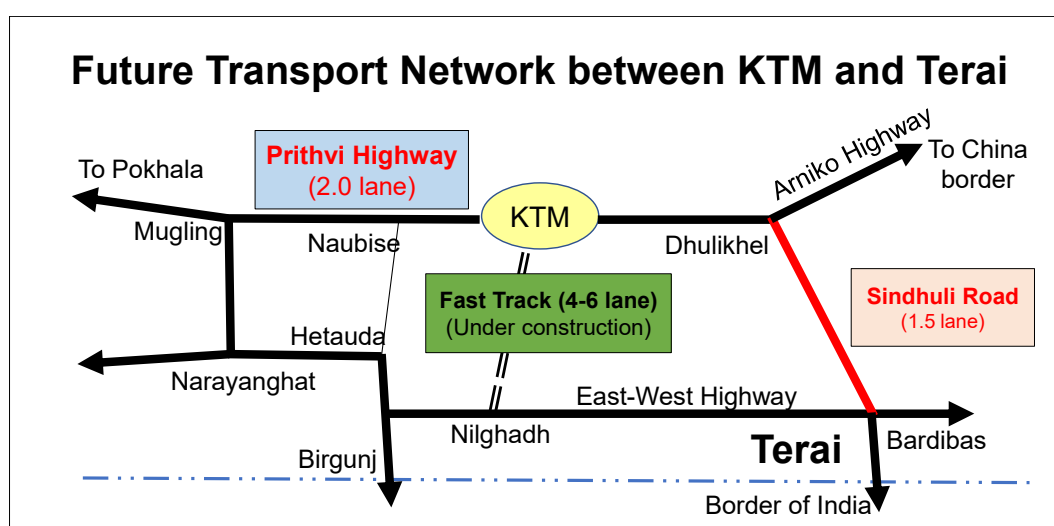
The mid/long-term plan has been formulated based on the PDM activities of Output 1, “1-3 Formulate the mid-term operation and maintenance plan for the Sindhuli Road which will be implemented after the completion of the Project” that is currently being implemented under the The Project for Operation and Maintenance of the Sindhuli Road Phase 2 (SROM2) supported by JICA. The mid-term plan will cover works to be implemented for five (5) years starting in 2023, and the long-term plan will be ten (10) years from 2023 to 2032.

In preparing this mid/long-term plan, we clarified the expected roles and functions of the Sindhuli Road in the future transport network between Kathmandu and Terai, paying attention to the Fast Track Road Project under construction with a high design standard of 4-6 lanes, since Fast Track will not only affect the future traffic demand of Sindhuli Road, but also it has a great impact on the decision whether to allow large heavy vehicles to pass on Sindhuli Road.

This mid/long term plan clarifies these issues and proposed concrete measures necessary for Sindhuli Road in the future.

2 Future Transport Network between Kathmandu and Terai

The future transport network between Kathmandu and Terai will be consist of three routes, namely Prithive Highway from western side, Sindhuli Road from eastern side and Fast Track Project passing through north-south as shown in Figure 1. Construction of the Fast Track Project is expected to be completed within 10 years from the date of this report.



Source: JICA Expert Team

Figure 1 Future Transport Network between Kathmandu and Terai

Fast Track will be the most important transport route between Kathmandu and Terai since it is only 80km long and has large road capacity with high design standard with 4-6 lanes. Therefore, when the Fast Track Project is completed, it is needed to consider the impact of Fast Track Project when we estimate the future traffic demand of Sindhuli Road. The problem is that this construction progress has been significantly delayed from the initial expectations, so no one can predict when it will be completed. If considered the current progress of about 20%, it is considered to take 10 years or more to complete the construction. Therefore, in this road maintenance plan, it is assumed the completion of this Fast Track project is in 2032, 10 years from now on.

3 Future Traffic Demand Forecast in 2032

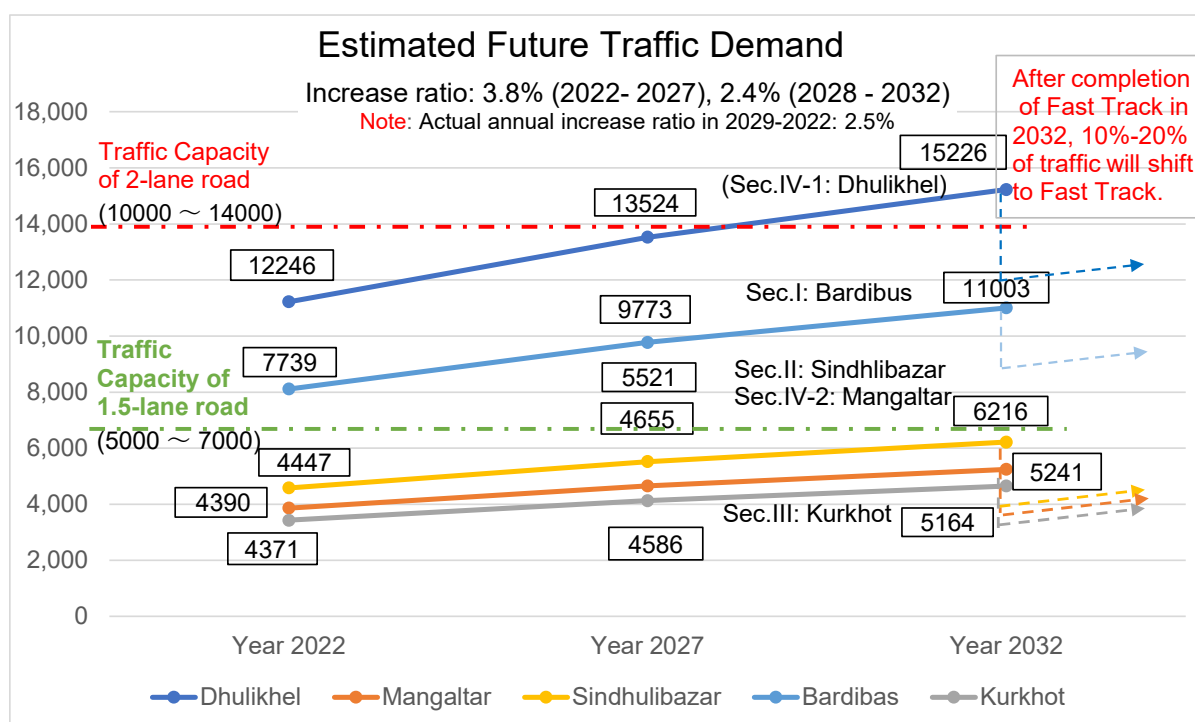
Future traffic volume was estimated for each section for the next 10 years (2023 - 2032) under the following assumptions.

- Base traffic volume is based on Traffic survey conducted by SROM 2 in May 2022.
- Traffic growth ratio is 3.8% for the year 2022 - 2027 and 2.4% for the year 2028 – 2032.

It is noted that the traffic growth rate after 2022 was developed based on the forecast trend in the survey report titled as “Data Collection Survey on the Sindhuli Road Capacity Enhancement in Nepal” conducted by JICA in February 2022. When compared with the actual growth rate of 2.5% in the Sindhuli Road over the past four years, these growth rate seems to be reasonable.

- Through traffic on the Sindhuli Road: According to the traffic survey conducted by SROM2 in 2019 and 2022, about 20% to 25% of the total traffic volume is through traffic between Kathmandu and West Terai.
- Impact of Fast Track: Once Fast Track is completed in 2032 and opened to traffic, we can assume that a half through traffic on the Sindhuli Road will be shifted to Fast Track after 2032.
- Traffic capacity: The traffic capacity of roads is assumed to be 5,000-7,000 ADT for 1.5-lane road and 10,000-14,000 ADT for 2-lane road. The traffic capacity varies depending on the width of the road, the longitudinal gradient, and the environment of the roadside conditions.

Based on the above assumption, the future traffic volume for 2032 was estimated as shown below.



Source: JICA Expert Team

Figure 2 Future Traffic Demand Forecast in 2032

Conclusion:

1. Even if 10-20% of traffic will shift to Fast Track after 2032, the traffic volume in section IV-1 and section I will be at level far exceeding the traffic capacity of 1.5-lane road. Therefore, these sections should be upgraded to 2-lane road as soon as possible giving the high priority.
2. Regarding the remaining three sections, it can be said that the situation is not yet serious in terms of traffic capacity, because these 3 sections are still within the capacity of a 1.5-lane road. However, upgrading to a 2-lane road is extremely necessary from the viewpoint of traffic safety and convenience for road users.

4 Assumed Role and Function of the Sindhuli Road

Sindhuli Road was constructed by Japanese grant aid with 1.5-lane road due to the severe natural conditions and financial constraints imposed. However, considering the increasing traffic demand in recent years as well as the importance of traffic safety, there is need for expanding the traffic capacity of Sindhuli Road by upgrading it to 2-lane road.

However, we need to check whether or not the Sindhuli Road should upgrade its function to allow the passage of large heavy vehicles. If these vehicles are allowed, widening road width and changing vertical alignment is necessary. Changing the vertical alignment on the steep terrain is difficult and costly as it's like building a new road.

At the same time, we should remind that Fast Track which has high traffic capacity will be completed in near future.

Therefore, it is proposed that the role of Sindhuli Road should be limited to a complement road to the Fast Track. In other words, the role for carrying large heavy vehicles should be entrusted to Fast Track. Based on this understanding, the Sindhuli Road should be upgraded for improvement of traffic safety and stabilization of the road structure, rather than upgrading the function to allow passage of large heavy traffic.

5 Proposed Traffic Capacity Enhancement Measures

Considering the result of future traffic demand forecast, traffic accident data and expected role of the Sindhuli Road, traffic capacity enhancement measures are proposed for each section as follows:

1. Sec. IV-1 (Dhulikhel - Bhakundebesi)

The traffic volume of section IV-1 has already far exceeded the traffic capacity of a 1.5-lane road; therefore, it should be upgraded to 2-lane as soon as possible. However, upgrading should be done only for the first 9 km from Dhulikhel and the remaining section up to Bhakundebesi should not be widened considering the unstable terrain condition.

In addition, since section IV-1 is likely to exceed the traffic capacity of a 2-lane road in near future, it is recommended that DOR initiate the study on the construction of a second route between Bhakundebesi and Dhulikhel.

2. Sec. IV-2 (Bhakundebesi - Nepalthok)

Considering the severe topographical conditions in Section IV-2, it should be upgraded only in the section which widening is possible. At the same time, the existing five bridges should be upgraded to double lanes from the viewpoint of traffic safety.

3. Sec. III (Nepalthok - Khurkot)

Section III runs through landslide areas along the Sunkoshi River, so, it is recommended to upgrade the road only in town and market areas. 12 single-lane causeways should also be upgraded to double-lane from the viewpoint of traffic safety.

4. Sec. II (Khurkot - Sindhulibazar)

Construction of tunnel is planned in Section II, which is one of the high priority projects in Nepalese government. Therefore, the project should be promoted in accordance with the government's policy. Since the tunnel project will take a time for realization. It is recommended to maintain the existing road properly enhancing traffic safety and preserving road structures.

5. Sec. I (Sindhulibazar – Bardibas)

Section I has already exceeded the 1.5-lane road capacity, so it is necessary to start upgrading of this section as soon as possible.

Proposed traffic capacity enhancement measures are summarized as follows.

Table 1 Proposed Traffic Capacity Enhancement Measures

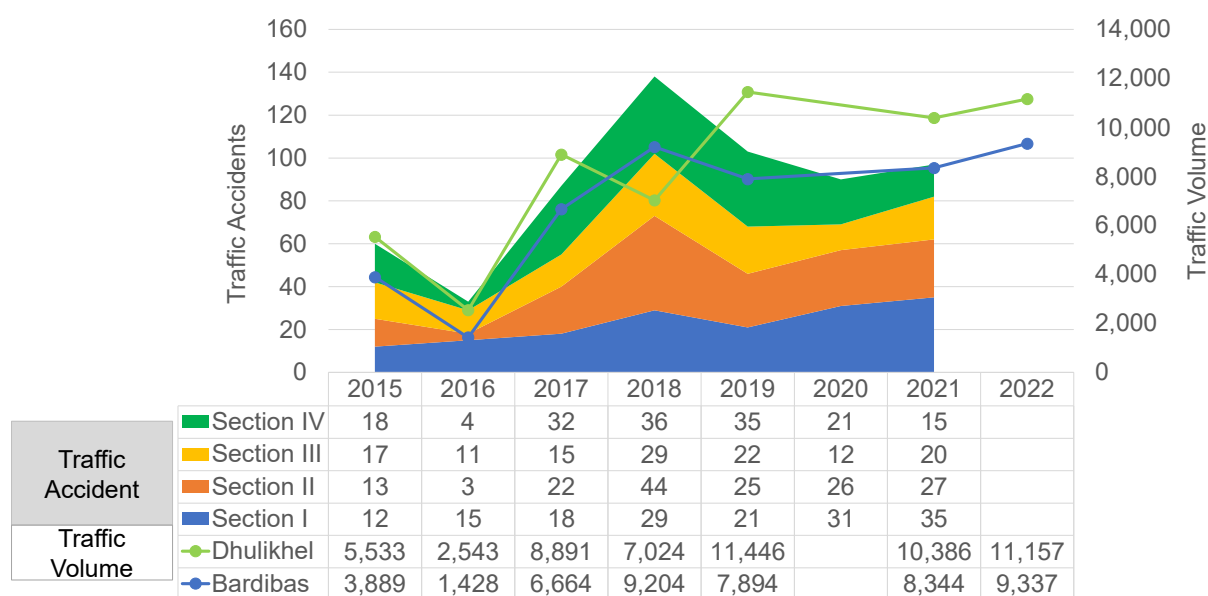
Section		Length (KM)	Traffic volume (ADT)			Saturation of traffic capacity in 2032	Issues and problems	Proposed Traffic Capacity Enhancement Plan
			2022	2027	2032			
Sec. IV-1	Dhulikhel-Bhakundebsi	20	12,246	13,524	15,226	Exceeds 2-lane traffic capacity	It is difficult to widen the road due to the steep terrain and the farmland developed along the road, except for the first 9 km in the Sec. VI-1.	- Upgrading of Sec. IV-1 (9 km from Dhulikhel) with design standard of class III
								- Installation of ETC toll plaza (No.1) should be considered.
								- Provide emergency parking lanes wherever possible.
								*It is recommended to examine the second routes in this section in the long-term plan.
Sec. IV-2	Bhakundebsi-Nepalthok	30	4,390	4,655	5,241	Within 1.5 lane traffic capacity	Widening is extremely difficult due to steep and fragile mountain slope except in the town and market areas.	- Partial widening to 2-lane road in the town and market areas
								- Upgrade of existing 1-lane bridge to double lane bridges (5 bridges)
								- Provide emergency parking lanes wherever possible
Sec. III	Nepalthok-Khurkot	37	4,371	4,586	5,164	Within 1.5 lane traffic capacity	Widening is extremely difficult due to steep and fragile mountain slope except in the town and market areas.	- Partial widening to 2-lane road in the town and market areas
								- Upgrade of existing 1-lane bridge to double lane bridges (12 causeways)
								- Provide emergency parking lanes as much as possible.
								*Early completion of Mid-hill Highway (Khurkot-Nepalthok) is expected.
Sec. II	Khurkot-Sindhulibazar	36	4,447	5,521	6,216	Within 1.5 lane traffic capacity	Widening is extremely difficult due to steep and fragile mountain slope except in the town and market areas.	- Strengthening of traffic safety measures and reinforcement of gabion retaining wall structures.
								- Provide emergency parking lanes as much as possible.
								- Implementation of Khurkot-Chiyabari Tunnel Project (7.0km)
Sec. I	Sindhulibazar-Bardibas	37	7,739	9,773	11,003	Exceed 2-lane traffic capacity soon	Section I is located on flat terrain and all bridges have already been constructed with two lanes.	- Upgrading the whole Sec. I to a two-lane road with a road standard Class III
								- Installation of toll plaza (No.2) should be considered.
								- Some causeways will need to be replaced with bridges.

Source: JICA Expert Team

6 Traffic Characteristic of the Sindhuli Road

Figure 3 shows the relationship between traffic accidents and traffic volume on Sindhuli Road. As can be seen in this table, the traffic volume at Dhulikhel in Sec. IV is the highest and close to 11,000 vehicles, but the number of traffic accidents has decreased in recent years. This seems to have the effect of strengthening safety measures. On the other hand, the traffic volume at Bardibas in Sec. I is also close to nearly 10,000 vehicles but the number of traffic accidents is on the rise. The number of traffic accidents in Sec. I is thought to be due to excessive speed due to the flat terrain and good alignment. The number of traffic accidents in Sec. II and Sec. III is also on the rise.

Based on these circumstances, it is considered necessary to further strengthen traffic safety measures for Sec. I, Sec. II and Sec. III.



Source: JICA Expert Team

Figure 3 Traffic Accidents and Traffic Volume on the Sindhuli Road

7 Proposed Road Maintenance Plan (Mid-term Plan and Long-term Plan)

Mid / Long term road maintenance plan of the Sindhuli Road is proposed as follows.

7.1 Mid-term Plan (5 years: 2023 - 2027)

Widening measures for each section that must be improved in accordance with future traffic increase were proposed in the proposed traffic capacity enhancement measures.

In addition to these countermeasures, issues that were not completed during the SROM 2 and new activities using new technology that will contribute road maintenance and management effectively and efficiently are suggested in the road maintenance plan as follows:

- 1) Construction of 3 bridges in Sec. IV (under construction as pilot project of SROM2)
- 2) Pavement Overlay of the entire Sindhuli Road
- 3) Partial road widening of town and market areas in Sec. IV-2 and Sec. III
- 4) Introduction of Electric Toll Collection (ETC)
- 5) Handover and integration of EIS to DOR Headquarters
- 6) Digitizing road and traffic management data
- 7) Strengthening traffic safety measures (Hard/Soft)
- 8) Road relocation due to Sunkoshi Marin Diversion Project (SMDP) for around 1.0km section near Khurkot
- 9) Countermeasure for Kaldhunga stream in Sec. IV
- 10) Installation of roadside facility “Michi-no-eki”

7.2 Long-term Plan (10 years: 2023 - 2032)

- 1) Upgrading of Section I (Bardibas - Sindhuli Bazar) to double lane with design standard of class III
- 2) Upgrading of Section IV-1 (Dhulikhel - 9.0 km Point) to double lane with design standard of class III
- 3) Upgrade of 5 bridges in Sec. IV and 12 causeways in Sec. III to double lane standard
- 4) Construction of Khurkot - Chiyabari Tunnel

8 Proposed Implementation Plan

Among the 10 activities proposed in the mid-term plan, the introduction of ETC is indispensable to ensure the implementation of this maintenance plan, and the digitization of road management data will contribute to efficient and effective maintenance of Sindhuli Road in the future. These measures are very important activities for conducting effective road maintenance work of the Sindhuli Road so that we strongly recommend its early implementation.

In addition, the expansion of the roads to 2-lane in Sec. IV-1 and Sec. I proposed in the long-term plan and upgrading of 5 bridges and 12 causeways to double lane are also necessary not only for the expansion of traffic capacity, but also from the viewpoint of traffic safety. Therefore, it is strongly suggested to implement as soon as possible.

Table 2 Proposed Implementation Plan

Plan	Activities		Implementation Plan (tentative)										
			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Mid-term Plan: 5 years 2023-2027	1	Construction of 3 bridges in Sec. IV (under construction as pilot project of SROM2)	■		to be completed by September 2023 as per contract								
	2	Pavement overlay of the entire Sindhuli Road	■										
	3	Partial road widening of town and market areas in Sec. IV-2, Sec. III	■	■	■	■	■	■					
	4	Introduction of Electric Toll Collection System (ETC)	■	■	■	■	▲	expect to start the operation in 2025					
	5	Handover and Integration of EIS to DOR Headquarter	■	■									
	6	Digitization of road management data			■	■	■	■	■				
	7	Strengthening traffic safety measures (Hard/Soft)	■	■	■	■	■	■	■	■	■		
	8	Road relocation due to Sunkoshi Marin Diversion Project (SMDP) for around 1.0 km section near Khurkot		■	■	■							
	9	Countermeasures for Kaldhunga Stream in Sec. IV	■	■		■							
	10	Roadside facilities "Michi-no-eki"				■	■	■					
Long-term plan: 10 years 2023-2032	11	Upgrading of Sec. I (Bardibas - Sindhuli Bazar) to double lane standard	■	■	■	■							
						DD & Tender	Construction						
	12	Upgrading of Sec. IV-1 (Dhulikhel - 9km Point) to double lane standard	■	■	■	■							
						DD & Tender	Construction						
13	Upgrading of 5 bridges in Sec. IV and 12 causeways in Sec. III to double lane standard	■	■	■									
					FS, DD & Tender	Construction							
14	Construction of Khurkot - Chiyabari Tunnel			■	■	■	■						
					FS, DD & Tender	Construction							

Source: JICA Expert Team

9 Maintenance Budget for the Sindhuli Road

The RBN and GON road maintenance budgets allocated to the Sindhuli Road Project over the past four years have been steadily increasing along with the increase in traffic as shown in the Table 3 below. Due to the increase in traffic, the maintenance budget will continue to be increased due to countermeasures such as partial widening, upgrading the causeway with bridges, double lane of existing bridges, strengthening retaining wall structures, overlaying pavement, strengthening traffic safety measures, etc. This increasing trend is expected to continue in the future, and it is hoped that steady funding from the RBN will be secured by improving the toll collection system through the introduction of ETC.

Table 3 Maintenance Budgets allocated to the Sindhuli Road

Source of Budget	Maintenance Activity	Allocated Budget for FY2018/2019	Allocated Budget for FY2019/2020	Allocated Budget for FY2020/2021	Allocated Budget for FY2021/2022	Allocated Budget for FY2022/2023
RBN Budget	RBN budget is used for road maintenance works, traffic safety, bridge maintenance, bioengineering, toll road maintenance, etc.	134,788,000	168,753,080	334,717,000	396,977,000	115,800,000
GON (DOR Budget)	GON budget is for ongoing Project having activities such as reconstruction/Rehab, resettlements, major repair works including administrative expenses	359,200,000	465,700,000	245,000,000	630,000,000	683,300,000
Total		493,988,000	634,453,080	579,717,000	1,026,977,000	799,100,000

Source: DOR

10 Recommendations

1. Support for the realization of Mid/Long-term plans:

In order to effectively implement the various activities proposed in the mid-term and long-term plans, it is desired the technical and financial supports from donors including JICA as follows:

- Mid-term plan: Technical support
- Long-term plan: Grant aid for upgrading the existing 1-lane bridge to double lane bridges in Sec. III (5 bridges) and Sec. IV-2 (12 causeways), and Loan aid for construction of long tunnels in Sec. II.

2. Jurisdiction of Sindhuli Road Office under DCID:

Since close cooperation with donors is essential for the steady implementation of the long-term plan, it is recommended that the Sindhuli Road Office will operate and manage under the jurisdiction of DCID as it is until the completion of the long-term plan.

3. Cooperative relationship scheme between DOR/DWRI/RBN:

Cooperation with RBN/DWRI/RBN should be maintained as it is until completion of long-term plan and it is recommended that DOR takes the initiative to hold regular meetings of the three parties about twice a year to exchange information in detail.

11 Some Selected Photographs

Proposed road maintenance works in the Mid/Long-term Plan is shown below.



Routine Maintenance



Recurrent Maintenance



Periodic Maintenance



Emergency Maintenance



Specific Maintenance (1)



Specific Maintenance (2)



Partial widening in town area



Provision of concrete block



Emergency Information System (EIS)



Upgrade of causeway to bridge



Retaining Wall Foot Protection



Strengthening Gabion Wall

Source: JICA Expert Team

JICA Expert Team
Nippon Koei Co., Ltd.
4 Kojimachi 5-chome, Chiyoda-ku,
Tokyo 102-8539

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Road Side Traffic Count Survey



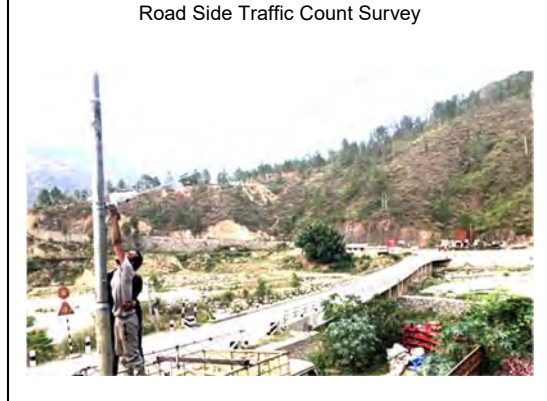
Road Side Origin – Destination Survey



Travel Speed Survey



Road Side Traffic Count Survey



FINAL REPORT

AUG, 2019

Submitted by:



Soil Test (P) Ltd.

GPO Box 2967, Sanepa, Kathmandu, Nepal
Phone: 977-1-5522234, 5553126, Fax: 977-1-5520486
E-mail: support@soiltest.com.np
soiltest@ntc.net.np

TABLE OF CONTENTS

1	INTRODUCTION	1--1
1.1	BACKGROUND OF THE SURVEY	1--1
1.2	OUTLINE OF THE SURVEY	1--1
	1.2.1 Objectives	1--1
	1.2.2 Target Area	1--2
	1.2.3 The Scope of Works	1--2
	i. Road Side Traffic Count Survey	1--2
	ii. Road Side O-D Survey	1--2
	iii. Travel Speed Survey	1--3
	1.2.4 Cooperating Agencies	1--3
1.3	ORGANIZATION (SOIL TEST) STUDY TEAM	1--3
1.4	SCHEDULE OF SURVEY AND REPORTING	1--5
2	METHODOLOGY OF THE SURVEY	2--1
2.1	DEVELOPMENT OF SURVEY FORMAT	2--1
2.2	RECONNAISSANCE SURVEY	2--1
2.3	OUTLINE OF SURVEY	2--3
	2.3.1 Road Side Traffic Count Survey	2--3
	2.3.2 Road Side O-D Survey	2--4
	2.3.3 Travel Speed Survey	2--4
2.4	TRAINING METHOD FOR SUPERVISORS AND SURVEYORS	2--4
2.5	CONSULTATION WITH OTHER STAKEHOLDERS	2--5
2.6	SUMMARY OF SURVEY SCHEDULE	2--5
2.7	PUBLIC ANNOUNCEMENT	2--6
3	ROAD SIDE TRAFFIC COUNT SURVEY	3--1
3.1	TRAFFIC VOLUME BY VEHICLE TYPE	3--1
3.2	TRAFFIC VOLUME BY VEHICLE TYPE IN PCU	3--10
3.3	HOURLY TRAFFIC VOLUME	3--12
3.4	COMPARISON OF TRAFFIC DATA	3--19
	3.4.1 Comparison of Traffic Data for Dhulikhel South	3--19
	3.4.2 Comparison of Traffic Data for Dhulikhel East	3--20
	3.4.3 Comparison of Traffic Data for Mangaltar	3--21
	3.4.4 Comparison of Traffic Data for Sindhulimadi	3--22
	3.4.5 Comparison of Traffic Data for Bardibas North	3--23
	3.4.6 Comparison of Traffic Data for Bardibas East	3--24

4	ROAD SIDE ORIGIN - DESTINATION SURVEY		4--1
4.1	SAMPLE RATE BY NUMBER OF VEHICLES, TYPES AND LOCATION		4--1
4.2	AVERAGE NUMBER OF PASSENGERS BY VEHICLE TYPE		4--3
4.3	TRIP PURPOSE		4--4
	4.3.1	Dhulikhel	4--4
	4.3.2	Khurkot Near Old Bus Park	4--5
	4.3.3	Bardibas	4--6
4.4	ORIGIN - DESTINATION DETAILS		4--7
	4.4.1	Dhulikhel	4--7
	4.4.2	Khurkot Near Old Bus Park	4--8
	4.4.3	Bardibas	4--8
4.5	TYPES OF GOODS/FREIGHT CONTENT FOR TRUCKS		4--9
5	TRAVEL SPEED SURVEY		5--1
5.1	ROUTE 1		5--1
	5.1.1	Route 1 – Direction 1	5--1
	5.1.2	Route 1 – Direction 2	5--2
	5.1.3	Summary of Route 1 – Direction 1 & Direction 2	5--3
5.2	ROUTE 2		5--4
	5.2.1	Route 2 – Direction 1	5--4
	5.2.2	Route 2 – Direction 2	5--5
	5.2.3	Summary of Route 2 – Direction 1 & Direction 2	5--6
6	CONCLUSION		6--1
6.1	ROAD SIDE TRAFFIC COUNT SURVEY		6--1
6.2	ROAD SIDE ORIGIN-DESTINATION SURVEY		6--1
6.3	TRAVEL SPEED SURVEY		6--1

LIST OF FIGURES

Fig 1.1: Location Map of the Survey Points	1--1
Fig 1.2: Travel Speed Survey Route	1--3
Fig 1.3: Schedule of Traffic Survey and Reporting	1--5
Fig 2.1: Roadside O-D Survey	2--1
Fig 2.2: Roadside Traffic Count (Camera Location)	2--2
Fig 2.3: Traffic Video Acquisition Process	2--3
Fig 2.4: O-D Survey at different survey locations	2--4
Fig 2.5: Vehicle used for Travel Speed Survey	2--4
Fig 3.1: Graph Representation of Total Traffic Movement by Vehicle Type on Weekdays	3--4
Fig 3.2: Graph Representation of Total Traffic Movement by Vehicle Type on Weekend	3--6
Fig 3.3: Hourly Variation of Traffic Volume on Weekdays	3--12
Fig 3.4: Hourly Variation of Traffic Volume on Weekend	3--15
Fig 3.5: Comparison of ADT for Dhulikhel South	3--19
Fig 3.6: Comparison of ADT for Dhulikhel East	3--20
Fig 3.7: Comparison of ADT for Mangaltar	3--21
Fig 3.8: Comparison of ADT for Sindhulimadi	3--22
Fig 3.9: Comparison of ADT for Bardibas North	3--23
Fig 3.10: Comparison of ADT for Bardibas East	3--24
Fig 4.1: Average No. of Passengers	4--3
Fig 4.2: Trip Purpose of each Vehicle Type at Dhulikhel	4--4
Fig 4.3: Trip Purpose of each Vehicle Type at Khurkot Near Old Bus Park	4--5
Fig 4.4: Trip Purpose of each Vehicle Type at Bardibas	4--6
Fig 4.5: Origin-Destination details for Dhulikhel Site	4--7
Fig 4.6: Origin-Destination details for Khurkot Near Old Bus Park Site	4--8
Fig 4.7: Origin-Destination details for Bardibas Site	4--8
Fig 5.1: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 1)	5--1
Fig 5.2: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 2)	5--2
Fig 5.3: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 1 & 2)	5--3
Fig 5.4: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 1)	5--4
Fig 5.5: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 2)	5--5
Fig 5.6: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 1 & 2)	5--6

LIST OF TABLES

Table 1.1: Target Locations on each Survey Stations	1--2
Table 1.2: Location and dates of O-D Survey	1--3
Table 1.3: Survey Locations, Type of Survey and Study Team from Soil Test	1--4
Table 2.1: Summary of Survey Methods	2--5
Table 2.2: Summary of Survey Schedule	2--5
Table 3.1: Vehicle Classification	3--2
Table 3.2: Total Traffic Movement by vehicle type on Weekdays	3--3
Table 3.3: Total Traffic Movement by vehicle type on Weekend	3--5
Table 3.4: Traffic Volume in PCU on Weekdays	3--10
Table 3.5: Traffic Volume in PCU on Weekend	3--11
Table 3.6: Comparison of ADT for Dhulikhel South	3--19
Table 3.7: Comparison of ADT for Dhulikhel East	3--20
Table 3.8: Comparison of ADT for Mangaltar	3--21
Table 3.9: Comparison of ADT for Sindhulimadi	3--22
Table 3.10: Comparison of ADT for Bardibas North	3--23
Table 3.11: Comparison of ADT for Bardibas East	3--24
Table 4.1: Number of Vehicles Interviewed in O-D Survey	4--1
Table 4.2: Sample Rate of Vehicles Interviewed in O-D Survey	4--2
Table 4.3: Average No. of Passengers	4--3
Table 4.4: Area ID for Origin and Destination Survey	4--7
Table 4.5: Types of freight content in Trucks	4--9
Table 5.1: Summary of Travel Speed Survey for Route 1 (Direction 1) at different check points	5--1
Table 5.2: Summary of Travel Speed Survey for Route 1 (Direction 2) at different check points	5--2
Table 5.3: Summary of Travel Speed Survey for Route 1 (In both direction 1 & 2)	5--3
Table 5.4: Breakdown of Travel Speed Survey for Route 1 in both the direction at each check points	5--3
Table 5.5: Summary of Travel Speed Survey for Route 2 (Direction 1) at different check points	5--4
Table 5.6: Summary of Travel Speed Survey for Route 2 (Direction 2) at different check points	5--5
Table 5.7: Summary of Travel Speed Survey for Route 2 (In both direction 1 & 2)	5--6
Table 5.8: Breakdown of Travel Speed Survey for Route 2 in both the direction at each check points	5--6

LIST OF ANNEXES

Annex 1:	Letters from DOR to Stakeholders
Annex 2:	Traffic Survey Forms
Annex 2.1:	Sample of Road Side Traffic Count Survey
Annex 2.2:	Sample of Road Side Origin-Destination Survey
Annex 2.3:	Sample of Travel Speed Survey
Annex 3:	Vehicle Classification for Road Side Traffic Count Survey
Annex 4:	Detailed Hourly Traffic Data
Annex 4.1:	Dhulikhel
Annex 4.2:	Mangaltar
Annex 4.3:	Khurkot near Old Bus Park
Annex 4.4:	Khurkot Causeway No. 3
Annex 4.5:	Sindhuli Madi
Annex 4.6:	Bardibas

LIST OF ABBREVIATION

SRP	Sindhuli Road Project
SRMU	Sindhuli Road Maintenance Unit
DoR	Department of Roads
DoTM	Department of Transport Management
JICA	Japan International Cooperation Agency
TS	Traffic Survey
O-D Survey	Origin-Destination Survey
EW HW	East-West Highway
BP HW	B.P Highway
PCU	Passenger Car Unit
T	Ton

**CHAPTER 1
INTRODUCTION**

1. INTRODUCTION

1.1 BACKGROUND OF THE SURVEY

The Sindhuli Road is one of the most important arterial roads in Nepal, linking Kathmandu City - the capital of the country – with Terai Plain area in South and joins MidHill highway connecting hilly regions of Nepal. The Sindhuli Road, having 160 km in total was constructed with the grant assistance of Government of Japan through JICA. The construction of the road has been completed in the year 2015 and the road is open for the public traffic. In order to improve the quality and safety of the road, JICA is providing technical assistance for the project for the Operation and Maintenance of Sindhuli Road.

1.2 OUTLINE OF THE SURVEY

1.2.1 Objectives

The main objective of the study (Survey) is to assist the JICA expert team by carrying out the Traffic Survey at six different stations along Sindhuli Road, East West Highway, and Araniko Highway. A location map of the survey points is presented in *Fig 1.1*.



Fig 1.1: Location Map of the Survey Points

1.2.2 Target Area

The target area comprises of six stations namely Station 1 to Station 6. Each of the stations includes total of ten different survey locations along Sindhuli Road (B.P. Highway), one survey location along Khurkot-Manthali Road, one survey location along Midhill Highway, one survey location along Araniko Highway and one survey location along East West Highway. The target locations are presented below in table 1.1:

Table 1.1: Target Locations on each survey stations

Survey Stations	Target survey areas in each stations
Station 1	<ul style="list-style-type: none"> • Dhulikhel along Araniko Highway • Dhulikhel along Sindhuli Road
Station 2	<ul style="list-style-type: none"> • Mangaltar along Sindhuli Road
Station 3	<ul style="list-style-type: none"> • Khurkot along Sindhuli Road (Near Old Bus Park) • Khurkot along Khurkot-Manthali Road
Station 4	<ul style="list-style-type: none"> • Khurkot along Sindhuli Road connecting Mid Hill Highway (Causeway No. 3) • Khurkot along Mid Hill Highway
Station 5	<ul style="list-style-type: none"> • Sindhulimadi along Sindhuli Road (Intersection Point)
Station 6	<ul style="list-style-type: none"> • Bardibas along Sindhuli Road • Bardibas along East-West Highway

1.2.3 The Scope of Works

The scope of works includes carrying out the following traffic surveys along the Sindhuli Road.

- i. Road Side Traffic Count Survey;
- ii. Road Side Origin-Destination Survey;
- iii. Travel Speed Survey

i. Road Side Traffic Count Survey

The scope of work for the Road Side Traffic Count Survey was to make total enumeration of fifteen different vehicle types (*Private Car/Taxi, Large Bus, Mini Bus, Micro Bus, Multi-Axle Truck, Heavy Truck, Light Truck, Pick-Up, Three Wheeler, Motorcycle, Tractor, Four Wheel Drive, Power Tiller, Bullock/Hand/ Horse Cart and Rickshaws*) on all directions at 6 locations.

ii. Road Side Origin-Destination Survey

The scope of work for the Road Side O-D Survey was to carryout road side interview with the drivers of different vehicle types at 3 different locations along Sindhuli Road for 16 hrs for one weekday (i.e. (6 am in the morning to 10 pm in the night). 20% sampling was the target during the O-D survey. The purpose of this survey was to interview Origin-Destination information, Number of Passengers, Trip Purpose, and Content of Goods/Freight in case of cargo Trucks. The survey was performed on normal working day. The public holiday was excluded from the survey date. The survey duration was one (1) day at each survey point. The locations for the Origin-Destination survey and the dates on which the surveys were undertaken are as follow in table 1.2:

Table 1.2: Location and dates of OD Survey

S. No.	O-D Survey Location	Dates O-D Survey undertaken
1	Dhulikhel along Sindhuli Road	17 th June 2019
2	Khurkot along Sindhuli Road	14 th June 2019
3	Bardibas along Sindhuli Road	13 th June 2019

iii. Travel Speed Survey

The scope of work for the Travel Speed Survey was to measure the Average Speed of the vehicle, Distance Travelled and the Average Travel Time. The routes are as follows:

Route 1: Maitighar-Dhulikhel-Nepalthok-Khurkot-Sindhuli-Bardibas and Bardibas- Sindhuli-Khurkot-Nepalthok- Dhulikhel –Maitighar.

Route 2: Maitighar-Naubise-Mugling-Narayangadh-Hetauda-Pathlaiya-Bardibas and Bardibas-Pathlaiya-Hetauda-Narayangadh-Mugling-Naubise- Maitighar. Travel Route is presented in Fig 1.2.

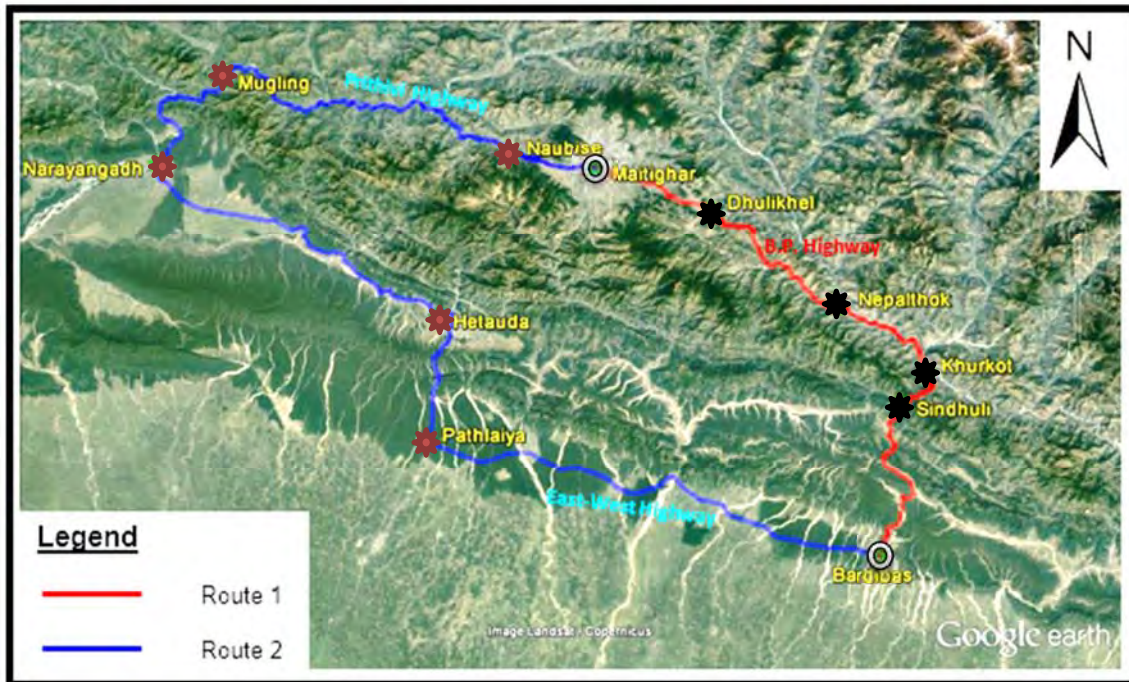


Fig 1.2: Travel Speed Survey Route

1.2.4 Cooperating Agencies

Traffic Survey along Sindhuli Road was successfully completed with help and cooperation from different agencies including Department of Roads (DoR) and JICA for technical assistance, District Police Office – Kavre, Sindhuli and Mahottari for site police assistant and Private Agencies for transportation facilities.

1.3 ORGANIZATION (SOIL TEST) STUDY TEAM

A high resolution surveillance camera and monitoring screen was installed at each of the site by the team of technicians and electrician. A team of trained supervisors from the consultant were appointed later to count the traffic along all the routes for each of the survey location. Surveyors at the site were trained by Team leader Mandy Karki a day before the actual survey. Table 1.3 represents the survey locations, type of survey, and study team from Soil Test.

Table 1.3: Survey Locations, Type of Survey and Study Team from Soil Test

S.No.	Location of Site	Type of Survey	Supervisor's Name	No. of Surveyors
1	Dhulikhel	Traffic Count Survey	Biswas Uprety	7
		Travel Speed Survey	Biswas Uprety	
		O-D Survey	Bikram Bhandari	
2	Mangaltar	Traffic Count Survey	Shankar Shrestha	7
3	Nepalthok	Travel Speed Survey	Biswas Uprety	2
4	Khurkot (Near Old Bus Park)	Traffic Count Survey	Shankar Shrestha	7
		Travel Speed Survey	Biswas Uprety	
		O-D Survey	Bikram Bhandari	
5	Khurkot (Causeway No. 3)	Traffic Count Survey	Shankar Shrestha	7
6	Sindhulimadi	Traffic Count Survey	Shankar Shrestha	7
		Travel Speed Survey	Biswas Uprety	
7	Bardibas	Traffic Count Survey	Shankar Shrestha	7
		Travel Speed Survey	Biswas Uprety	
		O-D Survey	Bikram Bhandari	

1.4 SCHEDULE OF SURVEY AND REPORTING

The schedule for the survey and reporting is presented in Fig 1.3.

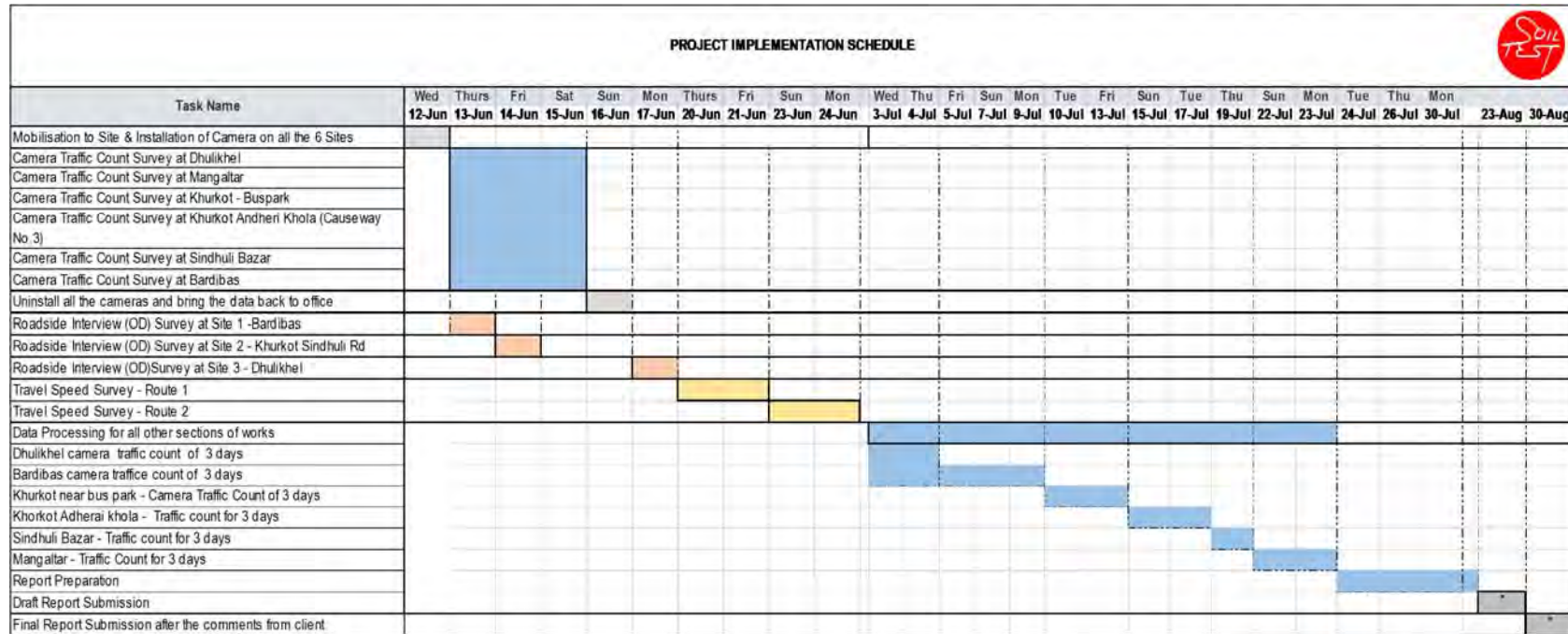


Fig 1.3: Schedule of Traffic Survey and Reporting

2. METHODOLOGY OF THE SURVEY

2.1 DEVELOPMENT OF SURVEY FORMAT

The formats for each traffic survey were developed by the Consultant (Soil Test Pvt. Ltd.) and approved by JICA Experts. The format for each survey is presented in *Annex-2*. [*Annex 2.1 (Road Side Traffic Count Survey)*, *Annex 2.2 (Road Side O-D Survey)* and *Annex 2.3 (Travel Speed Survey)*].

2.2 RECONNAISSANCE SURVEY

The reconnaissance survey (Joint Site Visit) was carried out with Local consultants JICA Experts and, DOR officials. The locations were proposed as previous year's location for the survey works and some modifications were made for electricity availability. The location of the different survey sites for both OD and Traffic count are shown in *Fig 2.1* & *Fig 2.2*.

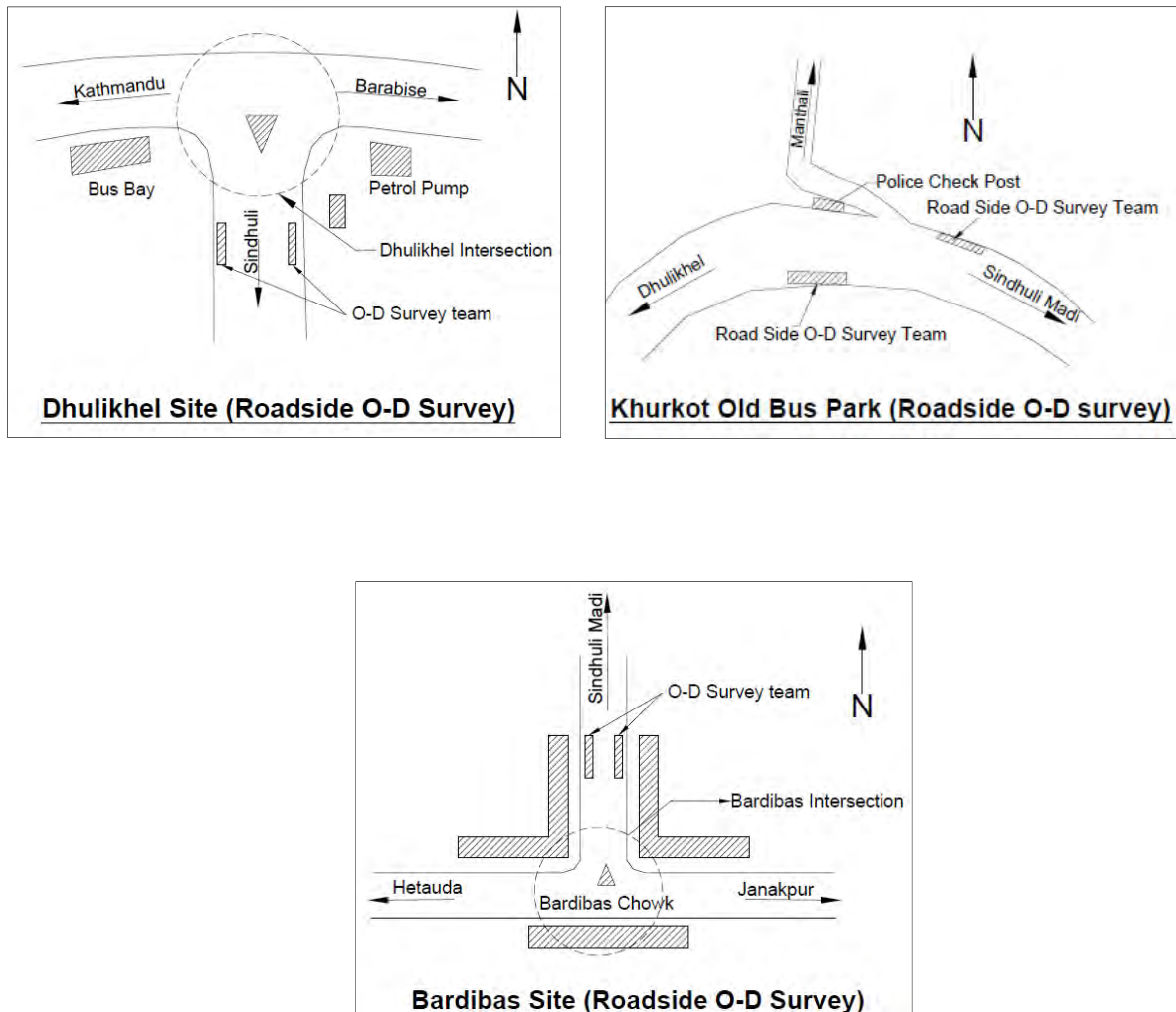


Fig 2.1: Roadside OD SURVEY

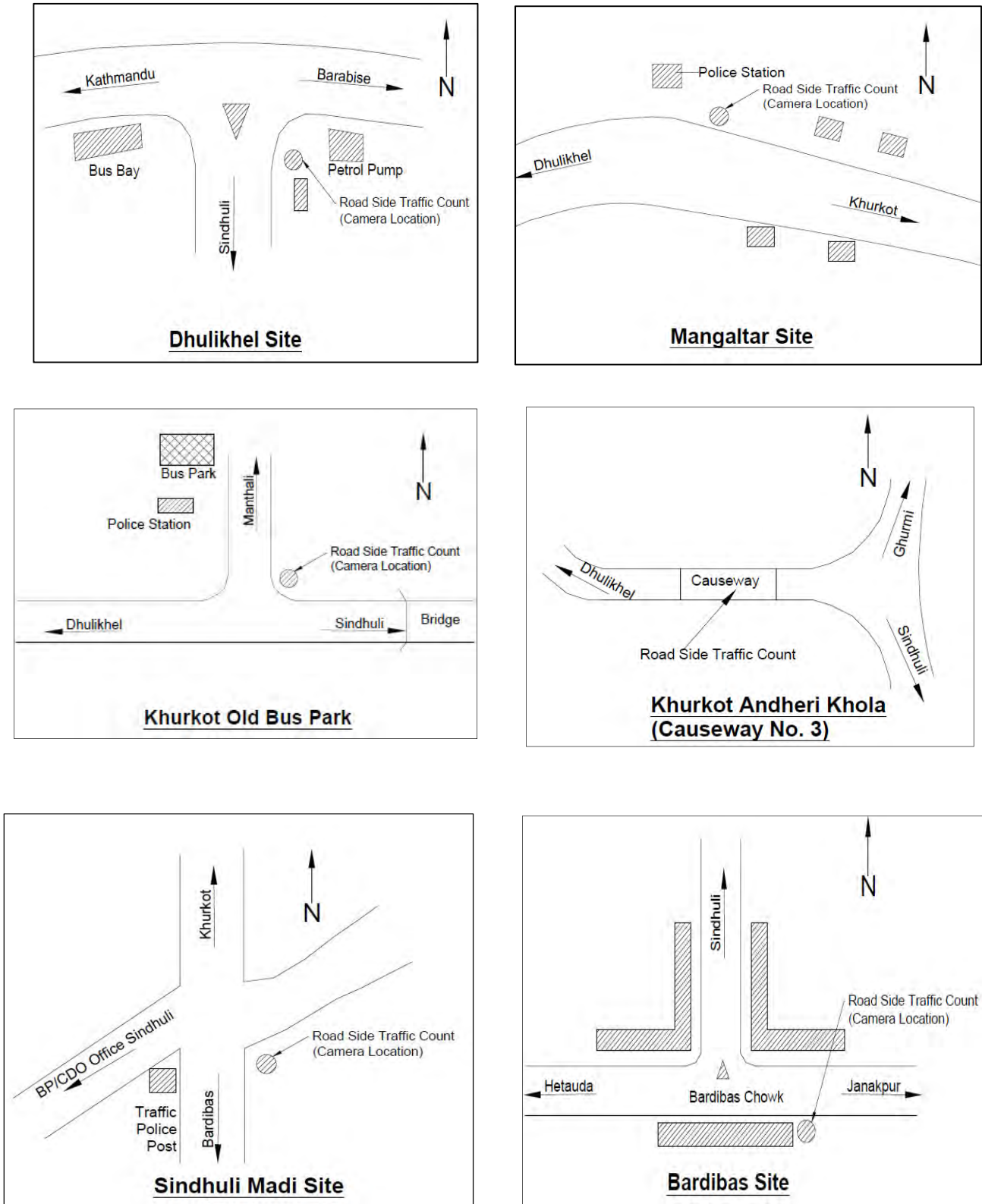


Fig 2.2: Road Side Traffic Count (Camera Location)

2.3 OUTLINE OF SURVEY

2.3.1 Road Side Traffic Count Survey

Traffic count survey was performed on 2 weekdays (Thursday and Friday) and 1 weekend (Saturday). The traffic counts were made for sixteen different types of vehicles on the road in both directions. For video based traffic count survey, the consultant utilized digital video cameras with infrared recording which enabled recording at night time as well. Traffic video acquisition process is shown in Fig.2.3. Detail Traffic Count Pictures are presented in *Photographs section*.



Fig 2.3: Traffic Video Acquisition Process

2.3.2 Road Side Origin-Destination Survey

Road Side O-D Survey was performed on one weekday for each destination. A previously approved survey sheet was used for the survey. Detail O-D Survey Pictures are presented in *Photographs section*.

Dhulikhel Survey Point



Khurkot Survey Point



Bardibas Survey Point



Fig 2.4: OD Survey at different Survey locations

2.3.3 Travel Speed Survey

A vehicle, travelling from origin to destination was stopped at each intermediate point (Check Points) and the travel time and travel distance was noted to calculate the average speed of the vehicle. Please Refer *Photographs section* for the Travel Speed Check Point. The vehicles used for the Travel Speed Survey is shown below.



Fig 2.5: Vehicle used for Travel Speed Survey

2.4 TRAINING METHOD FOR SUPERVISORS AND SURVEYORS

Two trainings were conducted before the actual survey at the sites. First the training was for the O-D Survey in which Surveyors were briefed about the requirements of the survey forms and the types of vehicles that have been classified.

Second training was conducted for the Travel Speed Survey where the surveyors were briefed about the method that will be carried out. Traffic Count was done based on the previous works in which the cameras were installed and post processing was briefed by an experienced supervisor.

The survey methods for surveyors are listed in *Table 2.1*.

Table 2.1: Summary of Survey Methods

S. No	Type of Survey	Purpose	Method	Contents of Survey
1	Road Side Traffic Count Survey	To capture traffic movement on weekdays and weekend	Traffic count by direction and by type of vehicles at survey points along the Sindhuli Road.	Survey Points : 10 (24hrs - 2 Weekdays, 1 Weekend)
2	Road Side O-D Survey	To capture vehicles Origin, Destination, Trip purpose etc.	Interview with drivers at survey points on the Sindhuli Road. The target sampling rate is 20% of all the vehicles.	Survey Point:3 (16hrs - 1 Weekday for 1 location)
3	Travel Speed Survey	To analyze vehicles speed affected by traffic congestion	Investigation of travel time by running each route.	Survey routes : 2

2.5 CONSULTATION WITH OTHER STAKEHOLDERS

During the survey works coordination with stakeholders for security and authentication was done especially with traffic police, District police and DOR officials with written letters for permission. The letters are presented in Annex 1.

2.6 SUMMARY OF SURVEY SCHEDULE

A summary of the traffic survey schedule is presented in Table 2.2.

Table 2.2: Summary of Survey Schedule

S.N.	Location	Survey Type	Date	Day	Time	Duration
1	Dhulikhel	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
2	Mangaltar	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
3	Khurkot near Old Buspark	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
4	Khurkot Causeway	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
5	Sindhuli	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
6	Bardibas	Traffic Count	13-14-15 June 2019	Thur-Fri-Sat	6:00 - 6:00	24hrs
7	Dhulikhel	O-D Survey	17 June 2019	Mon	6:00 - 10:00	16hrs
8	Khurkot near Old Buspark	O-D Survey	14 June 2019	Fri	6:00 - 10:00	16hrs
9	Bardibas	O-D Survey	13 June 2019	Thur	6:00 - 10:00	16hrs
10	Route 1	Travel Speed Survey	18 -19 June 2019.	Maitighar-Dhulikhel-Nepalthok-Khurkot-Sindhuli-Bardibas and Bardibas- Sindhuli-Khurkot- Nepalthok-Dhulikhel –Maitighar		
11	Route 2	Travel Speed Survey	22 -23 June 2019.	Maitighar-Naubise-Mugling-Narayangadh-Hetauda-Pathlaiya-Bardibas and Bardibas-Pathlaiya-Hetauda-Narayangadh-Mugling-Naubise- Maitighar		

2.7 PUBLIC ANNOUNCEMENT

नेपाल सरकार
भौतिक योजना तथा निर्माण मन्त्रालय
सडक विभाग

बनेपा-सिन्धुली-बर्दीबास सडक योजना

बनेपा-सिन्धुली-बर्दीबास सडकको आवश्यक मर्मत सम्भार, सडक सुरक्षा, अति-आवश्यक स्थानमा सडक फराकिलो बनाउने लगायतका कामको अध्ययनको सिलसिलामा मिति २०७६ असार १ र २ गते आइतबार र सोमबारका दिन काभ्रेको धुलिखेलमा Road Side Traffic Count Survey, Origin Destination Survey र Bus Passenger Survey कार्यमा सर्भेक्षण टोली आउने भएकोले आवश्यक सहयोग गरिदिनुहुनको लागि जिल्ला प्रशासन कार्यालय, जिल्ला प्रहरी कार्यालय, यातायात व्यवसायी संघ साथै सम्बन्धित सरोकारवाला निकाय तथा यात्रु महानुभावहरूमा हार्दिक अनुरोध गरिन्छ।

कार्यक्रम हुने स्थान:

१. धुलिखेल, काभ्रेपलाञ्चोक
२. खुर्कोट, सिन्धुली
३. बर्दीबास (वि.पी. राजमार्ग), महोत्तरी

सूर्यबहादुर भाट
योजना प्रमुख

सूर्यविनायक-धुलिखेल-सिन्धुली-बर्दीबास सडक योजना

CHAPTER 3
ROAD SIDE TRAFFIC COUNT SURVEY

3. ROAD SIDE TRAFFIC COUNT SURVEY

3.1 TRAFFIC VOLUME BY VEHICLE TYPE

Traffic count survey was conducted at six survey stations along Sindhuli Road, Dhulikhel (Araniko Highway), East West HW (Near Bardibas Junction) on two weekdays (Thursday, Friday) and 1 weekend (Saturday). The result of Traffic Count Survey is presented in *Table 3.2 (Weekday)* and *Table 3.3 (Weekend)*. Detailed information of Traffic survey in graph representation is shown in *Fig 3.1 (Weekday)* and *Fig 3.2 (Weekend)*.

Traffic Count Survey was carried from 6am on 13th June 2019 to 6am on 16th June 2019. We did not observe any disturbances at the site or in vehicle movement along Sindhuli Road or along East West Highway. Average of total vehicle movement has been considered for two weekdays while the actual count has been considered for one weekend. The directional flow of the vehicles movement at different survey sites are given below. Refer to Annex 4 for the hourly traffic count by vehicle type for each direction of vehicle movement for all the 6 station below:

Direction of Vehicle Movement:

Station 1: Traffic Count Direction for Dhulikhel - B.P Highway & Araniko Highway

- KTM ↔ Sindhuli
- KTM ↔ Barabise
- Barabise ↔ Sindhuli

Station 2: Traffic Count Direction for Mangaltar

- Dhulikhel ↔ Khurkot

Station 3: Traffic Count Direction for Khurkot (Near Old Bus Park)

- Dhulikhel ↔ Sindhuli
- Manthali ↔ Sindhuli
- Manthali ↔ Dhulikhel

Station 4: Traffic Count Direction for Khurkot (Causeway No. 3)

- Dhulikhel ↔ Sindhuli
- Ghurmi ↔ Dhulikhel
- Sindhuli ↔ Ghurmi

Station 5: Traffic Count Direction for Sindhuli Madi

- Khurkot ↔ Bardibas

Station 6: Traffic Count Direction for Bardibas (B.P Highway & East –West Highway)

- Sindhuli ↔ Hetauda
- Janakpur ↔ Sindhuli
- Janakpur ↔ Hetauda

Table 3.1 Vehicle Classification used during the Road Side Traffic Count Survey:

During Survey		During Reporting	
Vehicle Type	Code	Merged Vehicle Type	Code
Private Car/Taxi	1	Car/Jeep/Taxi/4WD	1
4 WD	2		
Large Bus	3	Large Bus	2
Mini Bus	4	Mini Bus	3
Micro Bus	5	Micro Bus	4
Multi-Axle Truck	6	Multi Axle Truck	5
Heavy Truck	7	Heavy Truck	6
Light Truck	8	Light Truck	7
Motorcycle	9	Motorcycle	8
Tractor	10	Tractor+Power Tiller	9
Power Tiller	11		
Three Wheeler	12	Others	10
Bullock/ Horse Cart	13		
Rickshaws	14		
Utility	15		

In summary, 15 different vehicle types were used in the survey sheet. For reporting purpose, the vehicle classifications has been summarised into 10 different vehicle types. Please refer Annex 3 for detailed vehicle classification and Annex 2.1 for road side traffic count survey format.

**Table 3.2: Total Traffic Movement by Vehicle Type on Weekday (Average of two days)
(From 6am on 13th June to 6am 15th June)**

Weekday (24Hrs Count : 6:00am - 6:00am)																
S.N	Survey Points	Direction of Vehicle Movement	Vehicle Type										Total (1 -10)	Total Except (8, 9 & 10)	Total Except (9 & 10)	Total Except 5 and 10
			1	2	3	4	5	6	7	8	9	10				
			Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Motorbike	Tractor +Power Tiller	Others				
1	Dhulikhel	Kathmandu <-> Barabise (Along Araniko)	1652	52	940	39	115	2227	411	7060	42	959	13495	5435	12495	12421
		Kathmandu <-> Sindhuli (Along BP)	2135	14	407	643	11	686	380	4586	30	885	9775	4275	8860	8880
		Sindhuli <-> Barabise (Along BP)	408	45	37	4	1	95	45	1278	16	73	2001	634	1912	1927
2	Mangaltar	Dhulikhel <-> Khurkot	1034	0	209	571	1	371	85	1375	3	483	4131	2271	3646	3648
3	Khurkot near Old Bus Park	Dhulikhel <-> Sindhuli	968	1	113	574	0	107	36	1396	24	418	3635	1798	3194	3218
		Dhulikhel <-> Manthali	117	0	53	17	0	69	14	224	37	53	582	269	493	529
		Manthali <-> Sindhuli	102	0	24	27	1	216	23	520	20	93	1024	392	912	930
4	Khurkot Causeway No. 3	Dhulikhel <-> Ghumi	230	0	42	6	1	28	8	357	36	125	831	314	670	705
		Dhulikhel <-> Sindhuli	710	0	93	551	1	243	116	944	37	347	3040	1713	2657	2693
		Sindhuli <-> Ghumi	26	0	3	1	0	14	5	93	12	41	194	49	142	154
5	Sindhuli Madi	Khurkot <-> Bardibas	698	1	95	546	66	269	66	2320	111	805	4975	1740	4060	4105
6	Bardibas	Hetauda <-> Janakpur (Along EW)	1413	12	678	152	973	422	77	6234	230	1396	11584	3725	9959	9216
		Hetauda <-> Sindhuli (Along BP)	449	0	70	73	78	203	33	2741	67	785	4496	904	3645	3633
		Sindhuli <-> Janakpur (Along BP)	501	1	47	451	46	131	6	1604	53	453	3292	1182	3292	2793
Percentage of Vehicles			16.6%	0.2%	4.5%	5.8%	2.0%	8.1%	2.1%	48.7%	1.1%	11.0%				
Vehicle Type 'Others' include Utility Vehicles, Motorised Three Wheeler, Rickshaws, Bullock Cart/Tanga																

Table 3.2 represents the traffic movement and the vehicles recorded in weekdays for 6 survey locations along Sindhuli Road, BP Highway, Araniko Highway and East-West Hwy. During weekdays it is seen that, over 49 % of the vehicle movement is due to motorbikes and 17% of the traffic movement is due to car/jeep/taxi/4WD. Micro Bus, Mini Bus and Heavy Truck were between 4-8 %. Light Truck & Multi Axle Trucks movement is 2%. Very less movement of Large Bus, Tractor/Power Tiller and were observed at the survey sites. Other vehicles (utility, three wheeler, rickshaws, bullock cart/tanga) comprises of 11 % of the total vehicle movement.

Highest vehicle movement was recorded along Kathmandu <-> Barabise (12421) and then at Hetauda <-> Janakpur (9216), followed by Dhulikhel - along B.P Highway (8880) and 4105 noted at Sindhulimadi along Khurkot <-> Bardibas. Medium to low vehicle movement were recorded at the other routes. Fig. 3.1 gives the graphical representation of Road Side Traffic Count Survey on weekdays.

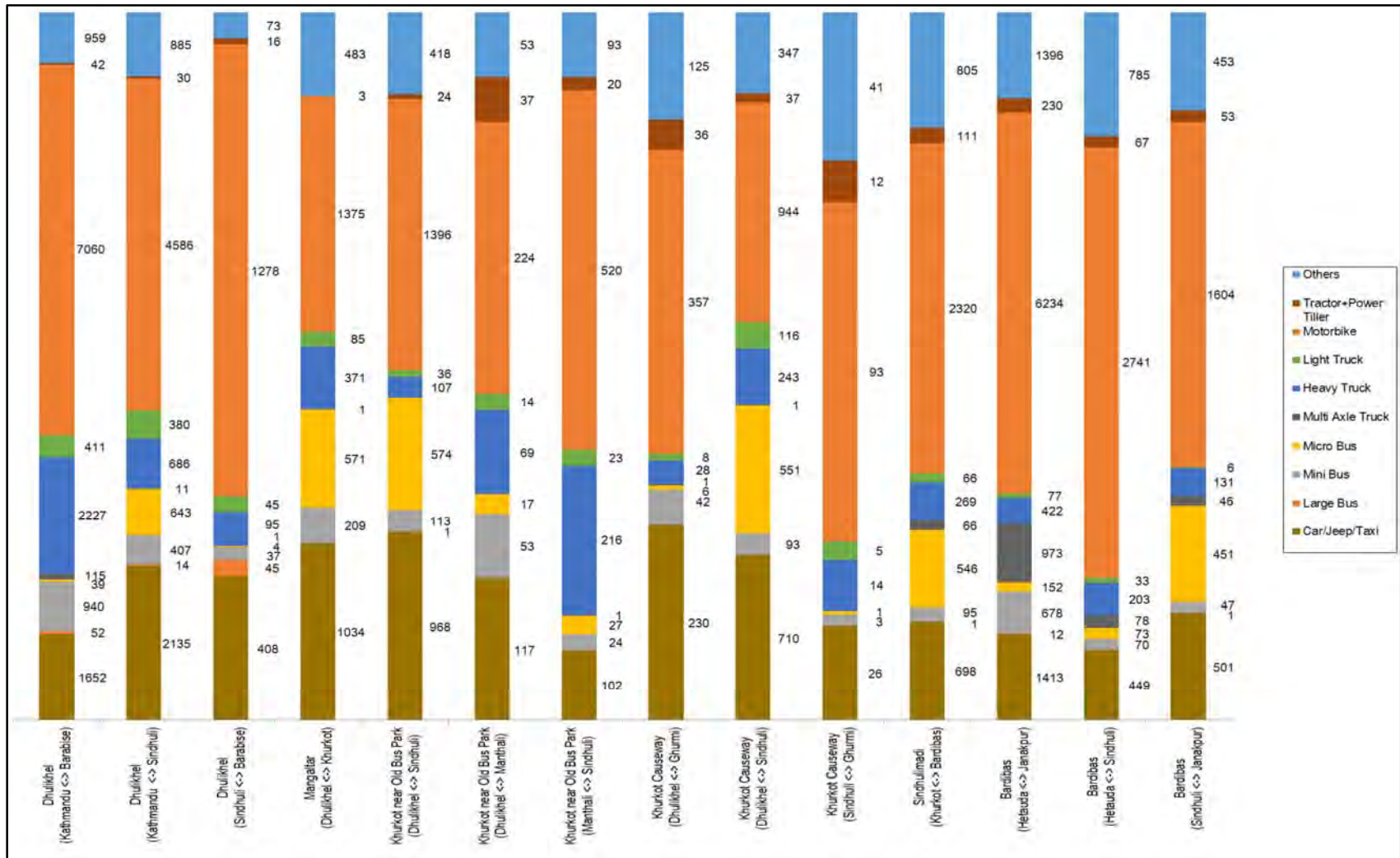


Fig 3.1: Graph Representation of Total Traffic Movement by Vehicle Type on Weekday (Average of two days) (From 6am on 13th June to 6am 15th June)

**Table 3.3: Total Traffic Movement by Vehicle Type on Weekend
From 6am on 15th June to 6am 16th June)**

Weekend (24Hrs Count : 6:00am - 6:00am)																
S.N	Survey Points	Direction of Vehicle Movement	Vehicle Type										Total (1 -10)	Total Except (8, 9 & 10)	Total Except (9 & 10)	Total Except 5 and 10
			1	2	3	4	5	6	7	8	9	10				
			Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Motorbike	Tractor +Power Tiller	Others				
1	Dhulikhel	Kathmandu <-> Barabise (Along Araniko)	2090	8	1018	65	99	2232	284	7537	36	769	14138	5796	13333	13270
		Kathmandu <-> Sindhuli (Along BP)	1997	3	322	551	18	728	148	4395	17	724	8903	3767	8162	8161
		Sindhuli <-> Barabise (Along BP)	335	2	22	3	1	98	21	1254	13	137	1886	482	1736	1748
2	Mangaltar	Dhulikhel <-> Khurkot	1225	4	238	636	4	324	103	1384	1	492	4411	2534	3918	3915
3	Khurkot near Old Bus Park	Dhulikhel <-> Sindhuli	922	0	112	507	0	93	13	1389	54	416	3506	1647	3036	3090
		Dhulikhel <-> Manthali	71	0	43	14	0	63	6	174	50	49	470	197	371	421
		Manthali <-> Sindhuli	112	0	17	26	0	197	24	429	18	94	917	376	805	823
4	Khurkot Causeway No. 3	Dhulikhel <-> Ghurmi	194	0	53	22	0	24	9	401	30	129	862	302	703	733
		Dhulikhel <-> Sindhuli	641	0	81	463	0	281	49	909	37	384	2845	1515	2424	2461
		Sindhuli <-> Ghurmi	29	0	0	3	0	15	5	100	7	37	196	52	152	159
5	Sundhuli Bazar	Khurkot <-> Bardibas	695	0	74	486	59	267	73	2237	118	791	4800	1654	3891	3950
6	Bardibas	Hetauda <-> Janakpur (Along EW)	1233	156	412	140	897	386	133	5398	241	1487	10483	3357	8755	8099
		Hetauda <-> Sindhuli (Along BP)	510	0	67	73	101	129	99	2792	64	970	4805	979	3771	3734
		Sindhuli <-> Janakpur (Along BP)	549	1	39	415	40	71	59	1581	54	494	3303	1174	2755	2769
Percentage of Vehicles			17.2%	0.3%	4.1%	5.5%	2.0%	8.0%	1.7%	48.7%	1.2%	11.3%				

Table 3.3 represents the traffic movement and the vehicles recorded in weekend for 6 survey locations along Sindhuli Road, BP Highway, Araniko Highway and East-West Hwy. During weekend it is seen that, over 49 % of the vehicle movement is due to motorbikes and 17% of the traffic movement is due to car/jeep/taxi/4WD. Micro Bus, Mini Bus and Heavy Truck were between 4-8 %. Multi Axle Trucks & Light Truck movement is 2%. Very less movement of Large Bus, Tractor/Power Tiller and were observed at the survey sites. Other vehicles (utility, three wheeler, rickshaws, bullock cart/tanga) comprises of 11 % of the total vehicle movement.

Highest vehicle movement was recorded at Dhulikhel along Kathmandu <-> Barabise (13270) then again at Dhulikhel along Kathmandu <-> Sindhuli (8161). The third highest recorded number was at Bardibas along Hetauda <-> Janakpur, E-W Highway (8099). Medium vehicle movement were recorded at Mangaltar, Khurkot near Old Bus Park (Dhulikhel<->Sindhuli), Sindhulimadi, Bardibas (Hetauda<->Sindhuli) routes. Low to very low movement were recorded on all the other routes. Weekend travel movement on the Kathmandu Barabise route is higher than the weekdays. Fig 3.2 gives the graphical representation of Road Side Traffic Count Survey on week

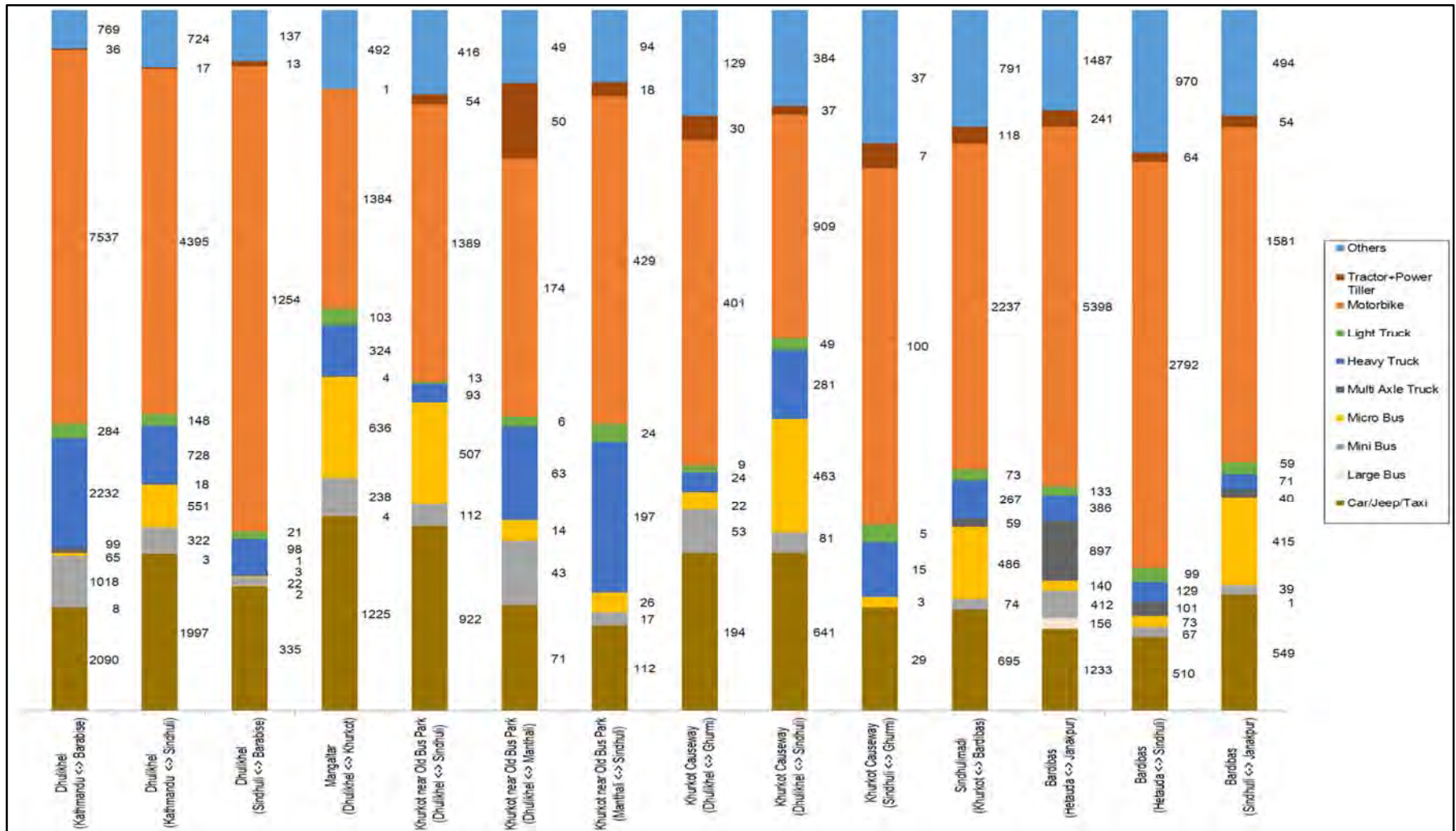


Fig 3.2: Graph Representation of Total Traffic Movement by Vehicle Type on Weekend (From 6am on 15th June to 6am 16th June)

1. Dhulikhel Site – along B.P Highway

The Traffic Volume Count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00am-6:00am). Direction of traffic movement observed at Dhulikhel was **Kathmandu←→Sindhuli along B.P Highway and Sindhuli <-> Barabise along B.P Highway.**

Fig 3.1 and 3.2 shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Dhulikhel site along B.P Highway for both directions on weekdays and weekend respectively.

It is seen that the traffic movement of vehicles via Dhulikhel site is a slightly higher during the weekdays compared to weekend. 2543 number of car/jeep/taxi is seen on weekdays while 2332 number during weekend. Even the numbers of motorbikes, large bus, Light truck, Heavy truck, and other vehicle were recorded a bit higher on weekdays than on weekend.

2. Dhulikhel Site – along Araniko Highway

The Traffic Volume Count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of traffic movement was **and Kathmandu←→ Barabise along Araniko Highway.** *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Dhulikhel site along Araniko Highway for both directions on weekdays and weekend respectively.

It is seen that the total movement of vehicle is a higher during the weekend than weekday along Araniko Highway in Dhulikhel site. The exceptions are large bus, multi-axle, light truck, tractor/power tiller and others exhibiting higher movements during weekday compared to weekend.

3. Mangaltar Site

Fig 3.1 and 3.2 shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Mangaltar site for both directions **Dhulikhel <-> Khurkot** on weekdays and weekend respectively. It is seen that the movement of vehicles is slightly higher during the weekend than on weekday. Total weekend traffic movement is 4411 whereas the weekday total traffic movement is 4131. 1225 number of car/jeep/taxi is seen on weekend while only 1034 numbers in weekday. All other types of vehicles are in higher movements on weekends then on weekdays.

4. Khurkot near Old Bus Park Site

At Khurkot near Old Bus Park site, traffic count was undertaken for different routes namely:

- Dhulikhel <-> Sindhuli
- Dhulikhel <-> Manthali
- Manthali <-> Sindhuli

- *Dhulikhel <-> Sindhuli*

The Traffic Volume count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of traffic flow was Dhulikhel <-> Sindhuli. *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of types of vehicles at Khurkot near Old Bus Park site for both directions on weekdays and weekend respectively.

It is seen that the movement of vehicles is slightly higher during the weekdays than weekend. The total vehicle number of 3635 seen on weekdays and total movement of 3506 is seen on weekend. Similarly, there are higher numbers of movements in all types of vehicle on weekday than weekend except for power tillers and tractors. The power tillers and tractors are double on weekend (54) compared to weekday (24).

- *Dhulikhel <-> Manthali*

Fig 3.1 and 3.2; Table 3.2 and 3.3 shows the movement of types of vehicles at Khurkot near Old Bus park site **Dhulikhel <-> Manthali** for both directions on weekdays and weekend.

It is seen that the movement of vehicles are only slightly higher during the weekdays than on weekend. The total vehicle number of 582 seen on weekdays and total movement of 470 is seen on weekend. Similarly, there are higher numbers of movements in all types of vehicle on weekday than weekend except for power tillers and tractors. The power tillers and tractors are higher on weekend (50) compared to weekday (37).

- *Manthali <-> Sindhuli*

Fig 3.1 and 3.2; Table 3.2 and 3.3 shows the movement of types of vehicles at Khurkot near Old Bus Park site along the route **Manthali <-> Sindhuli** for both directions on weekdays and weekend.

It is seen that the movement of vehicles is slightly higher during the weekday than weekend. The total vehicle movement of 1024 is seen on weekdays and total movement of 917 is seen on weekend. 102 number of car/jeep/taxi/4WD is seen on weekdays and 112 numbers in weekend. The movement of all other vehicles are only very slighter higher during weekday compared to weekend.

5. Khurkot Causeway No. 3 Site

The Traffic Volume count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of traffic movement were:

- Dhulikhel <-> Ghurmi
- Dhulikhel <-> Sindhuli
- Sindhuli <-> Ghurmi
- ***Dhulikhel <-> Ghurmi.*** *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Khurkot Causeway No. 3 site for both directions on weekdays and weekend respectively. It is seen that the movement of vehicles is similar in pattern during the weekdays (831) and weekend (862). The movement of vehicle is only slightly higher during weekend. However, car/jeep/taxi and heavy truck are slightly higher during weekdays compared to weekend. 230 number of car/jeep/taxi/4WD is seen on weekdays while 194 number is seen in weekend.
- ***Dhulikhel <-> Sindhuli*** The Traffic Volume count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of traffic flow was Dhulikhel <-> Sindhuli. *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of types of vehicles at Khurkot Causeway No. 3 site for both directions on weekdays (3040) and weekend (2845). It is seen that the movement of vehicles is slightly higher during the weekdays than weekend. Similarly, there are higher numbers of movements in all types of vehicle on weekday than weekend except for the others vehicle. The 'Others' type of vehicles are 384 on weekend compared to 347 on weekdays.
- ***Sindhuli <-> Ghurmi*** *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Khurkot Causeway No. 3 site for both directions on weekdays and weekend respectively. It is seen that the movement of vehicles is similar in pattern during the weekdays (194) and weekend (196). However, Car/jeep/taxi/4WD and heavy truck are slightly higher during weekend (29) compared to weekdays (26).

6. Bardibas - BP Highway Site

The Traffic Volume count survey was conducted on 2 weekdays for 24 hrs (6:00-6:00) in the traffic flow direction were:

- Hetauda <-> Sindhuli (Along BP) - 4496 (average of two week days)
- Sindhuli <-> Janakpur (Along BP) - 3292 (average of two week days)
- Total for 2 weekdays - 7788

The 1 weekend for 24hrs (6:00-6:00) are as below:

- Hetauda <-> Sindhuli (Along BP) - 4805
- Sindhuli <-> Janakpur (Along BP) - 3303
- Total for 1 weekend - 8108

The movement of traffic for Hetauda <-> Sindhuli (Along BP) is higher in weekend (4805) than in weekday (4496).

For Sindhuli <-> Janakpur (Along BP), the traffic movement number is similar on both on weekdays and weekend.

Overall, for both the routes along BP, the total movement of heavy truck, mini bus, micro bus, is higher during the weekdays than on weekend.

Fig 3.1 and 3.2 shows the graphical representation and *Table 3.2 and 3.3* details on movement of types of vehicles at Bardibas site for both directions on weekdays and weekend respectively.

7. Bardibas Along East-West Highway

(Hetauda →← Janakpur)

The Traffic Volume count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of flow was **Hetauda →← Janakpur**. *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of types of vehicles at Bardibas site for both directions on weekdays and weekend respectively.

It is seen that the movement of vehicles is higher in the weekday (11584) than weekend (10483).

1413 number of car/jeep/taxi/4WD is seen on weekday while only 1233 numbers in weekend. There is higher number of motorbike movements on weekday (6234) than on weekend (5398).

8. Sindhulimadi

The Traffic Volume count survey was conducted on 2 weekdays and 1 weekend for 24hrs (6:00-6:00). Direction of traffic movement was **Dhulikhel ↔ Bardibas**. *Fig 3.1 and 3.2* shows the graphical representation and *Table 3.2 and 3.3* details on movement of different types of vehicles at Sindhulimadi site for both directions on weekdays and weekend respectively.

It is seen that the movement of vehicles is higher during the weekday (4975) compared to weekend (4800). Only light truck, power tiller & tractor movement is higher during weekend compared to weekday. Similar number of car/jeep/taxi/4WD is seen on both weekday and in weekend.

3.2 TRAFFIC VOLUME BY VEHICLE TYPE IN PCU

The factors used for the calculation of PCU (Passenger Car Unit) are based on the specification provided by Department of Roads (DoR). Table 3.4 and Table 3.5 represent the traffic volume by vehicle type in PCU during weekdays and weekend respectively.

**Table 3.4: Traffic Volume in PCU on Weekday (Average of two days)
(From 6am on 13th June to 6am 15th June)**

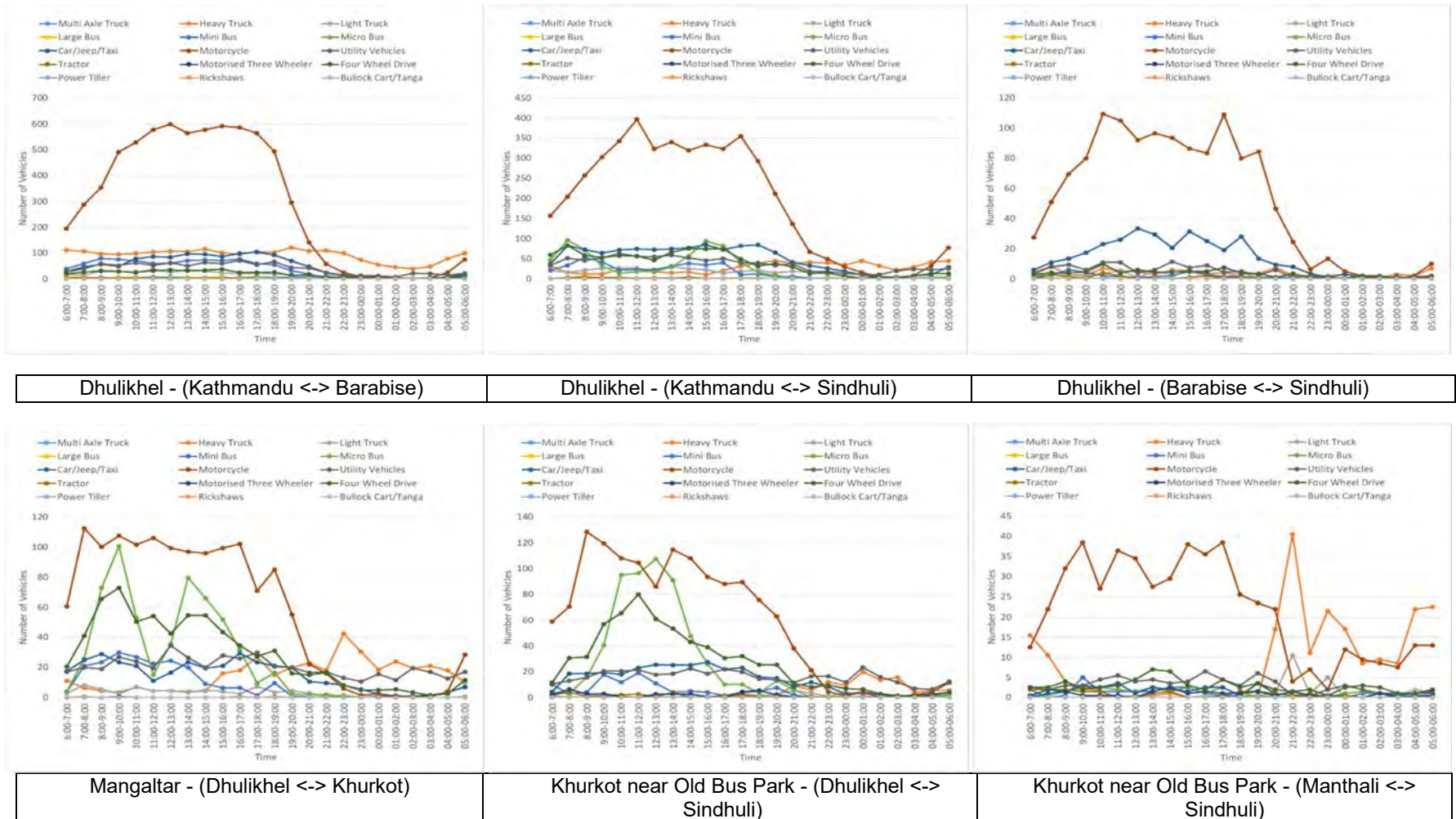
Weekday (24Hrs Count : 6:00am - 6:00am)																
S.N	Survey Station	Direction of Vehicle Movement	Vehicle Type										PCU/Day			
			1	2	3	4	5	6	7	8	9	10	Total (1-7)	Total (1-8)	Total Except 5 & 10	
			Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Motorbike	Tractor + PTiller	Others				
PCU Factor (as per DoR)			1	3	2.5	1.5	4	3	1.5	0.5	1.5	1	PCU			
1	Dhulikhel	Kathmandu <-> Barabise (Along Araniko)	1652	156	2350	58	460	6680	616	3530	62	959	11971	15501	15103	
		Kathmandu <-> Sindhuli (Along BP)	2135	42	1018	965	42	2057	569	2293	45	885	6827	9120	9123	
		Sindhuli <-> Barabise (Along BP)	408	135	93	5	4	284	68	639	24	73	995	1634	1654	
2	Mangaltar	Dhulikhel <-> Khurkot	1034	0	523	857	2	1113	128	688	4	483	3656	4343	4345	
3	Khurkot near Old Bus Park	Dhulikhel <-> Sindhuli	968	3	283	861	0	320	53	698	36	418	2487	3185	3221	
		Dhulikhel <-> Manthali	117	0	133	25	0	206	20	112	55	53	500	612	667	
		Manthali <-> Sindhuli	102	0	59	40	4	648	35	260	29	93	887	1147	1172	
4	Khurkot Causeway No. 3	Dhulikhel <-> Ghurmi	230	0	104	8	4	84	12	178	53	125	442	620	669	
		Dhulikhel <-> Sindhuli	710	0	233	826	2	728	174	472	55	347	2672	3144	3197	
		Sindhuli <-> Ghurmi	26	0	8	2	0	42	8	47	17	41	85	131	148	
5	Sindhuli Madi	Khurkot <-> Bardibas	698	3	238	818	262	807	98	1160	166	805	2924	4084	3988	
6	Bardibas	Hetauda <-> Janakpur (Along EW)	1413	35	1694	228	3890	1265	115	3117	345	1396	8639	11756	8211	
		Hetauda <-> Sindhuli (Along BP)	449	0	174	110	312	608	49	1370	100	785	1700	3070	2858	
		Sindhuli <-> Janakpur (Along BP)	501	3	116	677	184	392	8	802	80	453	1881	2683	2578	
Vehicle Type 'Others' include Utility Vehicles, Motorised Three Wheeler, Rickshaws, Bullock Cart/Tanga																

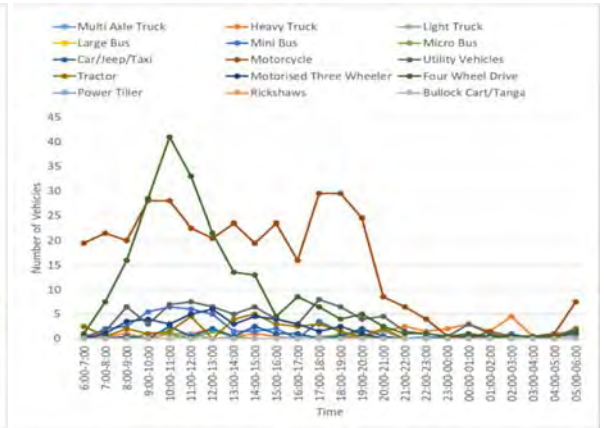
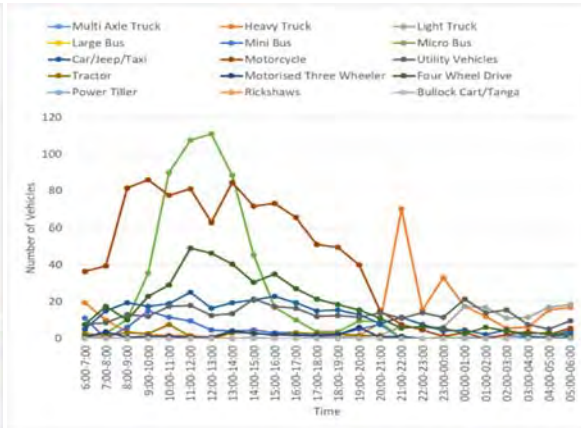
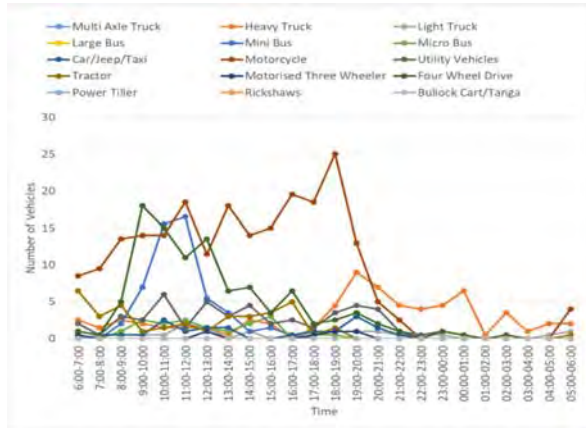
**Table 3.5: Traffic Volume in PCU on Weekend
(From 6am on 15th June to 6am 16th June)**

Weekend (24Hrs Count : 6:00am - 6:00am)															
S.N	Survey Station	Direction of Vehicle Movement	Vehicle Type										PCU/Day		
			1	2	3	4	5	6	7	8	9	10	Total (1-7)	Total (1-8)	Total Except 5 & 10
			Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Motorbike	Tractor/ PTiller	Others			
PCU Factor (as per DoR)			1	3	2.5	1.5	4	3	1.5	0.5	1.5	1	PCU		
1	Dhulikhel	Kathmandu <-> Barabise (Along Araniko)	2090	24	2545	98	396	6696	426	3769	54	769	12275	16043	15701
		Kathmandu <-> Sindhuli (Along BP)	1997	9	805	827	72	2184	222	2198	26	724	6116	8313	8267
		Sindhuli <-> Barabise (Along BP)	335	6	55	5	4	294	32	627	20	137	730	1357	1373
2	Mangaltar	Dhulikhel <-> Khurkot	1225	12	595	954	16	972	155	692	2	492	3929	4621	4606
3	Khurkot near Old Bus Park	Dhulikhel <-> Sindhuli	922	0	280	761	0	279	20	695	81	416	2261	2956	3037
		Dhulikhel <-> Manthali	71	0	108	21	0	189	9	87	75	49	398	485	560
		Manthali <-> Sindhuli	112	0	43	39	0	591	36	215	27	94	821	1035	1062
4	Khurkot Causeway No. 3	Dhulikhel <-> Ghurmi	194	0	133	33	0	72	14	201	45	129	445	646	691
		Dhulikhel <-> Sindhuli	641	0	203	695	0	843	74	455	56	384	2455	2909	2965
		Sindhuli <-> Ghurmi	29	0	0	5	0	45	8	50	11	37	86	136	147
5	Sindhuli Madi	Khurkot <-> Bardibas	695	0	185	729	236	801	110	1119	177	791	2756	3874	3815
6	Bardibas	Hetauda <-> Janakpur (Along EW)	1233	468	1030	210	3588	1158	200	2699	362	1487	7887	10586	7359
		Hetauda <-> Sindhuli (Along BP)	510	0	168	110	404	387	149	1396	96	970	1727	3123	2815
		Sindhuli <-> Janakpur (Along BP)	549	3	98	623	160	213	89	791	81	494	1734	2524	2445
Vehicle Type 'Others' include Utility Vehicles, Motorised Three Wheeler, Rickshaws, Bullock Cart/Tanga															

3.3 HOURLY TRAFFIC VOLUME

Fig 3.3 shows the hourly variation of vehicle movement on for weekdays in all the directions at 6 different survey station locations.

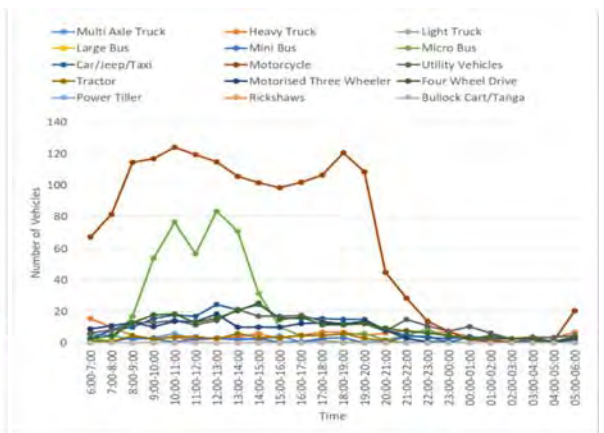
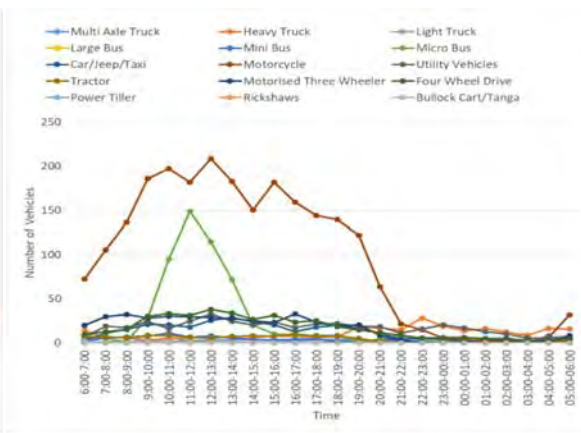
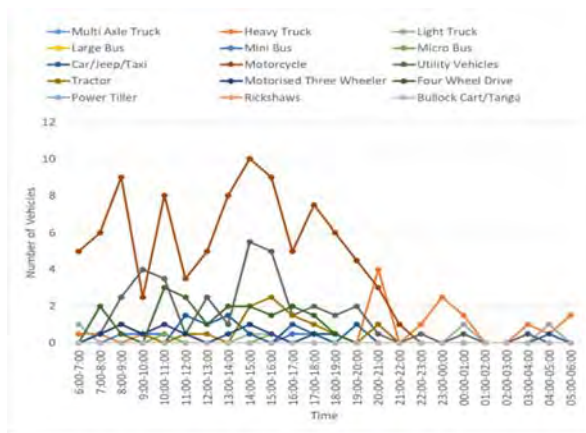




Khurkot near Old Bus Park - (Dhulikhel <-> Manthali)

Khurkot Causeway No. 3 - (Dhulikhel <-> Sindhuli)

Khurkot Causeway No. 3 - (Dhulikhel <-> Ghurmi)



Khurkot Causeway No. 3 - (Ghurmi <-> Sindhuli)

Sindhulimadi - (Khurkot <-> Bardibas)

Bardibas - (Sindhuli <-> Janakpur)

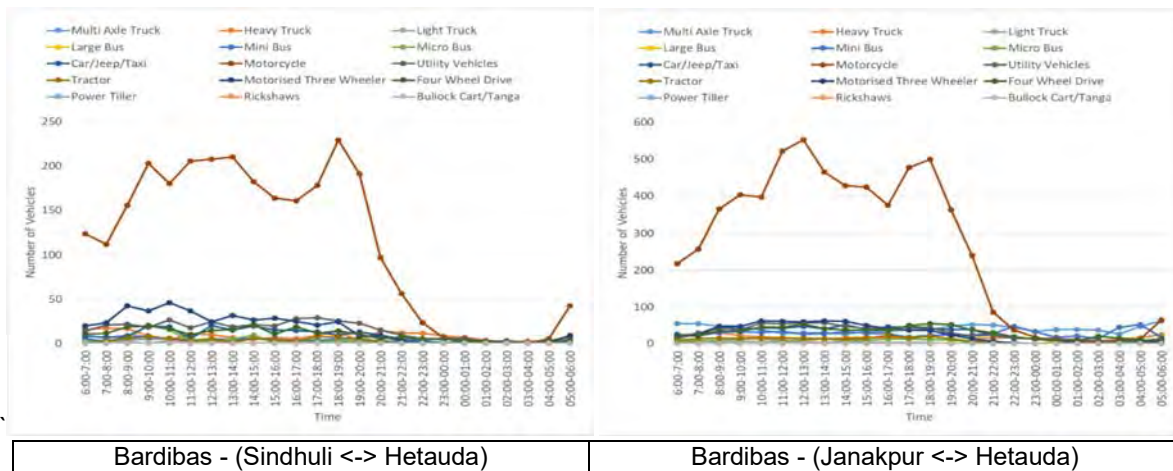
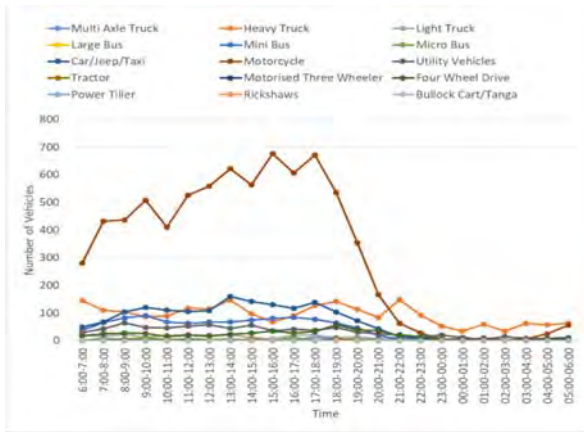
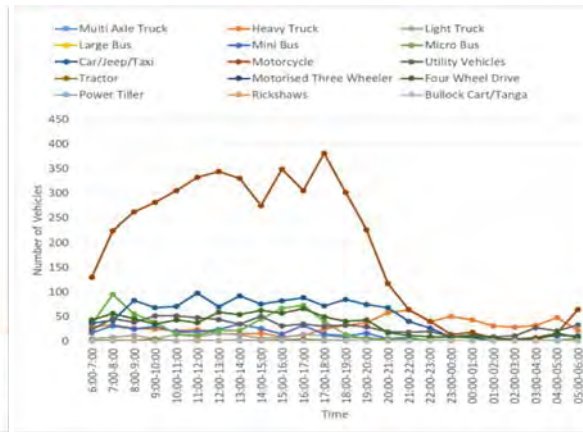


Fig 3.3: Hourly Variation of Traffic Volume on Weekday (Average of two days)

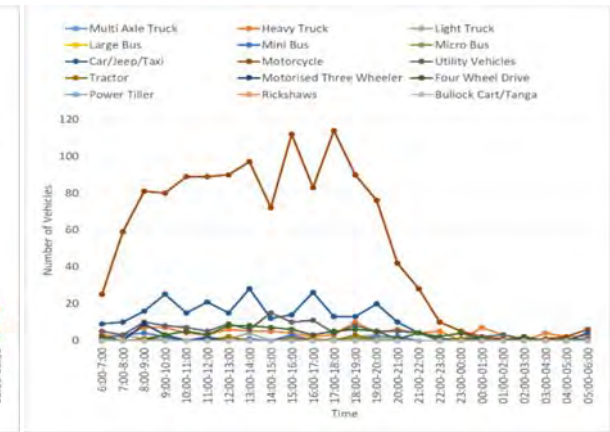
Fig 3.4 below shows the hourly variation of vehicle movement on weekend in all the directions at 6 different survey station locations.



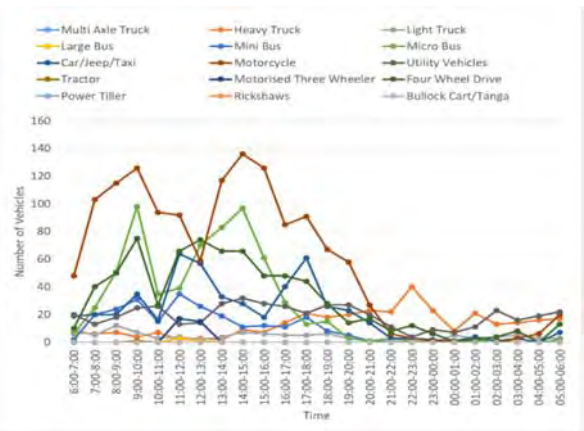
Dhulikhel - (Kathmandu <-> Barabise)



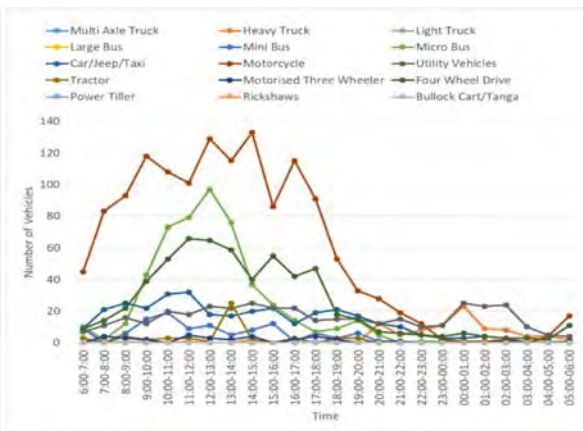
Dhulikhel - (Kathmandu <-> Sindhuli)



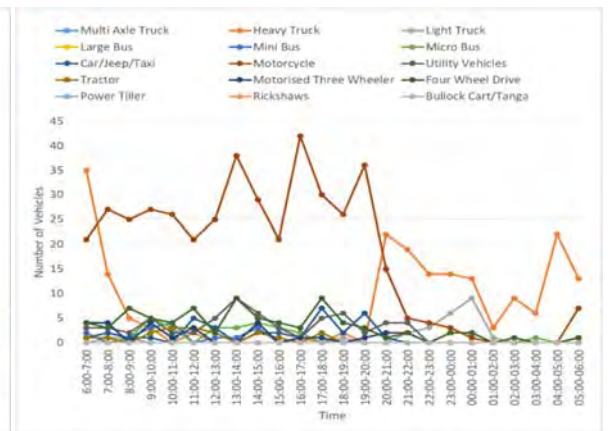
Dhulikhel - (Barabise <-> Sindhuli)



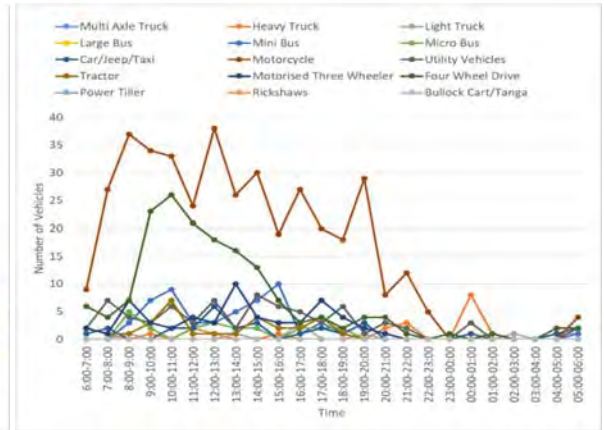
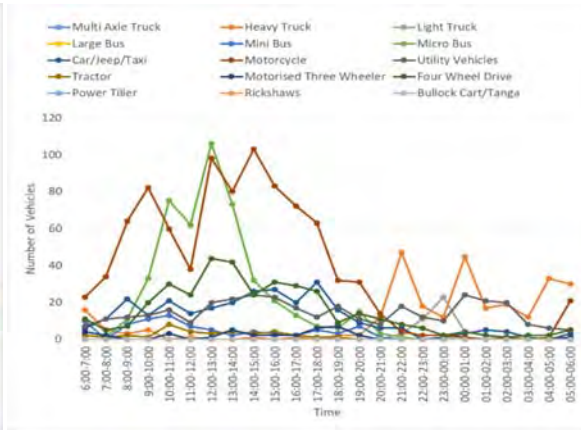
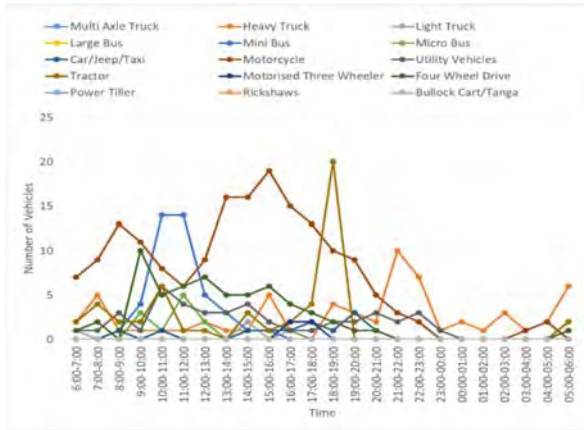
Mangaltar - (Dhulikhel <-> Khurkot)



Khurkot near Old Bus Park - (Dhulikhel <-> Sindhuli)



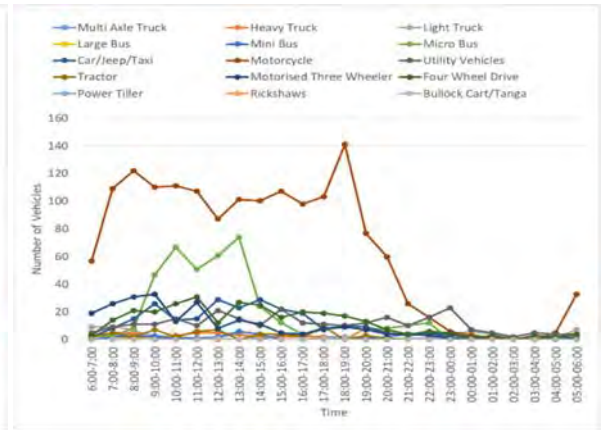
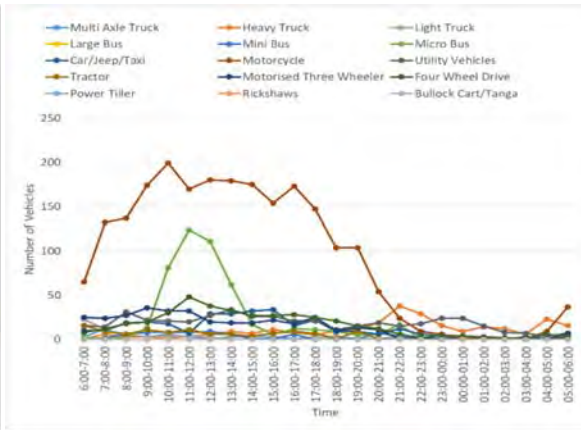
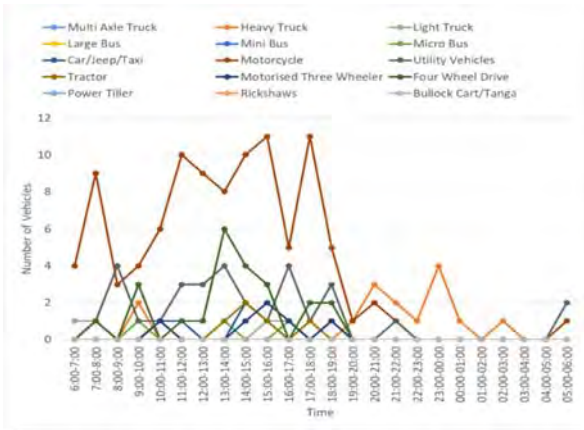
Khurkot near Old Bus Park - (Manthali <-> Sindhuli)



Khurkot near Old Bus Park - (Dhulikhel <-> Manthali)

Khurkot Causeway No. 3 - (Dhulikhel <-> Sindhuli)

Khurkot Causeway No. 3 - (Dhulikhel <-> Ghurmi)



Khurkot Causeway No. 3 - (Ghurmi <-> Sindhuli)

Sindhulimadi - (Khurkot <-> Bardibas)

Bardibas - (Sindhuli <-> Janakpur)

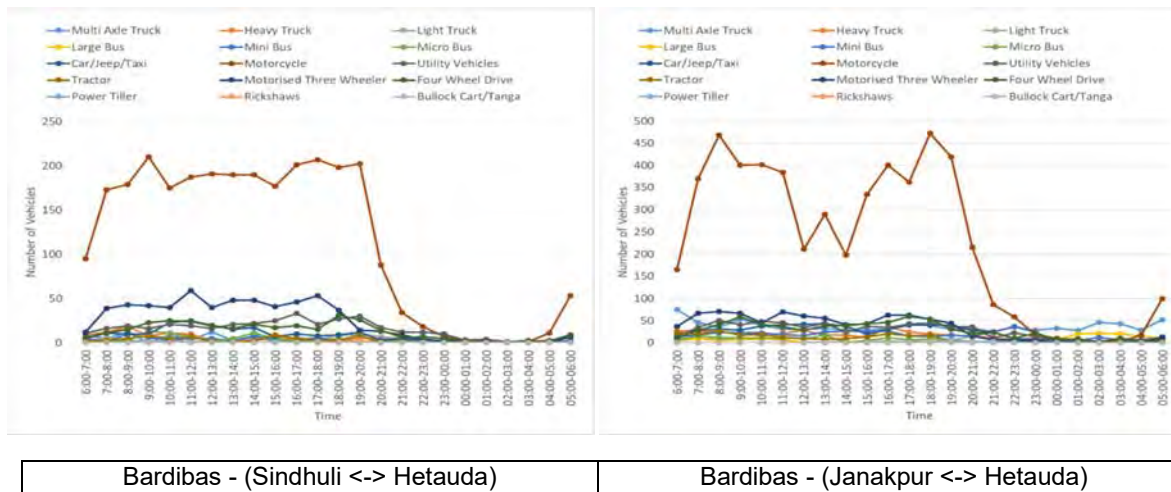


Fig 3.4: Hourly Variation of Traffic Volume on Weekend

1. Dhulikhel Site - B.P Highway

The hourly movement of motorbike is highest between 10:00-12:00 hrs and also between 17:00 -18:00 hours. While the movement of car/jeep/taxi/4WD is highest between 18:00-19:00 hrs in weekdays. Similarly, during weekend the highest traffic movement of motorbikes is recorded between 15:00-16:00 and 17:00-18:00 hrs. Car/jeep/taxi/4WD is recorded to have a pattern where the highest movement occurs between 12:00-13:00, 15:00-16:00 hrs and 18:00 to 19:00 hrs. The movement of busses, trucks and tractors are almost even throughout the day.

2. Dhulikhel Site - Araniko Highway

The hourly movement of motorbike is highest between 12:00-13:00 hrs while the movement of car/jeep/taxi/4WD is highest between 17:00-18:00 hrs in weekdays. Similarly, during weekend the highest traffic movement of motorbikes is recorded between 17:00-18:00 and of car/jeep/taxi/4WD is recorded highest between 13:00-14:00 hrs. The movement of busses, trucks and tractors are almost even throughout the day.

3. Mangaltar Site

Mixed hourly variation traffic is seen in Mangaltar site on weekdays and weekend, where the highest traffic recorded is motorbikes between 14:00-15:00 on weekend and at times 16:00-17:00 & 17:00-18:00 on weekdays. Movement of car/jeep/taxi/4WD is recorded to be highest between 16:00-17:00 hrs on weekdays and between 17:00-18:00 hrs on weekend. The highest traffic recorded is micro bus is between 9:00-10:00 & 14:00-15:00 both on weekend and weekday. The highest traffic recorded is Heavy Truck is between 22:00-23:00 both on weekdays and weekend.

4. Khurkot near Old Bus Park Site

The highest traffic recorded is motorbikes between 18:00-19:00 on weekdays and between 15:00-16:00 on weekend. Car/jeep/taxi/4WD movement is seen highest between 10:00 -11:00 & 11:00 - 12:00-13:00 hrs on both weekdays and on weekend. Micro bus movement is seen highest between 9:00-10:00 both on weekdays and on weekend.

5. Khurkot Causeway No. 3 Site

The highest traffic recorded is microbus between 12:00-13:00 both on weekdays and on weekend. Similarly, large movement of motorcycles are also seen in varying time slots 13:00 -14:00 and 17:00 to 19:00 on weekdays. Whereas a cyclic pattern is observed on weekend, with peak number at variable time slots such as 12:00-13:00, 14:00-15:00, 16:00-17:00, and 19:00-20:00.

6. Bardibas- BP Site

Along Sindhuli Road (Sindhulimadi – Bardibas)

The highest traffic recorded is motorbikes between 9:00-10:00 on weekdays and between 16:00-17:00 on weekend. The movement of busses, trucks, tractors and other vehicle are almost even throughout the day.

7. Bardibas-EW Site

Along East-West Highway (Janakpur – Hetauda)

The highest traffic recorded is motorbikes between 8:00-9:00 and between 18:00-19:00 on weekend. On the weekday, the peak movement occurs between 12:00-13:00 and 17:00-18:00 & 18:00-19:00. The movement of busses, trucks, tractors and other vehicle are almost even throughout the day.

8. Sindhulimadi Site

The highest traffic recorded is motorbikes between 12:00-13:00 on weekdays and between 10:00-11:00 on weekend. Micro bus movement is seen highest between 11:00-12:00 both on weekdays and weekend. The movement of busses, trucks, tractors and other vehicle are almost even throughout the day.

3.4 COMPARISON OF TRAFFIC DATA

Comparison of Traffic data between *Traffic Count Survey 2017* and *Traffic Count Survey 2019* shows difference in data due to change in location of Traffic Survey Count, methodology and events during survey date.

3.4.1 Dhulikhel South (Kathmandu<->Sindhuli) & (Barabise<->Sindhuli)

The table 3.6 and Fig 3.5 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is an increment of ADT by 25%.

Table 3.6: Comparison of ADT for Dhulikhel South (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Dhulikhel South)	3	893	186	9	343	451	1352	4560	379	44	0	960	0	0	0	9180
JICA 2019 [^] (Kathmandu <-> Sindhuli) & (Barabise<-> Sindhuli)	14	796	339	11	411	615	1511	5792	946	40	8	962	0	0	0	11445

[^] Ref to Annex 4.1: Dhulikhel for detailed count.

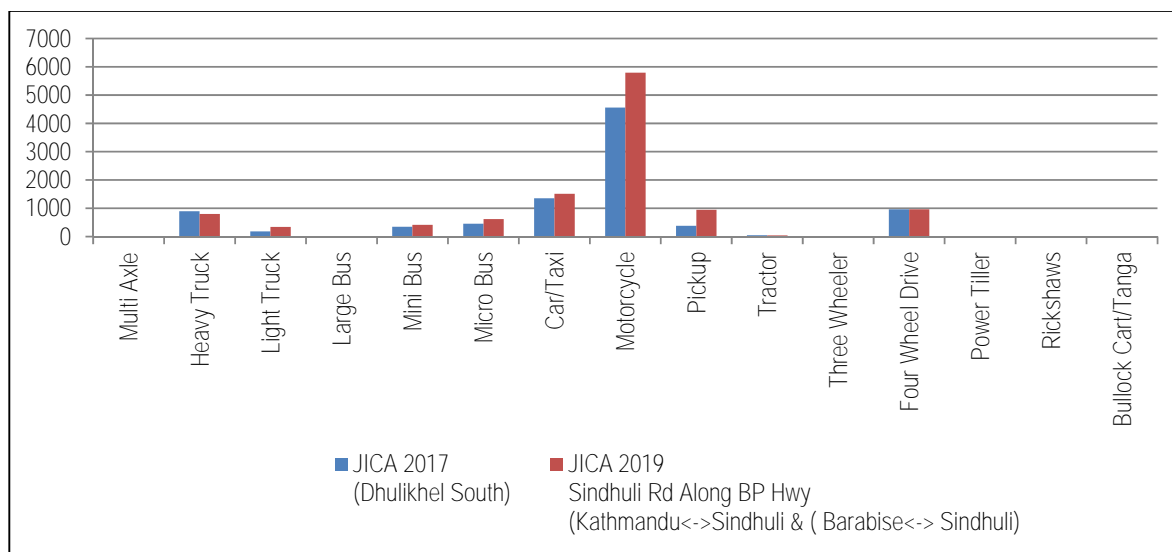


Fig 3.5: Comparison of ADT for Dhulikhel South

3.4.2 Dhulikhel East (Kathmandu <-> Barabise)

The table 3.7 and Fig 3.6 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is an increment of ADT by 35%.

Table 3.7: Comparison of ADT for Dhulikhel East (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Dhulikhel East)	17	1529	226	154	635	22	972	5611	485	53	0	459	0	0	0	10163
JICA 2019 [^] (Kathmandu <-> Barabise)	110	2228	368	37	966	47	1340	7219	891	40	4	458	0	0	0	13708

[^] Ref to Annex 4.1: Dhulikhel for detailed traffic count.

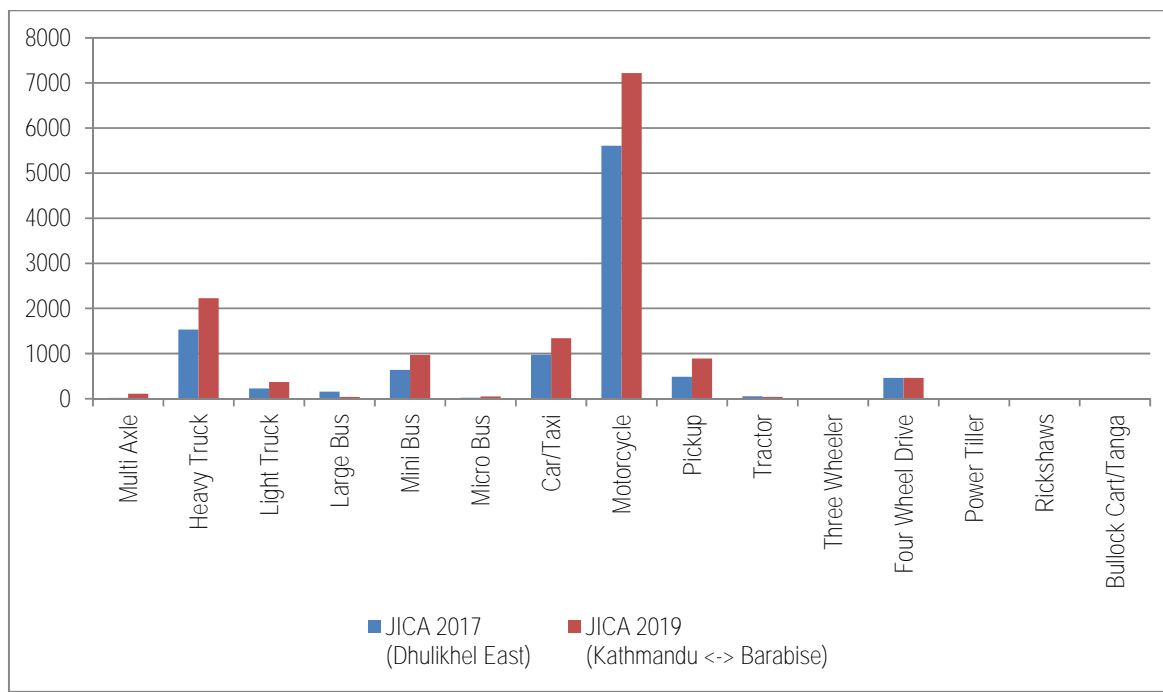


Fig 3.6: Comparison of ADT for Dhulikhel East

3.4.3 Mangaltar (Dhulikhel<->Khurkot)

The table 3.8 and Fig 3.7 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is an increment of ADT by 35%.

Table 3.8: Comparison of ADT for Mangaltar (Dhulikhel<->Khurkot) (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Dhulikhel <-> Bardibas)	0	494	84	10	135	429	291	994	206	1	0	568	0	0	0	3213
JICA 2019 [^] (Dhulikhel <-> Khurkot)	2	355	91	1	219	593	400	1378	475	2	11	697	0	0	0	4224

[^] Ref to Annex 4.2: Mangaltar for detailed traffic count.

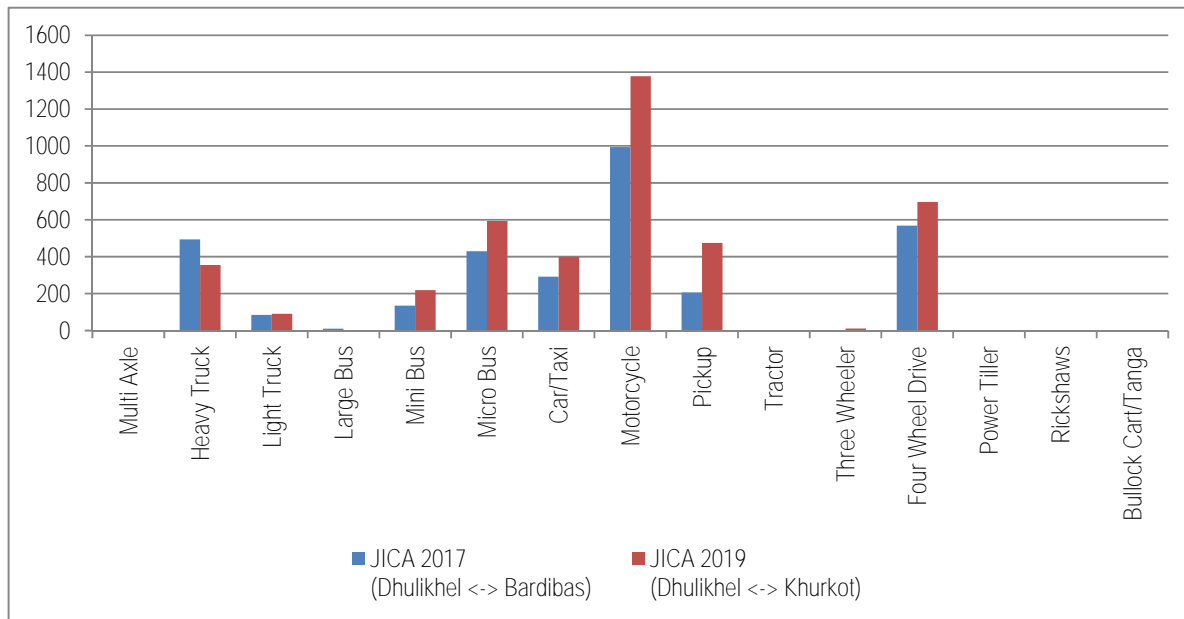


Fig 3.7: Comparison of ADT for Mangaltar (Dhulikhel<->Khurkot)

3.4.4 Sindhulimadi Along BP Hwy – (Khurkot<->Bardibas)

The table 3.9 and Fig 3.8 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is an increment of ADT by 4%.

Table 3.9: Comparison of ADT for Sindhulimadi Along BP Hwy – (Khurkot<->Bardibas) (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Dhulikhel <-> Bardibas)	47	179	19	17	111	371	241	2778	264	89	187	442	0	1	0	4745
JICA 2019 [^] (Khurkot <-> Bardibas)	63	268	68	1	88	526	297	2292	423	110	377	400	3	0	0	4916

[^] Ref to Annex 4.5: Sindhuli for detailed traffic count.

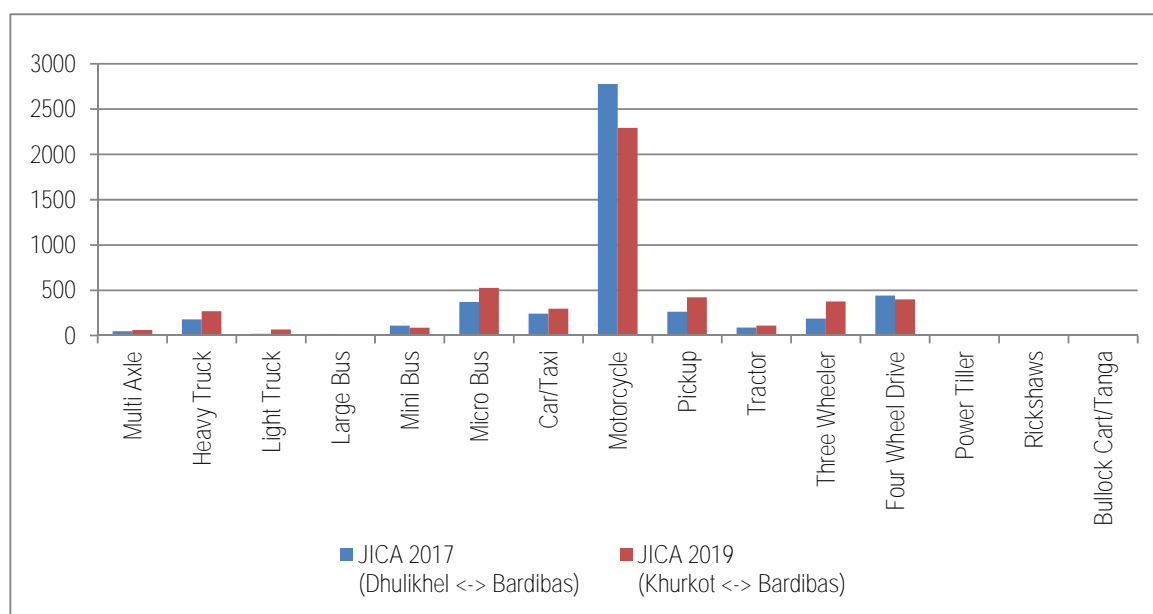


Fig 3.8: Comparison of ADT for Sindhulimadi Along BP Hwy – (Khurkot<->Bardibas)

3.4.5 Bardibas North (Hetauda<->Sindhuli) & (Sindhuli<->Janakpur)

The table 3.10 and Fig 3.11 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is an increment of ADT by only 1%.

Table 3.10: Comparison of ADT for Bardibas North (Hetauda<->Sindhuli) & (Sindhuli<->Janakpur) (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Bardibas North)	62	148	69	30	71	440	275	5044	407	95	600	548	0	46	0	7835
JICA 2019 [^] (Hetauda <-> Sindhuli) & (Sindhuli <-> Janakpur)	130	289	78	1	113	512	461	4354	633	118	679	525	0	1	0	7894

[^] Ref to Annex 4.6: Bardibas for detailed traffic count.

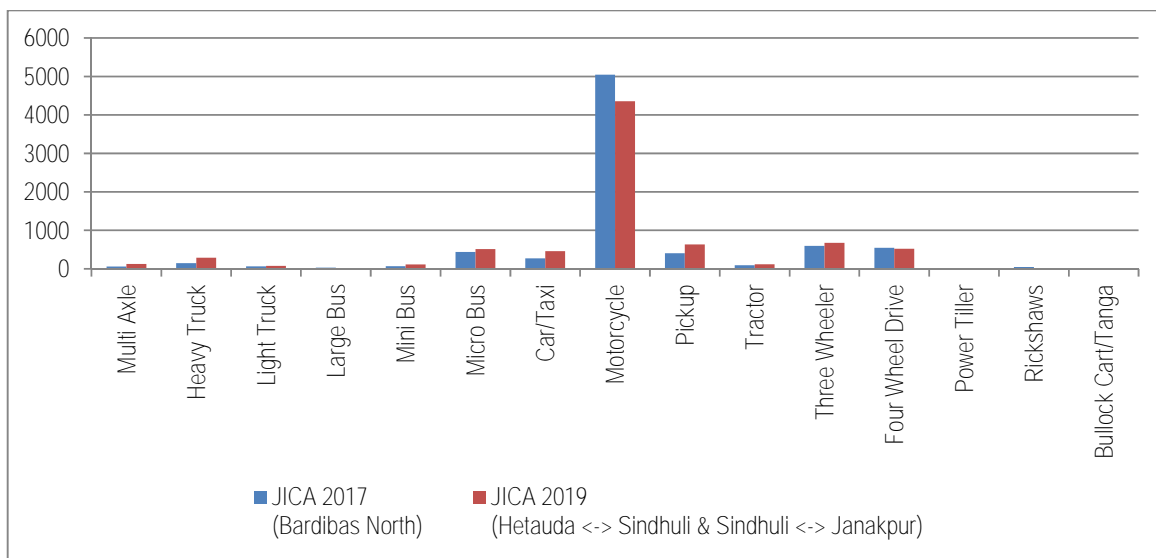


Fig 3.9: Comparison of ADT for Bardibas North (Hetauda<->Sindhuli) & (Sindhuli<->Janakpur) (2017 Vs 2019)

3.4.6 Bardibas East (Hetauda <-> Janakpur)

The table 3.11 and Fig 3.10 show the comparison of average daily traffic data recorded in 2019 to that of 2017. This comparison shows that there is a decrease of ADT by 12%.

Table 3.11: Comparison of ADT for Bardibas East (Hetauda <-> Janakpur) (2017 Vs 2019)

Average Daily Traffic (ADT)	Multi Axle	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Taxi	Motorcycle	Pickup	Tractor	Three Wheeler	Four Wheel Drive	Power Tiller	Rickshaws	Bullock Cart/Tanga	Total
JICA 2017 (Bardibas East)	643	388	68	306	211	517	378	7717	600	189	691	911	0	136	2	12757
JICA 2019 [^] (Hetauda <-> Janakpur)	947	410	95	60	589	148	647	5955	708	228	717	706	6	1	0	11217

[^] Ref to Annex 4.6: Bardibas for detailed traffic count.

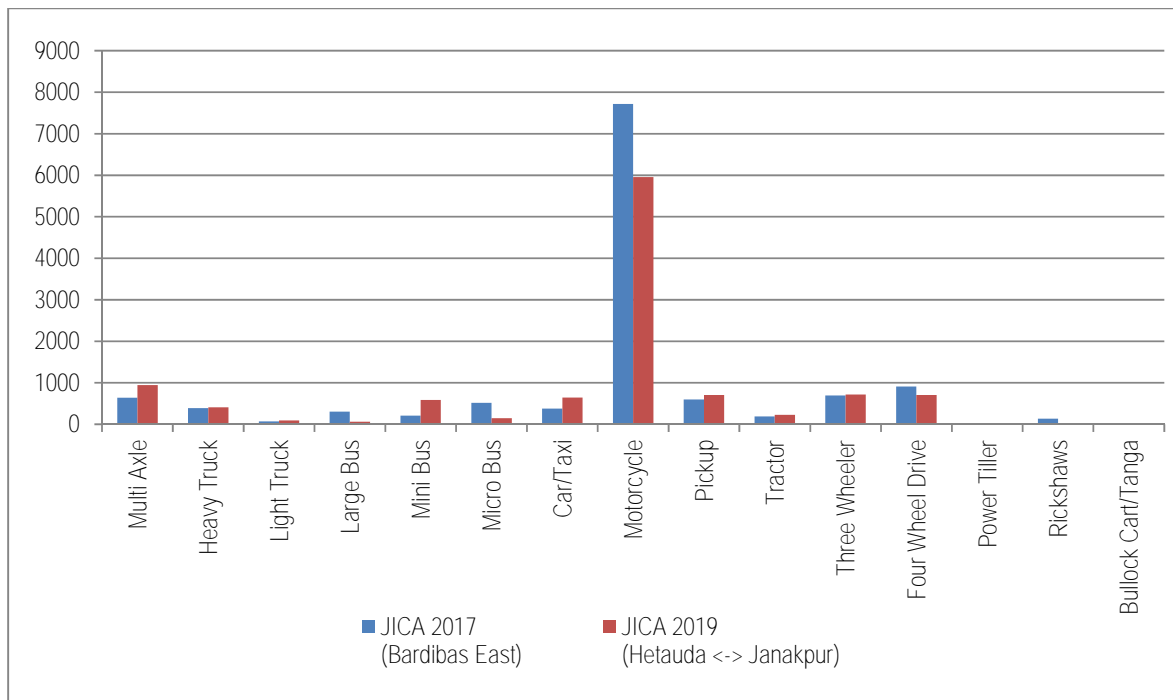


Fig 3.10: Comparison of ADT for Bardibas East (Hetauda <-> Janakpur)

CHAPTER 4
ROAD SIDE ORIGIN - DESTINATION SURVEY

4. ROAD SIDE ORIGIN - DESTINATION SURVEY

4.1 SAMPLE RATE BY NUMBER OF VEHICLES, TYPES AND LOCATION

Road Side Interview (O-D) survey was conducted on one weekday at each of the locations as below:

- Dhulikhel [17 June 2019 Mon 6:00 - 10:00 16hrs]
- Khurkot Buspark [14 June 2019 Fri 6:00 - 10:00 16hrs]
- Bardibas [13 June 2019 Thur 6:00 - 10:00 16hrs]

The survey captured the Origin-Destination information of each vehicle type, resulting in 1576 completed interviews at 3 survey location (i.e. Dhulikhel; Khurkot and Sindhulimadi) as listed in *Table 4.1*.

Table 4.1: Number of Vehicles Interviewed in O-D Survey

Vehicle Type	No. of interview s- Dhulikhel				No. of interview s- Khurkot				No. of interview s- Bardibas			
	Inbound	Outbound	Total	Sample Rate (%)	Inbound	Outbound	Total	Sample Rate (%)	Inbound	Outbound	Total	Sample Rate (%)
	Bar--> Dhu	Dhu--> Bar			Bar--> Dhu	Dhu--> Bar			Bar--> Dhu	Dhu--> Bar		
Motorcycle	45	31	76	1%	44	38	82	5%	62	39	101	2%
Car, Jeep & Van	31	18	49	4%	36	25	61	16%	45	33	78	18%
Utility Vehicles/Pickup	14	35	49	6%	25	20	45	13%	54	26	80	14%
Micro Bus	71	75	146	24%	126	88	214	35%	69	49	118	23%
Mini Bus	35	34	69	16%	56	28	84	57%	11	16	27	29%
Large Bus	0	1	1	20%	0	1	1	50%	0	0	0	0%
Light Truck	29	32	61	21%	10	2	12	32%	8	2	10	50%
Heavy Truck	44	21	65	13%	6	5	11	9%	68	44	112	41%
Multi Axle Truck	1	2	3	43%	0	0	0	0	13	7	20	17%
Others	0	0	0	0%	1	0	1	1%	0	0	0	0
Total	270	249	519		304	207	511		330	216	546	

SN	Survey Locations	Inbound	Outbound
1	Dhulikhel	Bardibas-Dhulikhel	Dhulikhel-Bardibas
2	Khurkot	Bardibas-Dhulikhel	Dhulikhel-Bardibas
3	Bardibas	Bardibas-Dhulikhel	Dhulikhel-Bardibas

From the above *Table 4.1*, it is seen that 146 micro bus, 76 motorcycle, 65 heavy trucks, 61 light truck, 69 mini bus and 49 Car/Jeep/Van were interviewed at Dhulikhel site.

Similarly, it is seen that 214 micro bus, 82 motorcycle, 61 Car/Jeep/Van, 45 utility vehicles, 84 mini bus, 1 large bus, 12 light truck, and 11 heavy truck were interviewed at Khurkot site.

118 micro buses, 101 motorcycles, 80 utility vehicles, 78 Car/Jeep/Van, 112 heavy truck, 10 light trucks were interviewed at Bardibas site.

Of total 1576 samples collected from all three sites, over 30% were micro bus, 16% motorcycle, 12% heavy truck and Car/Jeep/Van and 11 % were utility and mini buses 5% light truck and 1% multi axle.

Table 4.2: Sample Rate of Vehicles Interviewed in O-D Survey

Sample Rate of Vehicles Interviewed in O-D Survey															
Inbound															
Survey Station		Multi Axle Truck	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Jeep/ Van	Motorcycle	Pick Up	Tractor	Three Wheeler	Power Tiller	Rickshaws	Bullock/H and/Horse Cart
Dhulikhel	TV	2	212	126	0	218	295	555	1979	340	15	2	0	0	0
	VS	1	44	29	0	35	71	31	45	14	0	0	0	0	0
	SR	50%	21%	23%	0%	16%	24%	6%	2%	4%	0%	0%	0%	0%	0%
Khurkot Near Old Bus Park	TV	0	45	13	0	75	317	189	809	145	32	17	0	0	0
	VS	0	6	10	0	56	126	36	44	25	1	0	0	0	0
	SR	0.0%	13%	77%	0%	75%	40%	19%	5%	17%	3%	0%	0%	0%	0%
Bardibas	TV	55	125	14	0	41	252	222	2061	289	79	323	0	0	0
	VS	13	68	8	0	11	69	45	62	54	0	0	0	0	0
	SR	24%	54%	57%	0%	27%	27%	20%	3%	19%	0%	0%	0%	0%	0%
Outbound															
Survey Station		Multi Axle Truck	Heavy Truck	Light Truck	Large Bus	Mini Bus	Micro Bus	Car/Jeep/ Van	Motorcycle	Pick Up	Tractor	Three Wheeler	Power Tiller	Rickshaws	Bullock/H and/Horse Cart
Dhulikhel	TV	5	278	169	5	224	316	845	3210	476	30	5	0	0	0
	VS	2	21	32	1	34	75	18	31	35	0	0	0	0	0
	SR	40%	8%	19%	20%	15%	24%	2%	1%	7%	0%	0%	0%	0%	0%
Khurkot Near Old Bus Park	TV	0	83	25	2	72	293	181	997	208	25	23	0	0	0
	VS	0	5	2	1	28	88	25	38	20	0	0	0	0	0
	SR	0%	6%	8%	50%	39%	30%	14%	4%	10%	0%	0%	0%	0%	0%
Bardibas	TV	64	150	6	0	52	252	204	1997	295	59	244	0	0	0
	VS	7	44	2	0	16	49	33	39	26	0	0	0	0	0
	SR	11%	29%	33%	0%	31%	19%	16%	2%	9%	0%	0%	0%	0%	0%

Note: - TV: Traffic Volume; VS: No. of Valid Samples; SR: Sample Rate

4.2 AVERAGE NUMBER OF PASSENGERS BY VEHICLE TYPE

Average number of passengers per vehicle types was calculated for all 3 survey locations (i.e. Dhulikhel, Khurkot and Bardibas). The results are shown in *Table 4.3* and *Fig 4.1*.

At Dhulikhel site the average number of passengers in large bus, mini bus and micro bus were 25, 24 and 12 respectively. While in Khurkot, the average number of passengers in large buses, mini bus, micro bus and private car/taxi were 22, 18, 12 and 4 respectively. Similarly at Bardibas site, the average passengers in mini bus and micro bus were 26 and 13 respectively.

From the site observation and collected data, it is found that the average number of passengers in large buses is comparatively higher than the mini buses and micro buses. The average number of passengers in each vehicle seems to be within the passenger carrying capacity of each vehicle for all three survey sites.

Table 4.3: Average No. of Passengers

Vehicle Type	No. of Vehicles	No. of Passengers	Avg. Passengers	No. of Vehicles	No. of Passengers	Avg. Passengers	No. of Vehicles	No. of Passengers	Avg. Passengers
Locations	Dhulikhel			Khurkot			Bardibas		
Motorcycle	76	125	2	82	138	2	101	156	2
Car,Jeep &Van	49	158	3	61	230	4	78	266	3
Utility Vehicles/Pickup	49	89	2	45	97	2	80	171	2
Micro Bus	146	1709	12	214	2540	12	118	1481	13
Mini Bus	69	1633	24	84	1519	18	27	711	26
Large Bus	1	25	25	1	22	22	0	0	0
Light Truck	61	119	2	12	51	4	10	28	3
Heavy Truck	65	38	1	11	22	2	112	274	2
Muti Axle Truck	3	5	2	0	0	0	20	60	3
Others	0	0	0	1	0	0	0	0	0

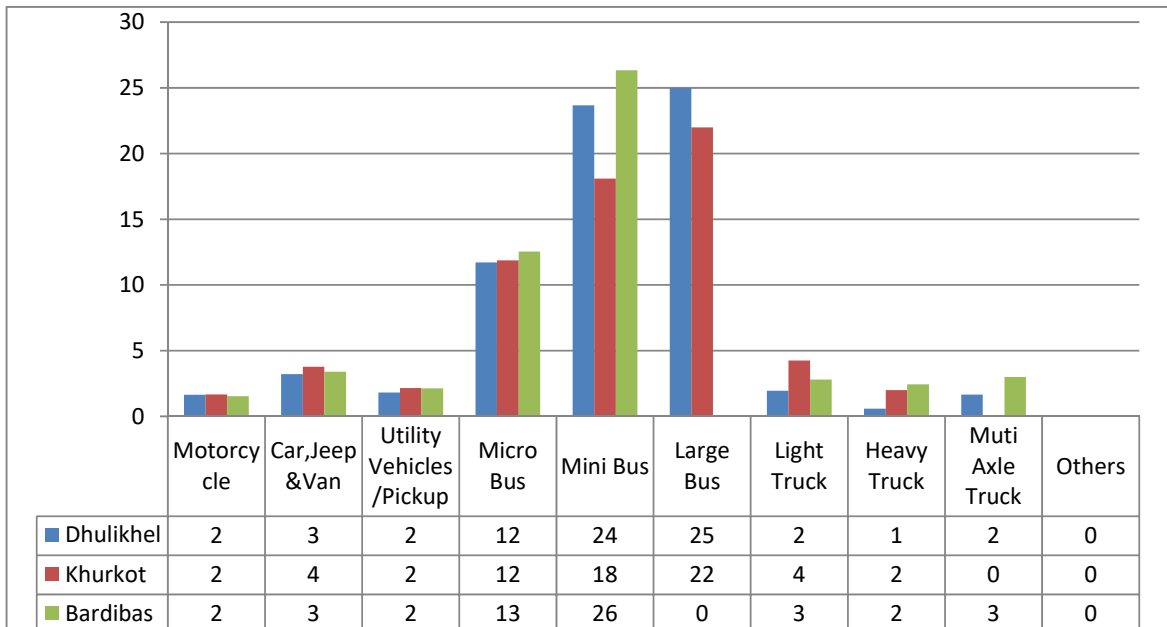


Fig 4.1: Average No. of Passengers

4.3 TRIP PURPOSE

4.3.1 Dhulikhel

Trip purpose of different types of vehicle at Dhulikhel site is shown in Fig 4.2. Let us consider only the higher percentage of trip purpose for each vehicle type. 100% of the utility, 95% of the light truck, 97% heavy truck, 100% multi axle, users' trip purpose is logistics. 24% car/taxi, 99% micro bus, 99% mini bus is used for public passenger. 49% motorcycle, 33% car/taxi, 2% light truck and 2% heavy truck's trip purpose is private. 18% motorcycle, 18% car/taxi, 1% micro bus and 100% large bus is used for leisure/tourism. 33% motorcycle, 24% car/taxi, 1% mini bus and 2% heavy truck is used for to/from work.

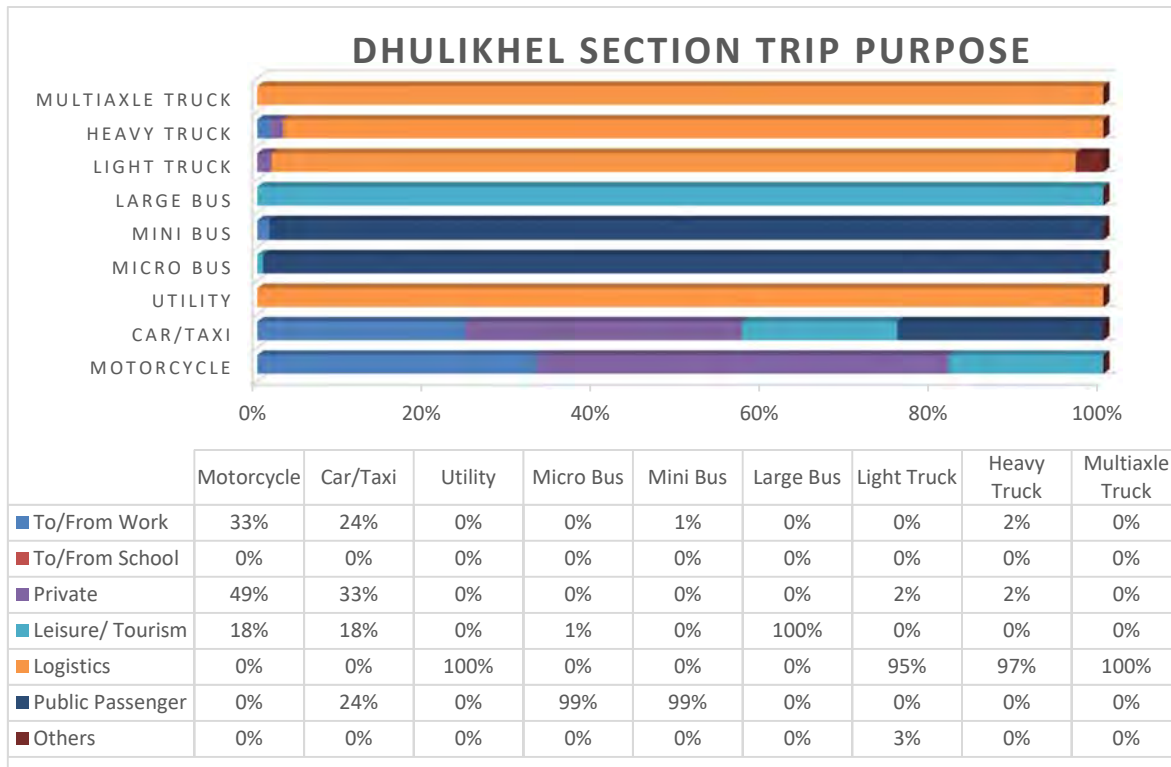


Fig 4.2: Trip Purpose of each Vehicle Type at Dhulikhel

4.3.2 Khurkot Near Old Bus Park

Trip purpose of different types of vehicle in Khurkot near old bus park site is shown in Fig 4.3. Let us consider only the higher percentage of trip purpose for each vehicle type. 100% of heavy truck, 83% light truck, 100 % tractor, 91% utility vehicles are used for logistics purpose. 100% of Large bus, 100% mini Bus, and 97% micro bus are used for public passengers. Only about 24%, 23% and 7% of motorcycle, car/taxi and utility are used for private purpose, 24%, 23% and 2% of motorcycle, car/taxi and micro bus are used for leisure/tourism. 55%, 43%, 2% and 8% of motorcycle, car/taxi, utility and light truck are used for to/from work.

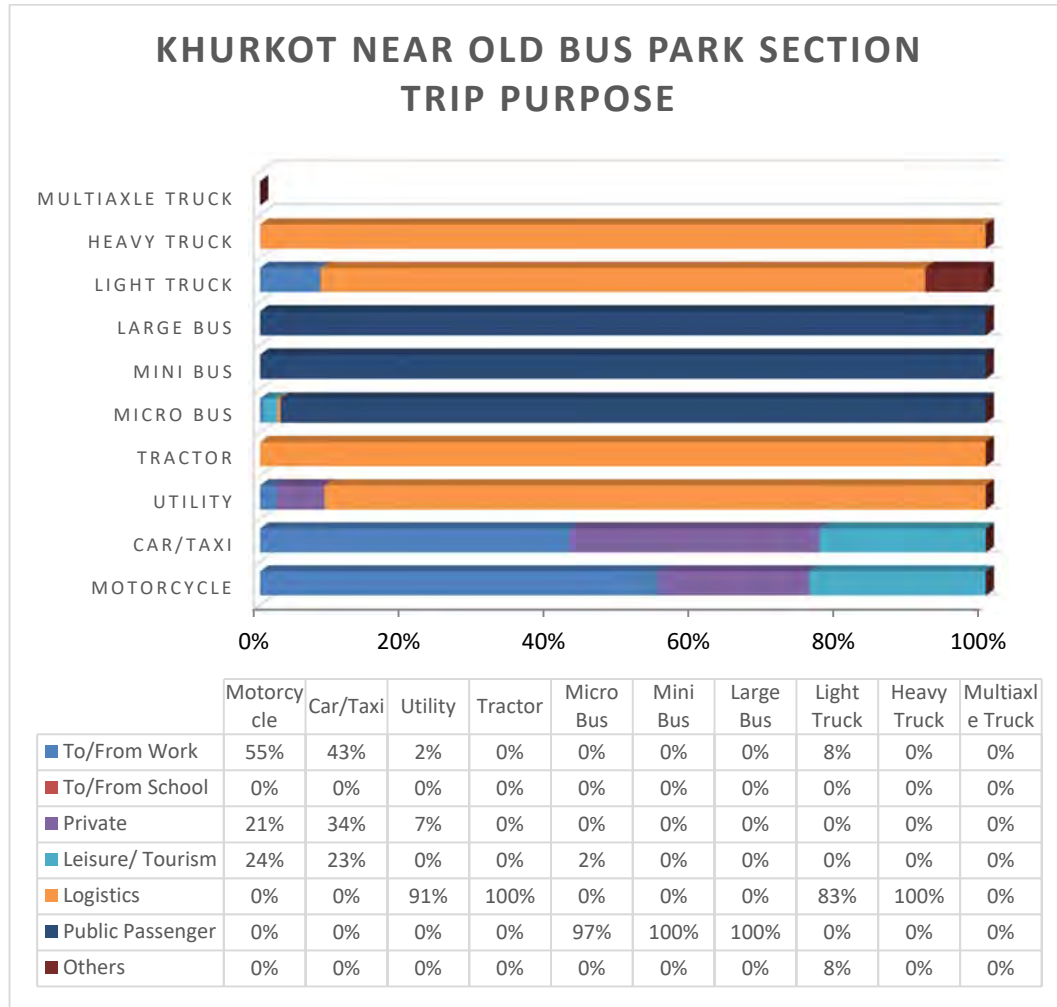


Fig 4.3: Trip Purpose of each Vehicle Type at Khurkot Near Old Bus Park

4.3.3 Bardibas

Trip purpose of different types of vehicle in Bardibas site is shown in Fig 4.4. Let us consider only the higher percentage of trip purpose for each vehicle type. From the figure it is seen that most of the trip purpose of vehicle types are logistics. 85% of multi axle truck, 99% heavy truck, 100% light truck, 1% micro bus, 96% utility vehicles are used for logistics purpose, 100% of mini bus and 99% of micro bus are used for public passengers. Whereas, about 41% and 24% of motorcycle and car/taxi are used for private purpose, 44% and 51% of motorcycle and car/taxi are used for to/from work. 16% and 24% of motorcycle and car/taxi are used for leisure/tourism. Rest about less than 1% vehicles are used for other purposes.

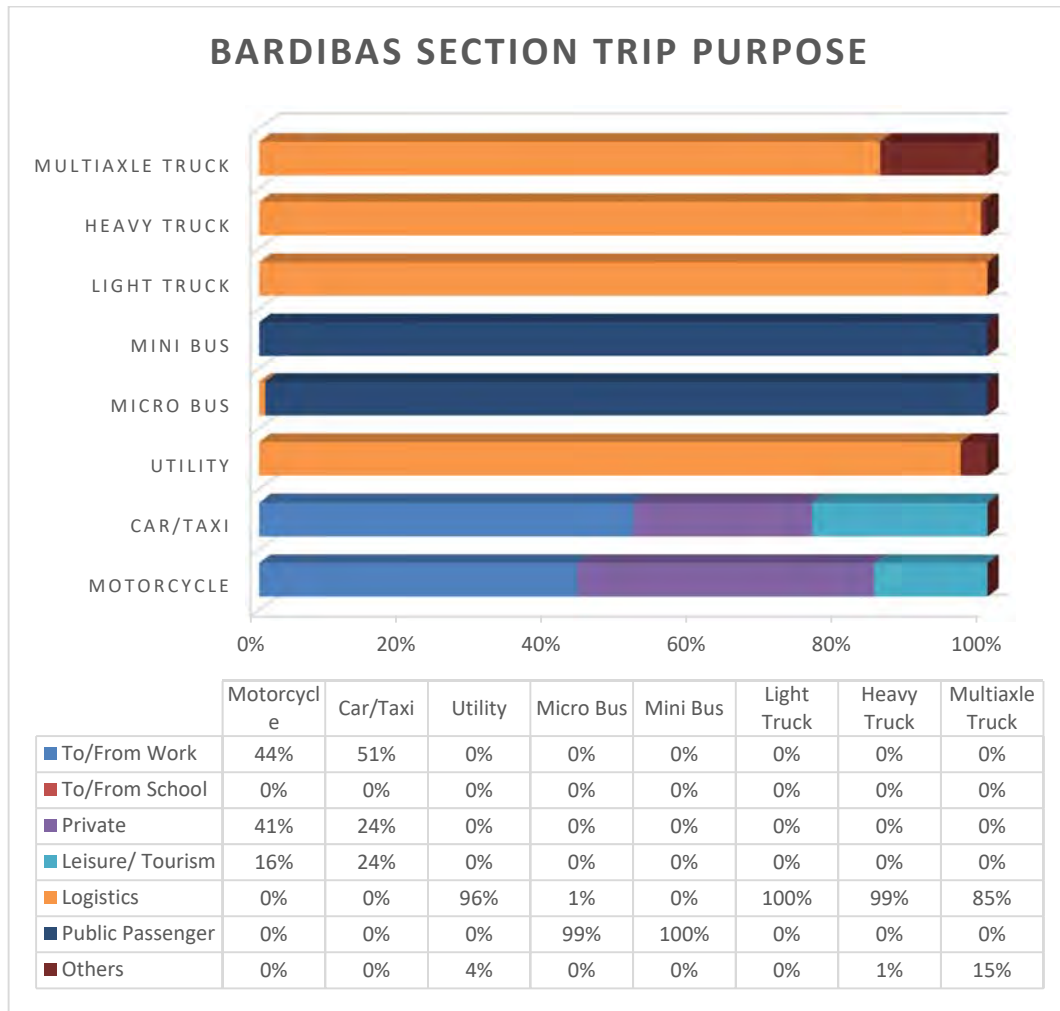


Fig 4.4: Trip Purpose of each Vehicle Type at Bardibas

4.4 ORIGIN - DESTINATION DETAILS

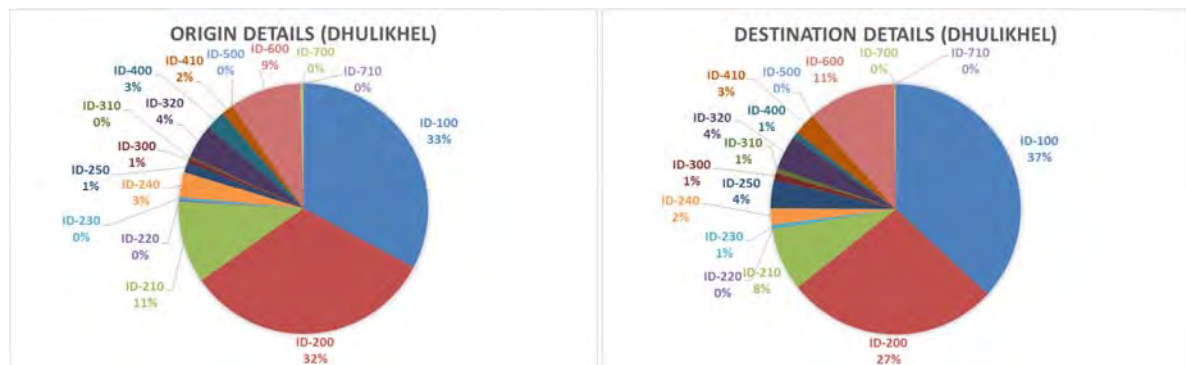
The following codes (Area ID) were used for the Origin and Destination enquiry as shown in the table 4.4 below:

Table 4.4: Area ID for Origin and Destination Survey

Area ID			
100	Kathmandu (including Lalitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar)	310	Charikot (including Dolakha, Jiri, Gelu, Tamakoshi, Chinese border)
200	Dhulikhel (including Banepa, Panauti, Kavre, Namobuddha, Dapcha, Batase, Patleket, Ratmate, Tinpile, Dolalghat, Zero Kilo)	320	Manthali (including Ramechhap, Rampur)
210	Nepalthok (including Bhakundebeesi, Mamti, Mangaltar, Timal, Halesi, Roshi)	400	Janakpur (including Dhanusha, Jaleswor, Laigadh, Pamhopalpur, Siraha, Indian border area)
220	Mulkot	410	Birgunj (including Hetauda, Ghurmi, Hariban, Amalekhgunj, Nijgadh, Gaidakot, Bara, Lalbandi, Sarlahi, Parsa, Chapur, Rautahat, Malangawa, Gaur, Kalaiya, Indian border area)
230	Khurkot	500	West Part (including WDR, MWDR, FWDR; Gangapur, Mahendranagar, Kanchanpur, Rupandehi, Pokhara, Dhaulagiri)
240	Sindhuli (including Kamalamai, Golanjor, Vimar)	600	East Part (including EDR; Illam, Jhapa, Morang, Phidim, Udayapur, Katari, Saptari, Dudhauri, Birtamod, Damak, Okhaldhunga, Solukhumbu, Gaighat, Khotang, Bhojpur, Baltar, Sankhuwasabha, Trijuga, Makalu, Pato, Bargachi, Buipa, Dhankuta, Dharan, Itahari, Lahan)
250	Bardibas, Mahottari	700	India (Kakadvitta, Kolkataa)
300	Kodari (including Chautara, Barabise, Melamchi, Sindhupalchowk, Sunkoshi, Tekanpur, Gaidada, Chinese border area)	710	China

4.4.1 Dhulikhel

Fig 4.5 represents the Origin - Destination information of the Vehicles recorded/interviewed in O-D Survey at Dhulikhel site. It is seen that, 33% of the Vehicles Origin is from ID-100 i.e. Kathmandu (including Lalitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar) and 32% is from ID-200 i.e. Dhulikhel (including Banepa, Panauti, Kavre, Namobuddha, Dapcha, Batase, Patleket, Ratmate, Tinpile, Dolalghat, Zero Kilo). Similarly, for Destination Details of the Vehicles at Dhulikhel site 37% is to ID-100 i.e. Kathmandu (including Lalitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar) and 27% is to ID-200 i.e. Dhulikhel (including Banepa, Panauti, Kavre, Namobuddha, Dapcha, Batase, Patleket, Ratmate, Tinpile, Dolalghat, Zero Kilo).



**Fig 4.5: Origin-Destination details for Dhulikhel Site
(Total No of Samples – 518)**

4.4.2 Khurkot Near Old Bus Park

Fig 4.6 represents the Origin and Destination information of the Vehicles recorded/interviewed in O-D Survey at Khurkot Near Old Bus Park site. It is seen that, 37 % of the Vehicles Origin is from ID-100 i.e. Kathmandu (including Laitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar) and 26% is from ID-600, i.e. East Part (including EDR; Illam, Jhapa, Morang, Phidim, Udayapur, Katari, Saptari, Dudhauri, Birtamod, Damak, Okhaldhunga, Solukhumbu, Gaighat, Khotang, Bhojpur, Baltar, Sankhuwasabha, Trijuga, Makalu, Pato, Bargachi, Buipa, Dhankuta, Dharan, Itahari, Lahan). Similarly for Destination Details of the Vehicles at Khurkot Near Old Bus Park site, 53 % is to ID-100 and 15% is to ID-600.

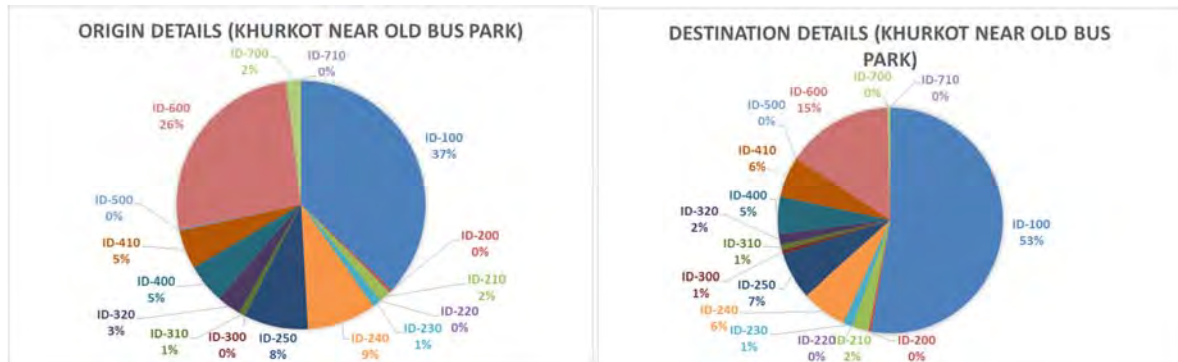


Fig 4.6: Origin-Destination details for Khurkot Near Old Bus Park Site
(Total No of Samples – 511)

4.4.3 Bardibas

Fig 4.7 represents the Origin and Destination information of the Vehicles recorded/interviewed in O-D Survey at Bardibas site. It is seen that, 20%, 19%, 17% and 17 % of the vehicles origin from ID-410 i.e. Birgunj (including Hetauda, Ghurmi, Hariban, Amalekhgunj, Nijgadh, Gaidakot, Bara, Lalbandi, Sarlahi, Parsa, Chapur, Rautahat, Malangawa, Gaur, Kalaiya, Indian border area), ID-240 i.e. Sindhuli, ID-100 i.e. Kathmandu (including Lalitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar) and ID-600 i.e. East Part respectively.

Similarly, for Destination Details of the Vehicles at Bardibas site 23% is to ID-100 i.e. Kathmandu (including Lalitpur, Bhaktapur, Nuwakot, Dhading, Nepaltar), 17% is to ID-240 i.e. Sindhuli, 15% is to ID-600 i.e. East Part and 15% is to ID-410 i.e. Birgunj (including Hetauda, Ghurmi, Hariban, Amalekhgunj, Nijgadh, Gaidakot, Bara, Lalbandi, Sarlahi, Parsa, Chapur, Rautahat, Malangawa, Gaur, Kalaiya, Indian border area).

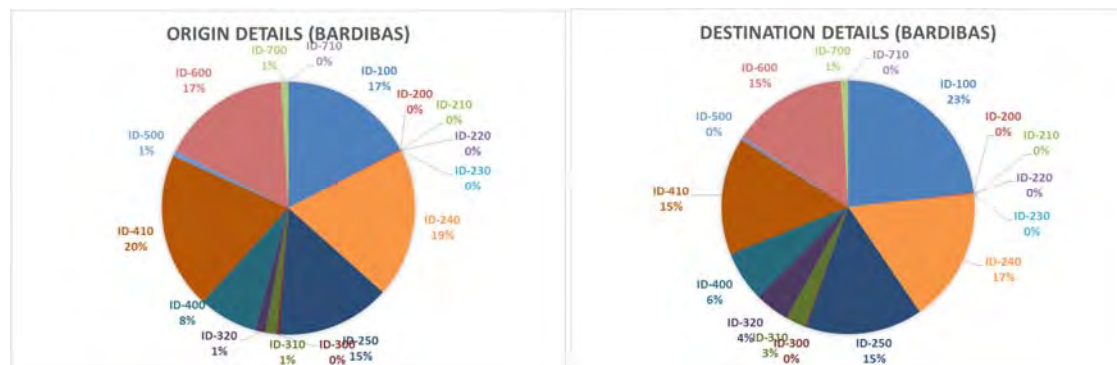


Fig 4.7: Origin-Destination details for Bardibas Site
(Total No of Samples – 544)

4.5 TYPES OF GOODS/FREIGHT CONTENT FOR TRUCKS

The percentage for each type of goods/freight is listed below. From *Table 4.4*, it is seen that about 18% in Dhulikhel, 51% in Khurkot and 40% in Bardibas carry fruits/vegetables. It is also seen that 18% in Dhulikhel, 5% in Khurkot and 12% in Baidibas carry groceries.

Table 4.5: Types of freight content in Trucks

Dhulikhel		Khurkot Near Old Bus Park		Bardibas	
Content of Freight (Trucks)	%	Content of Freight (Trucks)	%	Content of Freight (Trucks)	%
Aggregate	13%	Aggregate	5%	Aggregate	6%
Sand	17%	Fruits/Vegetables	51%	Animals	3%
Brick	8%	Groceries	5%	Sand	3%
Fruits/Vegetables	18%	Cement	9%	Brick	8%
Groceries	18%	Gas/Diesel	2%	Fruits/Vegetables	40%
Soft Drinks	1%	Water	2%	Groceries	12%
Cement	5%	Electrical items	5%	Cement	15%
Gas/Diesel	2%	Others	21%	Gas/Diesel	4%
Water	1%			GI wire	1%
Milk	2%			Rebars	1%
Garbage	3%			Others	8%
Others	13%				

**CHAPTER 5
TRAVEL SPEED SURVEY**

5. TRAVEL SPEED SURVEY

5.1 ROUTE 1

The travel speed survey for Route 1 was undertaken on 18th June 2019 and on 19th June 2019. The directions for Route 1 are defined as following:

- Route 1 (Direction 1)
Maitighar -> Dhulikhel -> Nepalthok -> Khurkot -> Sindhuli -> Bardibas
- Route 1 (Direction 2)
Bardibas -> Sindhuli -> Khurkot -> Nepalthok -> Dhulikhel -> Maitighar

5.1.1 Route 1 - Direction 1

The average speed for the direction 1 was 36 km/hr. The total time taken was 5 hours 24 minutes (324 min)

The speed and travel time between each check point are given in the diagrammatic representation in Fig 5.1 below:

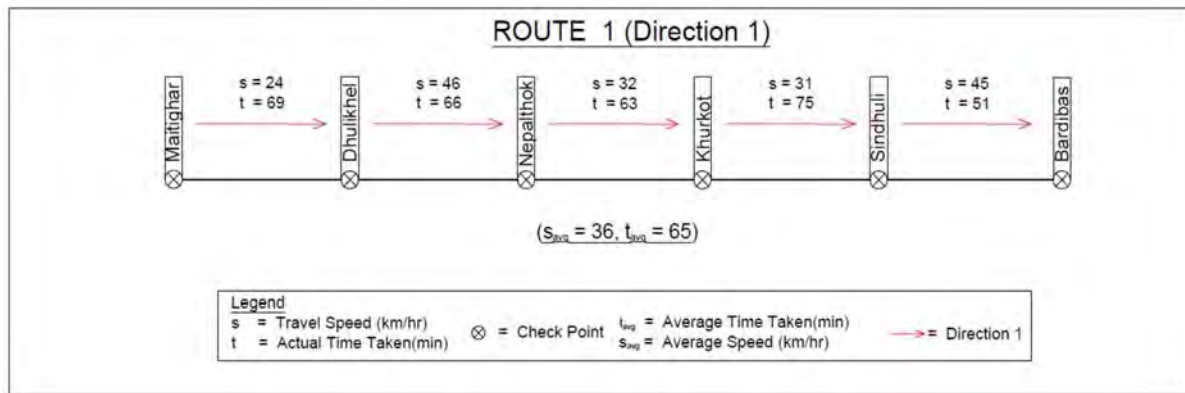


Fig 5.1: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 1)

The average speed and total time taken for the direction 1 of route 1 is presented in the table 5.1 below:

Table 5.1: Summary of Travel Speed Survey for Route 1 (Direction 1) at each Check Point

Route	Direction	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Actual Time Taken (min)	Cumulative Time Taken (min)	Distance Travelled (km)	Cumulative Distance Travelled (km)	Travel Speed (km/hr)
1	1	Maitighar-Dhulikhel	8:21	9:30	69	69	28	28	24
1	1	Dhulikhel-Nepalthok	10:37	11:43	66	135	51	79	46
1	1	Nepalthok- Khurkot	12:37	13:40	63	198	34	113	32
1	1	Khurkot-Sindhuli	14:36	15:51	75	273	39	152	31
1	1	Sindhuli-Bardibas	16:33	17:24	51	324	39	191	45
		Total			324		191		
		Average Speed							36

5.1.2 Route 1 – Direction 2

The average speed for the direction 2 was 33 km/hr. The total time taken was 5 hours 54 minutes (354 min).

The speed and travel time between each check points are given in the diagrammatic representation in Fig 5.2 below:

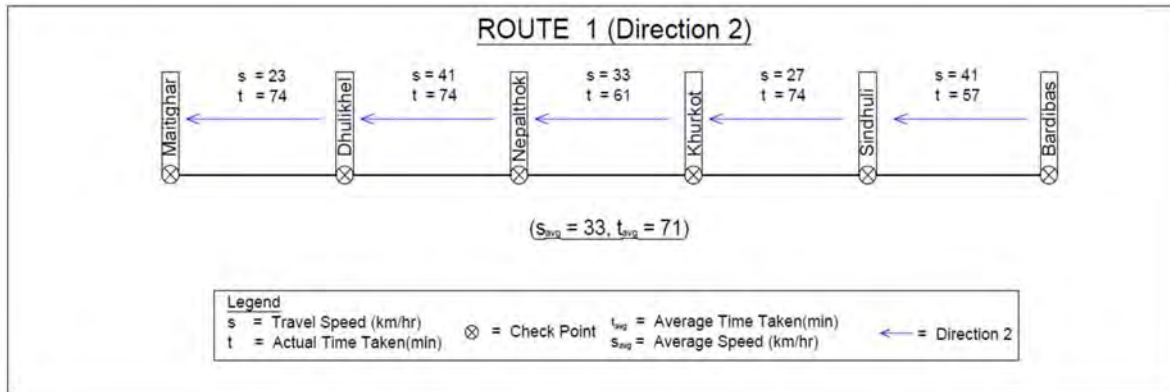


Fig 5.2: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 2)

The average speed and total time taken for the direction 2 of route 1 is presented in the table 5.2 below:

Table 5.2: Summary of Travel Speed Survey for Route 1 (Direction 2) at different Check Points

Route	Direction	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Actual Time Taken (min)	Cumulative Time Taken (min)	Distance Travelled (km)	Cumulative Distance Travelled (km)	Travel Speed (km/hr)
1	2	Bardibas-Sindhuli	7:23	8:20	57	57	39	39	41
1	2	Sindhuli-Khurkot	8:23	9:37	74	131	34	73	28
1	2	Khurkot-Nepalthok	10:42	11:43	61	192	34	106	33
1	2	Nepalthok-Dhulikhel	11:53	13:07	74	266	51	157	41
1	2	Dhulikhel-Maitighar	14:38	15:52	74	340	28	185	23
		Total			340		185		
		Average Speed							33

5.1.3 Summary of Route 1 – Direction 1 & Direction 2

The average speed for both the directions is tabulated as 35 km/hr with average travel time of 5 hour and 39 minutes.

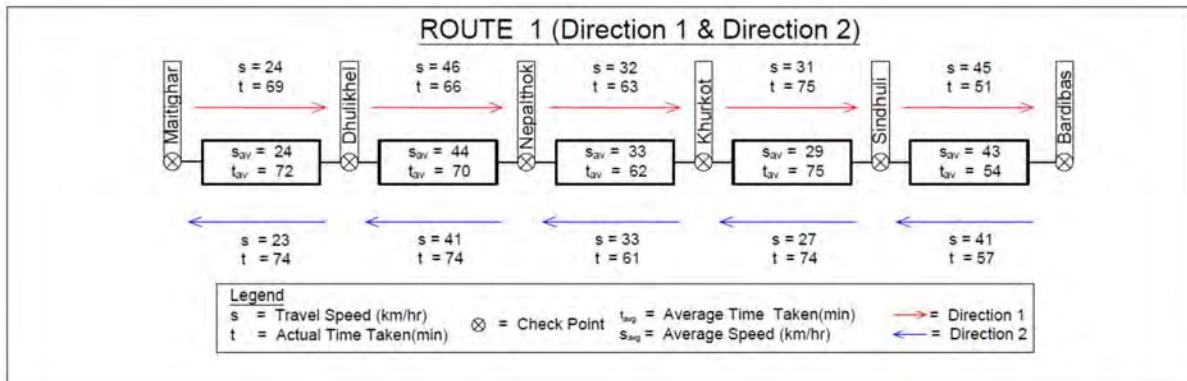


Fig 5.3: Diagrammatic Representation of Travel Speed Survey for Route 1 (Direction 1 & Direction 2)

Table 5.3: Summary of Travel Speed Survey for Route 1 (In both Direction 1 and 2)

Directions	Check Points	Distance (km)	Travel Speed (km/hr)	Average Speed (km/hr)	Travel Time (hr:min)	Average Travel Time (hr:min)
1	Maitighar-Bardibas	190	36	35	5:24	5:39
2	Bardibas-Maitighar	190	33		5:54	

Table 5.4: Breakdown of Travel Speed Survey for Route 1 in both the direction at each check Points

Directions	Check Points	Distance (km)	Travel Speed (km/hr)	Average Speed (km/hr)	Travel Time (hr:min)	Average Travel Time (hr:min)
1	Maitighar-Dhulikhel	28	24	24	1:09	1:12
2	Dhulikhel-Maitighar	28	23		1:14	
1	Dhulikhel-Nepalthok	51	46	41	1:06	1:17
2	Nepalthok-Dhulikhel	51	35		1:28	
1	Nepalthok-Khurkot	34	32	33	1:03	1:02
2	Khurkot-Nepalthok	34	33		1:01	
1	Khurkot-Sindhuli	39	31	31	1:15	1:15
2	Sindhuli-Khurkot	39	32		1:14	
1	Sindhuli-Bardibas	39	45	43	0:51	0:54
2	Bardibas-Sindhuli	39	41		0:57	

5.2 ROUTE 2

The travel speed survey for Route 2 was undertaken on 22nd June 2019 and on 23rd June 2019. The directions for Route 2 are defined as following:

- Route 2 (Direction 1)
Maitighar -> Naubise -> Mugling -> Narayangadh -> Hetauda -> Pathlaiya -> Bardibas
- Route 2 (Direction 2)
Bardibas -> Pathlaiya -> Hetauda -> Narayangadh -> Mugling -> Naubise -> Maitighar

5.2.1 Route 2 - Direction 1

The average speed for the direction 1 was 38 km/hr. The total time taken was 9 hours 21 minutes (561 min)

The speed and travel time between each check points are given in the diagrammatic representation in Fig 5.4 below:

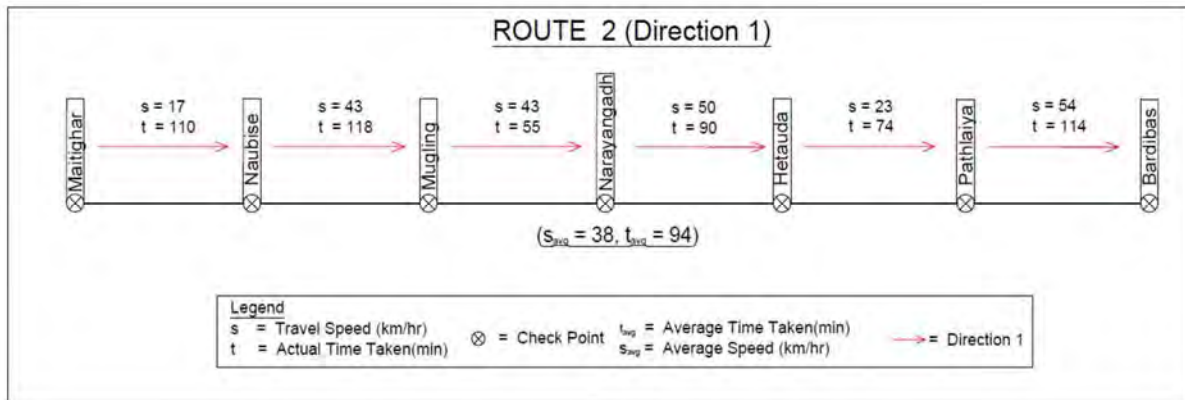


Fig 5.4: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 1)

The average speed and total time taken for the direction 1 of route 2 is presented in the table 5.4 below:

Table 5.5: Summary of Travel Speed Survey for Route 2 (Direction 1) at different Check Points

Route	Direction	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Actual Time Taken (min)	Cumulative Time Taken (min)	Distance Travelled (km)	Cumulative Distance Travelled (km)	Travel Speed (km/hr)
2	1	Maitighar-Naubise	7:17	8:27	110	110	32	32	17
2	1	Naubise-Mugling	9:02	11:00	118	228	84	116	43
2	1	Mugling-Narayangadh	11:50	12:45	55	283	39	155	43
2	1	Narayangadh-Hetauda	12:46	14:16	90	373	75	230	50
2	1	Hetauda-Pathlaiya	14:19	15:33	74	447	29	259	23
2	1	Pathlaiya-Bardibas	16:05	17:59	114	561	102	361	54
		Total			561		361		
		Average Speed							38

5.2.2 Route 2 - Direction 2

The average speed for the direction 2 was 35 km/hr. The total time taken was 11 hours 5 minutes (665 min)

The speed and travel time between each check points are given in the diagrammatic representation in Fig 5.4 below:

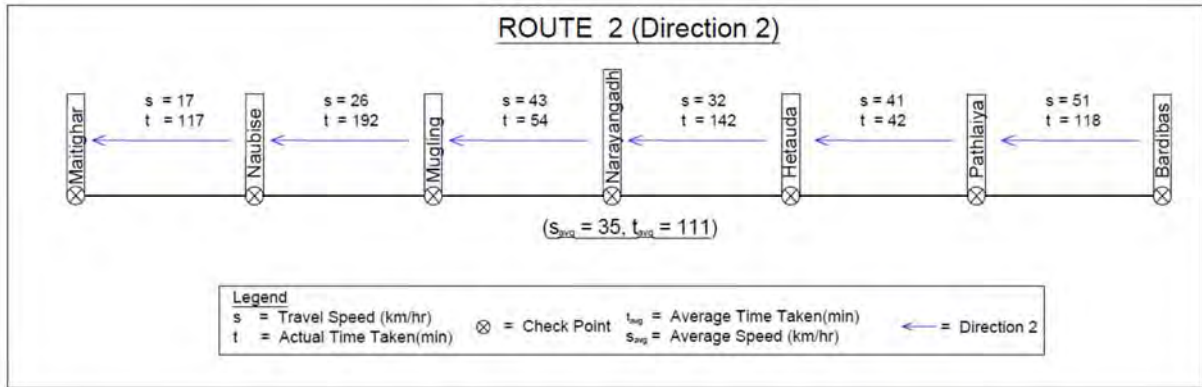


Fig 5.5: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 2)

The average speed and total time taken for the direction 2 of route 2 is presented in the table 5.5 below:

Table 5.6: Summary of Travel Speed Survey for Route 2 (Direction 2) at each check point

Route	Direction	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Actual Time Taken (min)	Cumulative Time Taken (min)	Distance Travelled (km)	Cumulative Distance Travelled (km)	Travel Speed (km/hr)
2	2	Bardibas-Pathlaiya	7:36	9:34	118	118	101	101	51
2	2	Pathlaiya-Hetauda	9:49	10:31	42	160	29	130	41
2	2	Hetauda-Narayangadh	10:32	12:54	142	302	75	205	32
2	2	Narayangadh-Mugling	13:58	14:52	54	356	39	244	43
2	2	Mugling-Naubise	14:53	18:05	192	548	84	328	26
2	2	Naubise-Maitighar	18:30	20:27	117	665	32	360	17
		Total			665		360		
		Average Speed							35

5.2.3 Summary of Route 2 – Direction 1 & Direction 2

The average speed for both the directions is tabulated as 37 km/hr with average travel time of 10 hours and 13 minutes.

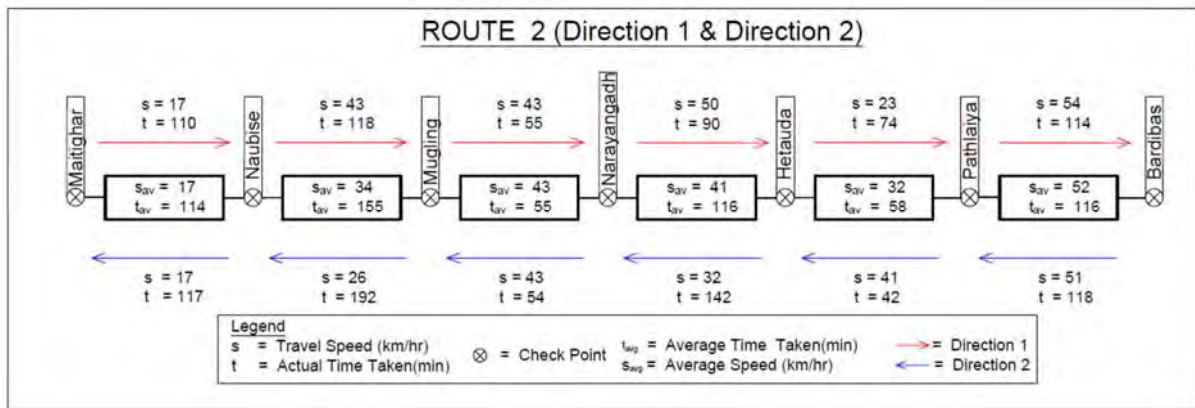


Fig 5.6: Diagrammatic Representation of Travel Speed Survey for Route 2 (Direction 1 & Direction 2)

Table 5.7: Summary of Travel Speed Survey for Route 2 (In both Direction 1 and 2)

Directions	Check Points	Distance (km)	Travel Speed (km/hr)	Average Speed (km/hr)	Travel Time (hr:min)	Average Travel Time (hr:min)
1	Maitighar - Bardibas	361	38	37	9:21	10:13
2	Bardibas- Maitighar	361	35		11:05	

Table 5.8: Breakdown of Travel Speed Survey for Route 2 in both the direction at each check Point

Directions	Check Points	Distance (km)	Travel Speed (km/hr)	Average Speed (km/hr)	Travel Time (hr:min)	Average Travel Time (hr:min)
1	Maitighar-Naubise	32.2	17.45	17.01	1:50	1:54
2	Naubise- Maitighar	32.2	16.56		1:57	
1	Naubise-Mugling	83.7	42.66	34.38	1:58	2:35
2	Mugling-Naubise	83.7	26.09		3:12	
1	Mugling-Narayangadh	39.1	42.87	43.10	0:55	0:55
2	Narayangadh-Mugling	39.1	43.33		0:54	
1	Narayangadh-Hetauda	75.2	50.13	40.95	1:30	1:56
2	Hetauda-Narayangadh	75.2	31.77		2:22	
1	Heteuda-Pathlaiya	28.9	23.43	32.36	1:14	0:58
2	Pathlaiya-Hetauda	28.9	41.29		0:42	
1	Pathlaiya-Bardibas	101.4	53.53	52.44	1:54	1:56
2	Bardibas-Pathlaiya	101.4	51.36		1:58	

6. CONCLUSION

Analysis results for the traffic survey are presented in Chapter 3, 4 and 5 of this report. Let us in brief see how these surveys have responded.

6.1 ROAD SIDE TRAFFIC COUNT SURVEY

The numbers of vehicles in each survey locations are presented separately in the report. All survey locations recorded higher number of motorbikes movement along BP and EW highway. Other higher composition of vehicles at Dhulikhel site was about 51% motorbike, 17% car/jeep/taxi followed by about 12% of heavy truck and about 5% mini bus.

33% of motorbike, 25% of car/jeep/taxi, 14% micro bus, 12% other types (namely utility, motorised three wheeler, rickshaws, bullock cart) and 9% heavy truck at Mangaltar site. About 41% of the vehicles recorded at Khurkot near Old Bus Park are motorbikes, 23% were car/jeep/taxi followed by about 12% micro bus. At Khurkot Causeway, 34% motorbike, about 24% vehicle composition was due to movement of car/jeep/taxi followed by 14% of micro bus and 7% of heavy truck. 56% of the recorded vehicles were motorbikes, only about 12% movement of car/jeep/taxi was observed at Bardibas-along B.P highway followed by 7% of micro bus and 4% of heavy truck. Similarly, at Bardibas-along EW highway, 54% were motorbike, 12% car/jeep/taxi was observed followed by 8% of multi axle truck and 4% of multi axle. Similarly, at Sindhulimadi 47% were motorbike, 14% compose of car/jeep/taxi and 11% of micro bus and 5% of heavy truck was recorded.

The recorded data shows that there was an increase in traffic volume during weekdays than on weekend.

6.2 ROAD SIDE ORIGIN-DESTINATION SURVEY

Out of total 1557 samples collected from all three survey locations (Dhulikhel, Khurkot and Bardibas), it was recorded that the number of passengers in vehicles was recorded highest in Dhulikhel, followed by Khurkot and Bardibas. The major trip purposes for the vehicles travelling at three sites were for carrying "public passenger" purpose followed by "private" and "logistic". Most of the vehicle origin at Dhulikhel site was from Kathmandu including Lalitpur, Bhaktapur and the destination of the vehicles were to Kathmandu including Laitpur, Bhaktapur. Most of the origin of vehicles at Khurkot site was seen from Kathmandu and the destination was recorded to Kathmandu followed by East Part. Similarly for Bardibas site, most of the vehicle origin was recorded from Sindhulimadi and Birgunj (including Hetauda, Malanggawa, Gaur, Kalaiya, Indian border area) followed by East Part and the destination was to Sindhulimadi and Kathmandu followed by Bardibas and East Part

6.3 TRAVEL SPEED SURVEY

The vehicle used for travel speed survey was equipped with GoPro Camera to track the path along the route. The video was recorded the entire travel route with the camera and later the video was processed to obtain the tracked path and speed of the vehicle along the entire route. The distance travelled for route 1 was 190.4kms. The average time required to travel was calculated to be about 5 hours 39 minutes. Route 2 was 360.5km travelled in 10hours and 13 minutes.

ANNEX-1: Letters from DOR to Stakeholders



भौतिक पूर्वाधार तथा यातायात मन्त्रालय
सडक विभाग

सूर्यविनायक-धुलिखेल, धुलिखेल-सिन्धुली-वर्दिवास सडक आयोजना

फोन नं. : ९७७-०१४४८९६०४
फ्याक्स/ फोन नं. : ९७७-०१४४८०४९६
सिन्धुली
काठमाण्डौ, नेपाल

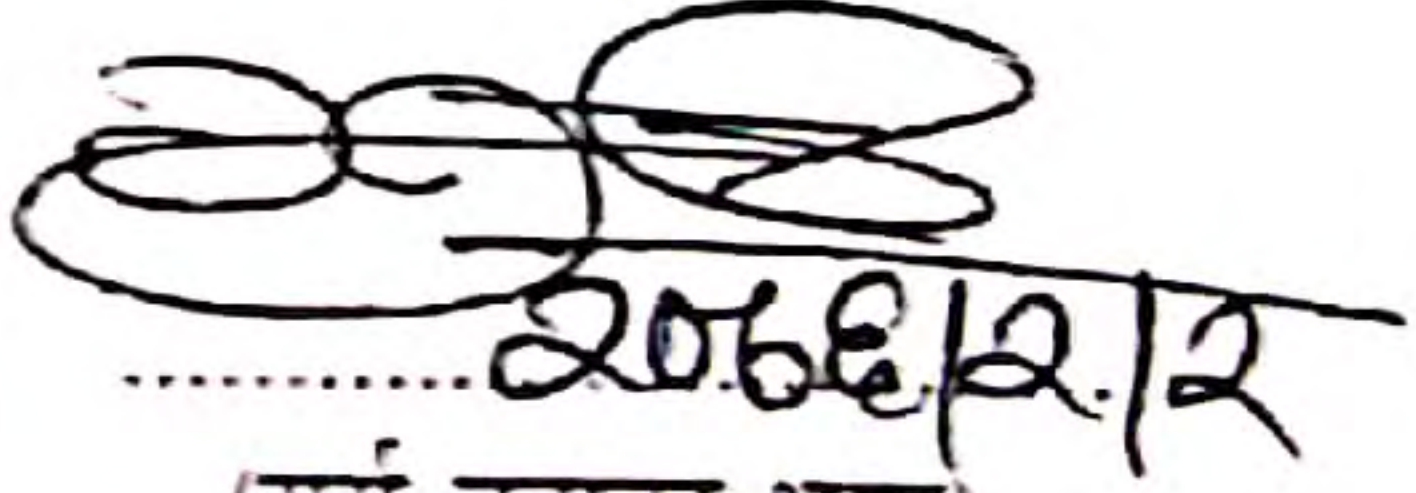
मिति :- २०७६/०२/०२

पत्र संख्या :- ०७५/७६
च.नं. :- ७२६

श्री जिल्ला प्रहरी कार्यालय, धुलिखेल, काभ्रेपलाञ्चोक ।
श्री जिल्ला प्रहरी कार्यालय, सिन्धुली ।
श्री इलाका प्रहरी कार्यालय, मंगलटार ।
श्री जिल्ला ट्राफिक प्रहरी कार्यालय, वर्दिवास ।

विषय : Traffic Count O,D Survey सम्बन्धमा ।

प्रस्तुत विषयमा यस सूर्यविनायक-धुलिखेल, धुलिखेल-सिन्धुली-वर्दिवास सडक आयोजना अन्तर्गत SROM- II को लागि वि.पी राजमार्गमा Traffic Count O,D Survey गर्नु पर्ने व्यहोरा जानकारीको लागि अनुरोध गर्दछु । उक्त कार्य गर्न Consultant श्री 'Nippon Koei' लाई जेठ महिनाको ३०, ३१ र आषाढ महिनाको १, २ गते जम्मा ४ दिनको लागि Traffic Count O,D Survey गर्न आवश्यक सहयोग गरिदिने व्यवस्थाका लागि अनुरोध छ ।


..... २०७६/०२/०२
(सूर्य बहादुर भाट)
आयोजना प्रमुख

बोधार्थ :

१. श्री Sindhuli Road Operation & Maintenance - Phase-II (SROM) थापायली, काठमाण्डौ ।
२. श्री Soil Test (P) Ltd.
CONSULTING ENGINEERS. Sanepa, Lalitpur.

ANNEX-2.1: Sample of Road side Traffic Count

ANNEX 2.1

Sample of Roadside Traffic Count Survey



ANNEX-2.2: Sample of Road side Origin Destination Survey



Project Name : The Project for the Operation & Maintenance of Sindhuli Road Phase 2 (SRM2)
 Work Type : Roadside OD Survey
 Location :
 Station No. :

Day _____ Time _____ Date _____
 Province No. _____ District Name _____ Municipality _____

A. VEHICLE TYPE & info	VEHICLE REGISTRATION	VEHICLE MAKE /MODEL
<input type="checkbox"/> 1. MOTORCYCLE <input type="checkbox"/> 2. CAR AND TAXI <input type="checkbox"/> 3. UTILITY <input type="checkbox"/> 4. MICRO BUS <input type="checkbox"/> 5. MINIBUS <input type="checkbox"/> 6. LARGE BUS <input type="checkbox"/> 7. LIGHT TRUCK <input type="checkbox"/> 8. HEAVY TRUCK <input type="checkbox"/> 9. MULTI AXLE TRUCK		
	NET LOAD CAPACITY	

Please fill Section B only if you have ticked 7, 8 & 9 in the section A above

B. GOODS CARRIED BY VEHICLES		
GOODS BEING CARRIED	GOODS OFTEN CARRIED	COMMODITY WEIGHT
Type 1 _____	Type 1 _____	Type 1 _____
Type 2 _____	Type 2 _____	Type 2 _____
Type 3 _____	Type 3 _____	Type 3 _____

C. PURPOSE OF TRIP		
<input type="checkbox"/> 1. TO/FROM WORK	<input type="checkbox"/> 3. PUBLIC PASSENGER	<input type="checkbox"/> 5. LEISURE/TOURISM
<input type="checkbox"/> 2. TO/ FROM SCHOOL/COLLEGE	<input type="checkbox"/> 4. PRIVATE	<input type="checkbox"/> 6. LOGISTICS
		<input type="checkbox"/> 7. OTHERS

D. NUMBER OF PASSENGERS	NUMBER OF SEATS IN VEHICLE
_____	_____
<i>(Including driver and conductor)</i>	

E. ORIGIN	Province No.	District	VDC/Municipality	ZONE ID
	_____	_____	_____	<input type="text"/>

F. DESTINATION	Province No.	District	VDC/Municipality	ZONE ID
	_____	_____	_____	<input type="text"/>

G. NAME OF PLACE FOR BREAK DURING THIS JOURNEY

H. SATISFACTION RATING OF THE DRIVERS OF THE VEHICLES FOR THE MAINTENANCE PERFORMANCE OF SINDHULI ROAD (1 -5)
<input type="checkbox"/> 1. EXCELLENT <input type="checkbox"/> 2. GOOD <input type="checkbox"/> 3. SATISFACTORY <input type="checkbox"/> 4. POOR <input type="checkbox"/> 5. VERY POOR

I. COMMENTS MADE BY DRIVERS/PASSENGERS

Summary of each O-D Survey at Bardibas Station

Station		BARDIBAS							
Task		O-D Survey							
Total Number of Survey Forms :		546							
Details from the Survey Form									
No.	Time	Origin	Destination	Vehicle Type	Purpose of Trip	No. of Passenger	Goods Carried	ORIGIN CODE	DESTINATION CODE
1	10:34	Dhanusha, Janakpur	Kathmandu	Motorcycle	To/From Work	2		400	100
2	9:36	Morang, Biratnagar	Kathmandu	Motorcycle	Leisure/ Tourism	2		600	100
3	8:35	Bardibas	Sindhuli	Motorcycle	To/From Work	1		250	240
4	8:32	Hetauda	Mahottari, Bardibas	Motorcycle	To/From Work	2		410	250
5	8:28	Kathmandu	Bardibas	Motorcycle	To/From Work	3		100	250
6	8:27	Mahottari, Bardibas	Mahottari, Bardibas	Motorcycle	To/From Work	2		250	250
7	8:21	Bardibas	Mahottari	Motorcycle	To/From Work	2		250	250
8	7:12	Dhanusha	Sindhuli	Motorcycle	To/From Work	3		400	240
9	4:41	Bardibas	Bardibas	Motorcycle	To/From Work	2		250	250
10	2:23	Kathmandu	Jhapa	Motorcycle	Private	1		100	600
11	1:22	Mahottari, Bardibas	Mahottari, Bardibas	Motorcycle	To/From Work	2		250	250
12	9:54	Morang, Biratnagar	Kathmandu	Car/Taxi	To/From Work	4		600	100
13	8:58	Bardibas	Bardibas	Car/Taxi	Leisure/ Tourism	5		250	250
14	8:35	Morang, Biratnagar	Kathmandu	Car/Taxi	To/From Work	2		600	100
15	8:10	Sindhuli	Mahottari, Bardibas	Car/Taxi	Private	3		240	250
16	8:03	Kathmandu	Mahottari	Micro Bus	Public Passenger	9		100	250
17	8:00	Kathmandu	Lalgad	Car/Taxi	Private	4		100	400
18	8:00	Sindhuli	Dhanusha, Janakpur	Car/Taxi	Private	4		240	400
19	6:10	Mahottari, Bardibas	Sindhuli	Car/Taxi	To/From Work	2		250	240
20	6:08	Kathmandu, Maharajjung	Rajbiraj	Car/Taxi	Private	2		100	600
21	5:58	Sindhuli	Mahottari, Bardibas	Car/Taxi	Private	1		240	250
22	5:41	Kathmandu	Sarlahi, Biratnagar	Car/Taxi	To/From Work	4		100	410
23	5:06	Makawanpur, Hetuda	Kavre, Dhulikhel	Car/Taxi	To/From Work	3		410	200
24	5:05	Kathmandu	Bardibas, Mahottari	Car/Taxi	To/From Work	3		100	250
25	4:45	Mahottari	Sindhuli	Car/Taxi	To/From Work	8		250	240
26	4:41	Sindhuli, Bardibas	Kathmandu	Car/Taxi	To/From Work	5		240	100
27	3:59	Mahottari, Bardibas	Kathmandu	Car/Taxi	To/From Work	1		250	100
28	3:18	Kathmandu	Bardibas	Car/Taxi	Private	2		100	250
29	2:55	Mahottari	Bardibas	Car/Taxi	To/From Work	4		250	250
30	4:54	Kathmandu	Itahari	Car/Taxi	Leisure/ Tourism	2		100	600
31	1:47	Siraha, Mirchaya	Bardibas, Mahottari	Car/Taxi	Leisure/ Tourism	3		400	250
32	1:25	Kathmandu	Birtamod	Car/Taxi	To/From Work	5		100	600
33	12:40	India, Madhubari	Kathmandu	Car/Taxi	Leisure/ Tourism	4		700	100
34	12:27	Kathmandu	Bardibas	Car/Taxi	To/From Work	3		100	250
35	12:15	Dhanusha, Mahendranagar	Sindhuli	Car/Taxi	To/From Work	3		400	240
36	9:55	Siraha	Kathmandu	Utility	Logistics	2	Mangoes	400	100
37	9:33	Dhanusha, Dharapani	Kathmandu	Utility	Logistics	2	Broiler	400	100
38	9:26	Sarlahi	Kathmandu	Utility	Logistics	2	Lichi	410	100
39	8:53	Lahan	Kathmandu	Utility	Logistics	3	Mangoes	600	100
40	8:42	Sarlahi, Nawalpur	Kathmandu	Utility	Logistics	2	Lichi	410	100
41	8:31	Dhanusha, Janakpur	Okahldhunga	Utility	Logistics	2	Electrical	400	600
42	8:17	Lahan	Kathmandu	Utility	Logistics	2	Mangoes	600	100
43	8:16	Bardibas	Bardibas	Utility	Others	2	Gass Cylen	250	250
44	7:15	Dhanusha	Kathmandu	Utility	Logistics	3	Mangoes	400	100
45	7:10	Panchthar, Phidim	Kathmandu	Utility	Logistics	3		600	100
46	6:00	Kathmandu	Mahottari, Bardibas	Micro Bus	Public Passenger	7		100	250
47	5:31	Dhanusha, Janakpur	Sindhuli, Bhiman	Utility	Logistics	2	Vegetables	400	240
48	4:28	Kathmandu	Itahari	Utility	Logistics	2	Vegetables	100	600
49	4:15	Kathmandu	Hariban	Utility	Logistics	3	Fish	100	410
50	4:05	Kathmandu	Hariban	Utility	Others	2	Fish	100	410
51	3:31	Sarlahi, Janakpur	Sindhuli	Utility	Logistics	3	Wires	410	240
52	3:19	Mahottari, Bardibas	Mahottari, Bardibas	Utility	Logistics	1	Cold Drink	250	250
53	2:50	Sarlahi, Lalbandi	Sindhuli	Utility	Logistics	2	Vegetables	410	240
54	2:06	Mahottari, Bardibas	Sindhuli	Utility	Others	1	Sands	250	240
55	12:58	Kathmandu	Morang	Utility	Business	2	Vegetables	100	600
56	12:44	Mahottari, Gausala	Sindhuli	Utility	Business	1	Groceries	250	240
57	10:31	Mahottari, Lalbandi	Sindhuli	Micro Bus	Business	7		250	240
58	10:06	Siraha	Kathmandu	Micro Bus	Business	18		400	100
59	9:48	Sarlahi, Lalbandi	Kathmandu	Micro Bus	Business	11		410	100
60	9:45	Sarlahi	Kathmandu	Micro Bus	Business	14		410	100
61	9:38	Sunsari, Dharan	Kathmandu	Micro Bus	Business	12		600	100
62	9:30	Janakpur, Dharan	Kathmandu	Micro Bus	Business	9		600	100
63	9:29	Sarlahi, Itahari	Kathmandu	Micro Bus	Business	11		410	100
64	9:25	Marong, Ulabari	Kathmandu	Micro Bus	Business	14		600	100
65	9:22	Udayapur, Gaighat	Kathmandu	Micro Bus	Business	11		600	100
66	9:20	Sunsari, Itahari	Kathmandu	Micro Bus	Business	14		600	100
67	9:16	Sunsari Tarahari	Kathmandu	Micro Bus	Business	12		600	100

Summary of each O-D Survey at Bardibas Station

Station		BARDIBAS							
Task		O-D Survey							
Total Number of Survey Forms :		546							
Details from the Survey Form									
No.	Time	Origin	Destination	Vehicle Type	Purpose of Trip	No. of Passenger	Goods Carried	ORIGIN CODE	DESTINATION CODE
68	9:05	Sunsari, Dharan	Kathmandu	Micro Bus	Business	11		600	100
69	9:00	Sunsari, Dharan	Kathmandu	Micro Bus	Business	14		600	100
70	8:46	Sarlahi, Mangaltar	Kathmandu	Micro Bus	Business	15		410	100
71	8:43	Dhanusha, Janakpur	Kathmandu	Micro Bus	Public Passenger	14		400	100
72	8:40	Udayapur, Gaighat	Kathmandu	Micro Bus	Business	14		600	100
73	8:37	Sunsari, Dharan	Kathmandu	Micro Bus	Business	9		600	100
74	8:30	Dhanusha, Janakpur	Kathmandu	Micro Bus	Business	12		400	100
75	8:29	Sunsari, Itahari	Kathmandu	Micro Bus	Business	8		600	100
76	8:20	Kathmandu	Mahottari, Bardibas	Micro Bus	Logistics	17		100	250
77	8:14	Morang, Biratnagar	Kathmandu	Micro Bus	Business	10		600	100
78	8:10	Janakpur, Dhanusha	Kathmandu	Micro Bus	Business	16		400	100
79	8:00	Sindhuli, Dudhari	Bardibas	Micro Bus	Business	8		240	250
80	7:48	Vimar, Sindhuli	Bardibas, Mahottari	Micro Bus	Business	4		240	250
81	7:46	Kathmandu	Janakpur	Micro Bus	Public Passenger	8		100	400
82	9:39	Kathmandu	Dhanusha, Janakpur	Micro Bus	Public Passenger	13		100	400
83	9:07	Kathmandu	Jhapa	Micro Bus	Public Passenger	11		100	600
84	7:24	mahottari	Bardibas	Micro Bus	Public Passenger	15		250	250
85	6:29	Jhapa, Ilam	Kathmandu	Micro Bus	Business	8		600	100
86	6:27	Kathmandu	lalbandi	Micro Bus	Public Passenger	17		100	410
87	6:17	Kathmandu	Dhanusha	Micro Bus	Public Passenger	15		100	400
88	6:15	Kathmandu	Dhanusha	Micro Bus	Public Passenger	8		100	400
89	5:35	Kathmandu	Dhanusha	Micro Bus	Public Passenger	15		100	400
90	5:12	Ilam, Pasupatinagar	Kathmandu	Micro Bus	Public Passenger	16		600	100
91	4:48	Mahottari, Bardibas	Kathmandu	Micro Bus	Public Passenger	7		250	100
92	4:18	Bardibas	Sindhuli	Micro Bus	Public Passenger	5		250	240
93	3:08	Kathmandu	Siraha, Nawalpur	Micro Bus	Public Passenger	14		100	400
94	1:31	Ilam	Kathmandu	Micro Bus	Business	16		600	100
95	1:13	Jhapa, Kakanbhitta	Kathmandu	Micro Bus	Business	17		600	100
96	1:07	Jhapa, Bhadrapur	Kathmandu	Micro Bus	Business	13		600	100
97	1:02	Kathmandu	Jhapa	Micro Bus	Business	16		100	600
98	12:50	Dhanusha, Janakpur	Kathmandu	Micro Bus	Business	14		400	100
99	12:32	Makalu	Bardibas	Micro Bus	Public Passenger	13		600	250
100	12:23	Kathmandu	Jhapa	Micro Bus	Business	15		100	600
101	12:22	Jhapa, Prithibinagar	Kathmandu	Micro Bus	Business	8		600	100
102	10:25	Morang, Biratnagar	Kathmandu	Micro Bus	Public Passenger	11		600	100
103	9:08	Mahottari, Bardibas	Sindhuli	Mini Bus	Public Passenger	35		250	240
104	9:00	Sunsari, Daharan	Kathmandu	Mini Bus	Public Passenger	15		600	100
105	6:20	Bardibas	Sindhuli	Mini Bus	Public Passenger	40		250	240
106	6:07	Kathmandu	Mahottari, Bardibas	Mini Bus	Public Passenger	8		100	250
107	6:02	Kathmandu	Sarlahi, Lalbandi	Mini Bus	Public Passenger	14		100	410
108	2:31	Dhanusha, Janakpur	Sindhuli	Mini Bus	Public Passenger	35		400	240
109	2:04	Mahottari, Bardibas	Sindhuli	Mini Bus	Public Passenger	34		250	240
110	1:40	Kathmandu	Udayapur	Mini Bus	Public Passenger	16		100	600
111	1:38	Kathmandu	Biratnagar	Mini Bus	Public Passenger	16		100	600
112	1:33	Bardibas	Sindhuli	Mini Bus	Public Passenger	60		250	240
113	12:52	Kathmandu	Dharan	Mini Bus	Public Passenger	16		100	600
114	12:47	Kathmandu	Biratnagar	Mini Bus	Public Passenger	16		100	600
115	12:49	Kathmandu	Kakabhitta	Mini Bus	Public Passenger	15		100	700
116	10:20	Sindhuli	Bardibas	Large Bus	Public Passenger	34		240	250
117	10:02	Dudhauri	Nijghad	Large Bus	Public Passenger	35		600	410
118	8:12	Gangapur	Bardibas	Large Bus	Public Passenger	34		500	250
119	7:45	Bardibas, Mahottari	Lalbandi	Large Bus	Public Passenger	2		250	410
120	5:11	Kathmandu	Chautara	Large Bus	Public Passenger	35		100	300
121	5:08	Chattara	Mahottari, Bardibas	Large Bus	Public Passenger	40		300	250
122	4:47	Kamalimai	Mahottari	Large Bus	Public Passenger	25		240	250
123	4:22	Kathmandu	Bardibas	Large Bus	Public Passenger	35		100	250
124	3:38	Sindhuli	Pokhara	Large Bus	Public Passenger	30		240	500
125	3:43	Kathmandu	Mahottari	Large Bus	Public Passenger	32		100	250
126	2:49	Sindhuli	Bardibas	Large Bus	Public Passenger	10		240	250
127	2:41	Sindhuli	Janakpur	Large Bus	Public Passenger	27		240	400
128	1:44	Kathmandu	Udayapur, Trijuga	Large Bus	Public Passenger	32		100	600
129	12:58	Darjelling, India	Kathmandu	Large Bus	Public Passenger	20		700	100
130	10:37	Sindhuli	Mahottari	Light truck	Business	3	Rice	240	250
131	10:37	Mahottari	Sindhuli	Light truck	Business	1	Bircks	250	240
132	10:20	Mahottari, Sittapur	Sindhuli	Light truck	Business	2	Bircks	250	240
133	10:10	Sindhuli	Bardibas	Light truck	Logistics	3	Chundhun	240	250
134	9:47	Biratnagar	Kathmandu	Light truck	Logistics	2	Vegetables	600	100

Summary of each O-D Survey at Bardibas Station

Station		BARDIBAS							
Task		O-D Survey							
Total Number of Survey Forms :		546							
Details from the Survey Form									
No.	Time	Origin	Destination	Vehicle Type	Puropose of Trip	No. of Passenger	Goods Carried	ORIGIN CODE	DESTINATION CODE
135	9:34	Mahendranagar	Kathmandu	Light truck	Logastics	3	Buffalos	500	100
136	9:10	Sarlahi	Kathmandu	Light truck	Logastics	2	Mangoes	410	100
137	9:10	Sarlahi	Ramchhapur	Light truck	Logastics	3	Buffalos	410	320
138	8:18	Gaidakot	Bargachi	Light truck	Business	4	Pillar box	410	600
139	8:17	Bardibas	Sindhuli	Light truck	Business	2	Rice	250	240
140	7:59	Ramechhap	Rautahat	Light truck	Logastics	3	Rice	320	410
141	7:50	Buipa	Chapur	Light truck	Business	3	Buffalos	600	410
142	6:23	Kathmandu	Mahottari	Light truck	Logastics	2	Vegetables	100	250
143	6:05	Bardibas, Mahottari	Bardibas, Mahottari	Light truck	Logastics	4	gas cilinde	250	250
144	17:32	Bardibas, Mahottari	Mahottari, Rauta Khola	Light truck	Logastics	3	send aggre	250	250
145	17:04	Mahottari, Bardibas	Dhanusha	Light truck	Logastics	2	Fruits	250	400
146	17:18	Mahottari, Bardibas	Kamalamai	Light truck	Logastics	3	sugar	250	240
147	16:30	Kathmandu	Siraha	Light truck	Logastics	8	Vegetables	100	400
148	16:20	Kathmandu	Jhapa	Light truck	Logastics	1	Stationery	100	600
149	16:10	Pato	Bardibas	Light truck	Logastics	2	Hen	600	250
150	16:00	Bardibas	Sindhuli	Light truck	Logastics	3	Animals	250	240
151	15:34	Gaidada	Multar	Light truck	Business	2		300	
152	15:29	Sindhuli	Bardibas	Light truck	Business	3	Rice	240	250
153	15:10	Kathmandu	Sarlahi	Light truck	Logastics	3	Fruits and	100	410
154	15:00	Sindhuli	Bardibas	Light truck	Logastics	4	Bircks	240	250
155	14:52	Kathmandu	Siraha, Golbazzar	Light truck	Business	1	Vegetables	100	400
156	14:52	Sindhuli	Bardibas	Light truck	Logastics	5	Wires	240	250
157	14:19	Sindhuli	Ghuridada	Light truck	Logastics	1	Fish	240	
158	14:14	Sindhuli	Mahottari	Light truck	Business	2		240	250
159	13:58	Sindhuli	Bardibas	Light truck	Logastics	1		240	250
160	13:44	Kathmandu	Dhanusha	Light truck	Logastics	2	Vegetables	100	400
161	13:13	Bardibas	Dhanusha	Light truck	Logastics	2	wine	250	400
162	13:06	Sindhuli	Mathottari	Light truck	Logastics	4	Bircks	240	250
163	10:23	Sindhuli	Birgunj	Heavy Truck	Business	3	aggregate	240	410
164	10:14	Sindhuli	Merchaya	Heavy Truck	Business	5	Cement	240	600
165	10:11	Sunsari	Bardibas	Heavy Truck	Business	3	Cement	600	250
166	9:56	Sindhuli	Sindhuli	Heavy Truck	Business	4	Bircks	240	240
167	9:43	Sarlahi	Ramechhap, Manthali	Heavy Truck	Business	2	Rice	410	320
168	9:33	Mahottari	Sindhuli	Heavy Truck	Business	2	Sands	250	240
169	9:27	Dhanusha	Kathmandu	Heavy Truck	Logastics	2	Mangoes	400	100
170	9:24	Birgunj	Solukhambu	Heavy Truck	Logastics	3	Cement	410	600
171	9:18	Bardibas	Ramechhap	Heavy Truck	Logastics	3	Bircks	250	320
172	9:17	Mahottari	Dolakha	Heavy Truck	Logastics	2	Cement	250	310
173	9:14	Dhanusha	Kathmandu	Heavy Truck	Logastics	1	Mangoes	400	100
174	9:11	Ilam	Kathmandu	Heavy Truck	Logastics	2	Bamboo	600	100
175	9:05	Bara	Okhaldhunga	Heavy Truck	Logastics	1	Diesel	410	600
176	8:55	Parsa	Mahottari	Heavy Truck	Business	2	Rice	410	250
177	8:51	Dhanusha	Kathmandu	Heavy Truck	Logastics	2	Plywood	400	100
178	8:42	Morang	Sulukhambu	Heavy Truck	Logastics	2	Giwre	600	600
179	8:24	Birgunj	Sindhuli	Heavy Truck	Logastics	3	Cement	410	240
180	8:07	Bardibas	Tamakoshi	Heavy Truck	Logastics	3	cement &	250	310
181	7:52	Siraha	Ramechhap	Heavy Truck	Logastics	4	Cement	400	320
182	7:45	Parsa	Ramechhap	Heavy Truck	Logastics	1	Roda	410	320
183	7:40	Sindhuli	Mahottari	Heavy Truck	Logastics	2	Cement	240	250
184	7:38	Lalbandi	Kathmandu	Heavy Truck	Logastics	2	Vegetables	410	100
185	7:34	Dhanusha	Sindhuli	Heavy Truck	Logastics	2	Bircks	400	240
186	7:27	Mahottari	Dolakha	Heavy Truck	Logastics	2	Bircks	250	310
187	7:20	Sindhuli	Sarlahi	Heavy Truck	Logastics	3	Cement	240	410
188	7:17	Amlejung	Sindhuli	Heavy Truck	Logastics	3	Diesel	410	240
189	7:12	Parsa	Manthali	Heavy Truck	Logastics	3	Cement	410	320
190	7:03	Mahottari	Sindhuli	Heavy Truck	Logastics	1	Bircks	250	240
191	6:55	Parsa	Solukhambu	Heavy Truck	Logastics	2	Cement	410	600
192	6:55	Dhanusha	Ramechhap , Manthali	Heavy Truck	Logastics	2	Soap	400	320
193	6:50	Makawanpur	Okhaldhunga	Heavy Truck	Logastics	1	Pipe and P	410	600
194	6:50	Bardibas	Ramechhap , Manthali	Heavy Truck	Logastics	2	Spics	250	320
195	6:47	Jhapa	Kathmandu	Heavy Truck	Logastics	3	sugar	600	100

ANNEX-2.3: Sample of Travel Speed Survey

Soil Test (P) Ltd.
Sanepa, Lalitpur

THE PROJECT FOR THE OPERATION AND MAINTAINENCE OF SINDHULI ROAD PHASE 2

TRAVEL SPEED SURVEY

ROUTE 1

Summary of Travel Speed Survey for Route 1 (Direction 1 & Direction 2) - At Each Check Points Maitighar -> Dhulikhel -> Nepalthok -> Khurkot -> Sindhuli -> Bardibas									
Route	Direction	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Acutal Time Taken (min)	Distance Travelled (km)	Travel Speed (km/hr)	Average Speed (km/hr)	Average Time Taken (min)
1	1	Maitighar-Dhulikhel	8:21	9:30	69	28	24	24	72
1	2	Dhulikhel-Maitighar	14:38	15:52	74	28	23		
1	1	Dhulikhel-Nepalthok	10:37	11:43	66	51	46	44	70
1	2	Nepalthok-Dhulikhel	11:53	13:07	74	51	41		
1	1	Nepalthok-Khurkot	12:37	13:40	63	34	32	33	62
1	2	Khurkot-Nepalthok	10:42	11:43	61	34	33		
1	1	Khurkot-Sindhuli	14:36	15:51	75	39	31	29	75
1	2	Sindhuli-Khurkot	8:23	9:37	74	34	27		
1	1	Sindhuli-Bardibas	16:33	17:24	51	38	45	43	54
1	2	Bardibas-Sindhuli	7:23	8:20	57	39	41		

Soil Test (P) Ltd.
Sanepa, Lalitpur













THE PROJECT FOR THE OPERATION AND MAINTAINENCE OF SINDHULI ROAD PHASE 2



TRAVEL SPEED SURVEY

ROUTE 2

Summary of Travel Speed Survey for Route 2 (Direction 1 & Direction 2) - At Each Check Points Bardibas -> Pathlaiya -> Hetauda -> Narayangadh -> Mugling -> Naubise -> Maitighar										
Route	Direction	Trip	Check Points	Departure Time (hh:mm)	Arrival Time (hh:mm)	Acutal Time Taken (min)	Distance Travelled (Km)	Travel Speed (km/hr) (v)	Average Speed (km/hr) (v)	Average Time Taken (min)
2	1	1	Maitighar-Naubise	7:17	8:27	110	32	17	17	114
2	1	2	Naubise-Maitighar	18:30	20:27	117	32	17		
2	1	1	Naubise-Mugling	9:02	11:00	118	84	43	34	155
2	1	2	Mugling-Naubise	14:53	18:05	192	84	26		
2	1	1	Mugling-Narayangadh	11:50	12:45	55	39	43	43	55
2	1	2	Narayangadh-Mugling	13:58	14:52	54	39	43		
2	1	1	Narayangadh-Hetauda	12:46	14:16	90	75	50	41	116
2	1	2	Hetauda-Narayangadh	10:32	12:54	142	75	32		
2	1	1	Heteuda-Pathlaiya	14:19	15:33	74	29	23	32	58
2	1	2	Pathlaiya-Hetauda	9:49	10:31	42	29	41		
2	1	1	Pathlaiya-Bardibas	16:05	17:59	114	102	54	52	116
2	1	2	Bardibas-Pathlaiya	7:36	9:34	118	101	51		

ANNEX-3: Vehicle classification for Road side Traffic Count

S.N.	Classification	Type of Vehicle	Description
1	Private Car/Taxi	 	<p>Passenger 4-Wheel Private Cars and Taxis With Seating Capacity 5 or less than 5 seats.</p>
2	Large Private Car/Taxi	 	<p>Passenger 4-Wheel Private Cars and Taxis With Seating Capacity From 6 or more than 6 to 10 seats including 2 or 4-Wheel Drive. (e.g. Jeep, Landcruiser, TATA Sumo and so on)</p>
3	Large Bus	 	<p>Buses Having Seating Capacity more than 35 Seats.</p>
4	Mini Bus	 	<p>Buses Having Seating Capacity Ranging From 20 or more than 20 to 35 Seats.</p>
5	Micro Bus	 	<p>Small Buses or Vans Having Seating Capacity Ranging less than 20 Seats. (e.g. TOYOTA HILUX and so on)</p>
6	Multi-Axle Truck	 	<p>Heavy Trucks, Trailers or Articulated Trucks with more than Two Axles.</p>

7	Heavy Truck			Standard 6-Wheel Trucks With Two (2) Axles.
8	Light Truck			Mid-sized 4-Wheel Trucks With Single Rear-Two (2) Axles or Mid-sized 6-Wheel Trucks with Two (2) Axles (Usually 4-Wheeled, Gross Vehicle Weight<8MT)
9	Motorcycle			Motorised Two Wheel-Vehicle Having Engine Capacities Mainly in the Range of 100cc to 150cc.
10	Tractor			Farm Tractors With or Without the Trailer Unit.
11	Power Tiller			Motorised Light Farm Tractor with Hand Steering Used for Carrying Light Freights along with the Trailer Unit.
12	Three Wheeler			Electric/Gasoline/LPG - Fuelled Tricycles for Carrying Passengers excluding Power Tillers, Farm Tractors. (e.g. Tempo)

13	Bullick/Hand/ Horse Cart			Non-Motorised Vehicle Driven by Bulls, Horses or Human-beings.
14	Rickshaws			Non-motorised tricycles for Carrying Passengers.
15	Utility Vehicle/Pick- Up			4-Wheel Pickups with Single/Twin Cabin and an Integrated Trailer Compartment (Open/Hooded) For Carrying Freights.

ANNEX-4: Detailed Hourly Traffic Data

ANNEX-4.1 : **DHULIKHEL**

Station name: Dhulikhel
 Route: Kathmandu<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	97	1	22	47	1	32	21	157	1	34	410
7:00-8:00	166	3	34	96	1	16	16	204	3	51	589
8:00-9:00	132	7	53	73	0	13	22	258	4	46	606
9:00-10:00	117	0	42	32	1	13	26	303	4	53	589
10:00-11:00	130	1	22	14	2	23	28	343	4	64	628
11:00-12:00	132	0	24	18	0	24	27	396	2	57	678
12:00-13:00	119	0	23	18	0	17	20	324	3	55	578
13:00-14:00	141	0	32	30	0	16	31	340	2	60	650
14:00-15:00	153	0	39	57	0	17	25	319	4	52	665
15:00-16:00	160	1	35	95	0	11	23	333	2	46	703
16:00-17:00	148	1	40	82	1	21	14	323	2	51	682
17:00-18:00	132	1	11	42	0	32	19	355	1	41	632
18:00-19:00	117	1	12	16	1	39	22	293	1	40	541
19:00-20:00	104	0	5	10	1	45	16	212	1	34	425
20:00-21:00	72	1	6	3	2	40	19	137	0	38	315
21:00-22:00	46	2	3	0	0	41	18	67	0	19	194
22:00-23:00	43	0	1	4	0	41	13	50	0	18	168
23:00-00:00	25	0	2	1	0	35	10	31	0	15	117
00:00-01:00	13	0	0	3	0	45	1	16	0	11	88
01:00-02:00	8	0	1	1	0	33	2	6	0	11	60
02:00-03:00	6	0	0	1	1	22	1	4	0	20	53
03:00-04:00	15	0	1	0	1	29	1	8	0	25	79
04:00-05:00	24	0	1	0	1	42	5	33	0	23	128
05:00-06:00	43	0	3	6	1	45	4	77	0	25	202
Total	2135	14	407	643	11	686	380	4586	30	885	9775

Station name: Dhulikhel
Route: Kathmandu<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	79	0	17	35	0	29	5	130	1	23	319
7:00-8:00	98	0	31	95	1	33	8	225	1	46	538
8:00-9:00	129	0	24	55	1	26	11	262	1	38	547
9:00-10:00	103	0	30	38	4	24	5	281	3	51	539
10:00-11:00	114	0	19	14	0	21	13	305	0	51	537
11:00-12:00	135	1	19	12	1	23	9	332	1	48	581
12:00-13:00	129	0	23	22	1	15	16	344	0	44	594
13:00-14:00	146	1	35	22	2	14	12	330	1	35	598
14:00-15:00	137	1	25	45	0	16	6	275	1	50	556
15:00-16:00	139	0	14	67	2	9	7	349	1	32	620
16:00-17:00	154	0	32	73	3	11	13	305	3	36	630
17:00-18:00	121	0	14	40	2	24	11	381	1	30	624
18:00-19:00	125	0	10	13	1	32	7	302	1	33	524
19:00-20:00	117	0	16	4	0	37	7	227	0	29	437
20:00-21:00	85	0	5	4	0	58	4	117	1	19	293
21:00-22:00	51	0	7	3	0	63	3	64	0	18	209
22:00-23:00	35	0	0	3	0	39	2	40	0	20	139
23:00-00:00	17	0	0	1	0	50	0	13	0	9	90
00:00-01:00	16	0	0	0	0	43	0	18	0	12	89
01:00-02:00	7	0	0	0	0	31	0	5	0	9	52
02:00-03:00	8	0	0	1	0	28	0	3	0	10	50
03:00-04:00	8	0	1	1	0	32	1	7	0	27	77
04:00-05:00	27	0	0	1	0	48	2	16	0	21	115
05:00-06:00	17	0	0	2	0	22	6	64	1	33	145
Total	1997	3	322	551	18	728	148	4395	17	724	8903

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Kathmandu to Sindhuli and Sindhuli to Kathmandu

Surveyed and Supervised By: **Soil Test P.Ltd**



DHULIKHEL

Flow of Vehicles

a = Direction of the movement of vehicle from	KTM to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to KTM

Data Source : CCTV Camera
 Data Collection Period :
 From : 6am on 13th June 2019 (Thursday)
 To : 6am on 16th June 2019 (Sunday)

Station Name: Dhulikhel
 Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)
 DOR Seasonal : 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total					
			Multi-axle Truck		Heavy		Light		Big		Mini		Micro		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
13th June 2019	06:00	07:00	1	-	12	12	11	3	1	-	20	2	43	-	35	7	118	30	18	13	-	-	57	4	-	-	-	-	-	-	316	71		
	07:00	08:00	1	-	4	9	12	6	2	-	26	7	106	-	67	24	131	73	38	20	2	1	-	-	69	6	-	-	-	-	458	146		
	08:00	09:00	-	-	9	10	8	8	2	-	38	15	68	6	56	22	151	94	25	22	1	1	1	-	51	8	-	-	-	-	410	186		
	09:00	10:00	-	-	3	10	12	17	-	-	21	25	27	4	43	18	177	118	37	19	3	2	-	-	50	16	-	-	-	-	373	229		
	10:00	11:00	1	-	5	12	14	15	-	-	6	14	8	1	39	36	197	120	29	25	1	2	1	-	24	21	-	-	-	-	325	246		
	11:00	12:00	-	-	9	25	12	15	-	-	8	19	9	6	38	35	196	185	34	19	1	-	-	-	27	33	-	-	-	-	334	337		
	12:00	13:00	-	-	10	7	5	7	-	-	5	19	10	3	34	39	148	135	35	18	2	1	-	-	17	18	-	-	-	-	266	247		
	13:00	14:00	-	-	8	7	12	13	-	-	14	23	6	21	33	34	126	197	28	23	-	-	-	-	16	47	-	-	-	-	245	367		
	14:00	15:00	-	-	11	7	11	8	-	-	8	27	10	39	31	39	142	160	23	23	4	2	-	-	19	55	-	-	-	-	259	360		
	15:00	16:00	-	-	5	3	15	8	-	-	16	13	11	98	30	55	126	171	24	28	-	-	-	-	25	47	-	-	-	-	253	425		
	16:00	17:00	1	-	18	9	2	4	-	-	18	27	10	81	30	55	124	204	19	32	1	-	-	1	13	53	-	-	-	-	236	466		
	17:00	18:00	-	-	17	15	6	6	-	-	4	15	6	26	29	51	173	152	18	26	-	-	-	-	14	27	-	-	-	-	267	321		
	Sub Total			4	-	111	126	120	110	5	-	184	206	314	285	465	415	1,809	1,639	328	268	15	15	5	2	382	335	-	-	-	-	3,742	3,401	
14th June 2019	18:00	19:00	-	-	15	24	6	7	-	-	7	4	-	5	30	51	85	161	14	23	-	-	-	-	3	28	-	-	-	-	160	303		
	19:00	20:00	1	-	14	25	6	6	-	-	6	-	5	30	39	77	95	11	20	-	-	-	-	9	20	-	-	-	-	148	216			
	20:00	21:00	-	-	2	35	14	6	1	-	-	2	1	-	16	28	55	60	13	22	-	-	-	-	6	14	-	-	-	-	132	143		
	21:00	22:00	-	-	2	29	23	-	2	-	-	1	-	-	7	22	10	24	6	7	-	-	-	-	4	4	-	-	-	-	57	82		
	22:00	23:00	-	-	33	19	-	1	-	-	1	-	-	2	9	17	12	21	5	16	-	-	-	-	2	17	-	-	-	-	62	93		
	23:00	00:00	-	-	33	18	1	5	-	-	2	1	-	-	10	9	16	10	10	7	-	-	-	-	2	3	-	-	-	-	74	53		
	00:00	01:00	-	-	14	30	-	1	-	-	-	-	-	-	6	9	3	3	3	6	-	-	-	-	1	1	-	-	-	-	27	50		
	01:00	02:00	-	-	9	19	-	1	-	-	1	1	1	-	2	2	1	1	1	5	-	-	-	-	1	4	-	-	-	-	16	33		
	02:00	03:00	-	-	1	6	18	-	-	-	-	-	-	1	1	-	-	1	2	10	-	-	-	-	2	-	-	-	-	-	9	33		
	03:00	04:00	-	-	9	20	-	-	-	-	2	-	-	-	5	5	8	-	3	22	-	-	-	-	3	3	-	-	-	-	28	52		
	04:00	05:00	-	-	22	29	2	2	-	-	1	-	-	-	6	7	26	8	7	21	-	-	-	-	12	-	-	-	-	-	76	67		
	05:00	06:00	-	-	24	21	-	1	-	-	2	2	5	-	24	8	72	17	10	13	-	-	-	-	17	-	-	-	-	-	154	62		
	Sub Total			1	3	243	260	21	27	-	-	15	18	7	13	146	197	365	401	85	172	-	-	-	-	60	96	-	-	-	-	943	1,187	
Total Day1			5	3	354	386	141	137	5	-	199	224	321	298	611	612	2,174	2,040	413	440	15	15	5	2	442	431	-	-	-	-	4,685	4,588		
14th June 2019	06:00	07:00	-	-	27	12	10	17	-	-	19	3	48	2	27	5	117	49	21	15	1	-	-	-	54	5	-	-	-	-	324	108		
	07:00	08:00	-	-	16	3	5	9	2	1	29	6	86	6	66	9	140	64	26	18	3	-	-	-	83	7	-	-	-	-	456	117		
	08:00	09:00	-	-	5	1	13	15	10	1	39	14	64	8	54	13	159	111	27	17	2	4	-	-	54	5	-	-	-	-	427	189		
	09:00	10:00	2	-	8	4	9	14	-	-	21	17	32	1	42	25	181	129	28	21	1	1	-	-	21	19	-	-	-	-	345	231		
	10:00	11:00	2	-	5	23	8	18	1	-	11	13	15	4	35	34	199	170	42	31	2	2	-	-	48	22	-	-	-	-	368	317		
	11:00	12:00	-	-	7	7	17	10	-	-	7	13	13	8	34	43	203	208	32	27	1	1	1	-	23	30	-	-	-	-	338	347		
	12:00	13:00	-	-	1	16	12	15	-	-	6	16	17	6	43	29	193	171	30	27	1	1	-	-	25	33	-	-	-	-	328	314		
	13:00	14:00	-	-	6	10	27	9	-	-	9	17	8	24	41	41	170	187	32	35	-	-	-	-	23	47	-	-	-	-	316	371		
	14:00	15:00	-	-	13	3	29	2	-	-	15	27	11	53	43	41	156	180	29	29	1	1	-	-	33	44	-	-	-	-	330	380		
	15:00	16:00	-	-	10	3	16	7	-	1	12	28	5	75	25	60	156	213	18	21	-	-	-	-	18	59	-	-	-	-	260	468		
	16:00	17:00	1	-	10	5	11	11	-	1	15	20	7	66	22	39	140	178	30	20	1	1	-	-	16	68	-	-	-	-	253	409		
	17:00	18:00	-	-	16	15	12	14	1	-	1	1	7	44	28	56	180	205	14	23	-	-	-	-	14	44	-	-	-	-	273	402		
	Sub Total			5	-	124	102	169	141	14	4	184	175	313	291	460	395	1,994	1,865	329	284	13	13	1	-	412	383	-	-	-	-	4,018	3,653	
18:00	19:00	1	1	7	32	22	9	1	-	7	6	4	23	18	71	146	193	20	21	1	1	1	-	11	22	-	-	-	-	239	379			
19:00	20:00	-	-	12	38	13	6	-	-	3	1	2	12	18	44	119	132	18	18	1	-	-	-	16	31	1	-	-	-	204	282			
20:00	21:00	1	1	8	22	29	2	1	-	4	5	2	2	15	24	73	85	13	27	-	-	-	-	22	18	-	-	-	-	169	186			
21:00	22:00	-	-	12	18	28	5	3	-	4	-	-	-	9	27	53	47	8	17	-	-	-	-	8	10	-	-	-	-	125	124			
22:00	23:00	-	-	7	22	21	3	-	-	-	-	2	3	5	21	30	37	6	9	-	-	-	-	6	8	-	-	-	-	77	103			
23:00	00:00	-	-	3	16	11	2	-	-	-	-	1	1	2	17	14	21	3	9	-	-	-	-	3	4	-	-	-	-	37	70			

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Kathmandu to Sindhuli and Sindhuli to Kathmandu

Surveyed and Supervised By: Soil Test P.Ltd

DHULIKHEL

Flow of Vehicles

a = Direction of the movement of vehicle from	KTM to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to KTM

Data Source CCTV Camera

Data Collection Period

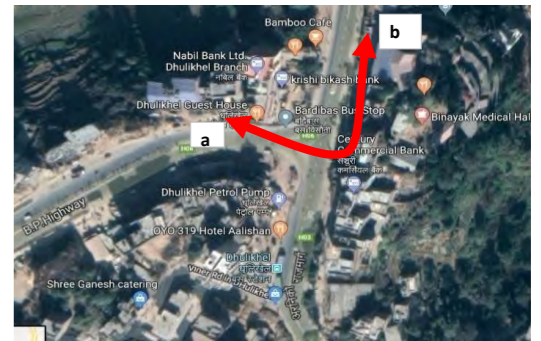
From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Dhulikhel

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																														
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total				
			Multi-axle Truck		Heavy		Light		Big		Mini		Micro		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
15th June 2019	00:00	01:00	-	-	10	36	-	-	-	-	-	-	-	5	6	6	20	1	12	-	-	-	-	-	-	-	-	-	-	-	17	81	
	01:00	02:00	-	-	15	22	-	3	-	-	-	-	-	-	2	1	3	7	4	11	-	-	-	-	1	2	-	-	-	-	25	46	
	02:00	03:00	1	-	6	13	1	1	-	-	-	-	-	-	1	4	3	3	24	-	-	-	-	-	7	-	-	-	-	-	15	49	
	03:00	04:00	1	-	3	26	2	2	-	-	-	-	-	-	2	4	6	2	22	-	-	-	-	-	2	5	-	-	-	-	18	59	
	04:00	05:00	1	-	18	15	2	4	-	-	-	-	-	-	5	3	20	12	7	10	-	-	-	-	10	5	-	-	-	-	63	49	
	05:00	06:00	1	-	32	12	4	3	-	-	2	-	6	-	20	6	50	15	13	14	-	-	-	-	6	4	-	-	-	-	134	54	
	Sub Total 18:00-6:00 hrs			6	2	133	272	133	38	5	-	20	12	17	46	96	225	524	574	98	194	2	1	3	-	85	118	1	-	-	-	1,123	1,482
	Total Day2			11	2	257	374	302	179	19	4	204	187	330	337	556	620	2,518	2,439	427	478	15	14	4	-	497	501	1	-	-	-	5,141	5,135
	06:00	07:00	-	-	21	8	3	2	-	-	15	2	35	-	30	6	88	42	11	12	1	-	-	-	37	6	-	-	-	-	241	78	
	07:00	08:00	1	-	19	14	2	6	-	-	30	1	95	-	38	4	159	66	32	14	-	1	-	-	54	2	-	-	-	-	430	108	
	08:00	09:00	1	-	9	17	6	5	-	-	18	6	49	6	58	25	176	86	23	15	-	1	-	-	38	8	-	-	-	-	378	169	
	09:00	10:00	4	-	13	11	2	3	-	-	19	11	32	6	45	23	164	117	32	19	2	1	-	-	23	12	-	-	-	-	336	203	
	10:00	11:00	-	-	4	17	7	6	-	-	4	15	12	2	37	34	178	127	30	21	-	-	-	-	20	23	-	-	-	-	292	245	
	11:00	12:00	1	-	15	8	4	5	1	-	6	13	8	4	63	35	177	155	24	24	-	-	-	-	20	17	-	-	-	-	320	261	
	12:00	13:00	-	1	2	13	3	13	-	-	8	15	10	12	31	39	176	168	24	20	-	-	-	-	24	35	-	-	-	-	278	316	
	13:00	14:00	-	2	5	9	6	6	1	-	7	28	13	9	50	42	175	155	24	11	-	1	-	-	23	31	-	-	-	-	304	294	
	14:00	15:00	-	-	10	6	3	3	1	-	8	17	1	44	30	45	119	156	28	22	1	-	-	-	19	43	-	-	-	-	220	336	
	15:00	16:00	-	2	6	3	3	4	-	-	7	7	4	63	30	52	140	209	16	15	1	-	1	-	20	37	-	-	-	-	228	392	
	16:00	17:00	-	3	6	5	6	7	-	-	20	12	13	60	27	61	76	229	6	29	2	1	1	-	16	50	-	-	-	-	173	457	
	17:00	18:00	-	2	16	8	5	6	-	-	3	11	6	34	17	55	103	278	10	20	1	-	-	-	10	39	-	-	-	-	171	453	
	Sub Total 6:00-18:00 hrs			7	10	126	119	50	66	3	-	145	138	278	240	456	421	1,731	1,788	260	222	9	5	2	-	304	303	-	-	-	-	3,371	3,312
18:00	19:00	-	1	17	15	3	4	-	-	2	8	-	13	34	51	109	193	14	19	-	1	-	-	5	35	-	-	-	-	184	340		
19:00	20:00	-	-	16	21	3	4	-	-	-	16	-	4	22	52	73	154	14	15	-	-	-	-	4	39	-	-	-	-	132	305		
20:00	21:00	-	-	19	39	1	3	-	-	-	5	2	2	9	59	40	77	5	14	-	1	-	-	5	12	-	-	-	-	81	212		
21:00	22:00	-	-	38	25	-	3	-	-	-	7	-	3	7	33	27	37	7	11	-	-	-	-	3	8	-	-	-	-	82	127		
22:00	23:00	-	-	19	20	-	2	-	-	-	-	-	3	6	20	16	24	5	15	-	-	-	-	1	8	-	-	-	-	47	92		
23:00	00:00	-	-	32	18	-	-	-	-	-	-	1	-	4	5	2	11	1	8	-	-	-	-	1	7	-	-	-	-	41	49		
16th June 2019	00:00	01:00	-	-	19	24	-	-	-	-	-	-	-	1	6	7	11	1	11	-	-	-	-	1	8	-	-	-	-	29	60		
	01:00	02:00	-	-	7	24	-	-	-	-	-	-	-	-	-	2	3	-	9	-	-	-	-	1	6	-	-	-	-	10	42		
	02:00	03:00	-	-	14	14	-	-	-	-	-	-	1	2	3	3	3	2	8	-	-	-	-	1	2	-	-	-	-	22	28		
	03:00	04:00	-	-	4	28	-	1	-	-	1	-	1	1	6	1	6	1	26	-	-	-	-	-	2	-	-	-	-	7	70		
	04:00	05:00	-	-	22	26	-	2	-	-	-	1	-	1	6	5	15	1	4	17	-	-	-	-	10	6	-	-	-	58	57		
	05:00	06:00	-	-	9	13	4	2	-	-	-	-	2	-	9	1	41	23	7	26	1	-	-	-	7	-	-	-	-	80	65		
Sub Total 18:00-6:00 hrs			-	1	216	267	11	21	-	-	3	36	6	27	100	241	336	540	61	179	1	2	-	-	39	133	-	-	-	-	773	1,447	
Total Day3			7	11	342	386	61	87	3	-	148	174	284	267	556	662	2,067	2,328	321	401	10	7	2	-	343	436	-	-	-	-	4,144	4,759	
Total			23	16	953	1,146	504	403	27	4	551	585	935	902	1,723	1,894	6,759	6,807	1,161	1,319	40	36	11	2	1,282	1,368	1	-	-	-	13,970	14,482	
Grand Total (a+b)			39		2,099		907		31		1,136		1,837		3,617		13,566		2,480		76		13		2,650		1		28,452				
Average Daily Traffic (ADT)			13		700		302		10		379		612		1,206		4,522		827		25		4		883		0		9,484				
Composition (%)			0%		7%		3%		0%		4%		6%		13%		48%		9%		0%		0%		9%		0%		0%				
Total ADT excl. MC & Rickshaws			4962																														
Composition excl. MC, rickshaws (%)			0%		14%		6%		0%		8%		12%		24%		-		17%		1%		0%		18%		0%		0%				
Average Annual Daily Traffic (AADT)			12		651		281		10		352		569		1,121		4,205		769		24		4		822		0		8,820				
AADT excl. MC, Rickshaws			12		651		281		10		352		569		1,121		-		769		24		4		822		0		4,615				
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		2.00				
AADT in PCUs			48		1,952		422		29		880		854		1,121		2,103		769		35		3		822		0		9,039				
AADT in PCUs excl. MC & Rickshaws			48		1,952		422		29		880		854		1,121		-		769		35		3		822		0		6,936				

Station name: Dhulikhel
 Route: Kathmandu<->Barabise

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	50	6	39	1	5	112	16	196	3	27	453
7:00-8:00	73	7	59	2	4	108	16	287	5	39	598
8:00-9:00	88	3	80	2	6	97	29	354	4	60	721
9:00-10:00	78	6	76	3	4	95	30	491	3	53	837
10:00-11:00	104	6	72	2	5	99	23	529	3	64	904
11:00-12:00	119	3	60	2	8	105	38	578	4	52	967
12:00-13:00	120	3	62	4	8	107	25	599	2	64	991
13:00-14:00	130	6	71	3	5	105	35	565	4	51	972
14:00-15:00	130	4	75	3	3	115	30	578	3	65	1003
15:00-16:00	126	9	72	3	3	102	24	592	2	61	991
16:00-17:00	125	0	77	4	3	96	21	586	5	71	985
17:00-18:00	129	0	60	9	8	106	22	565	1	55	953
18:00-19:00	120	0	55	2	6	103	21	494	2	67	868
19:00-20:00	83	0	32	1	7	122	16	296	2	44	602
20:00-21:00	65	0	19	1	6	109	11	141	0	43	393
21:00-22:00	31	0	3	0	7	110	13	59	1	25	247
22:00-23:00	24	0	2	0	6	100	19	25	0	12	186
23:00-00:00	8	0	0	1	4	75	6	10	0	13	115
00:00-01:00	6	0	0	0	3	55	8	9	1	13	95
01:00-02:00	2	0	0	0	5	46	2	5	0	7	66
02:00-03:00	3	0	0	0	2	40	1	1	0	23	69
03:00-04:00	6	0	2	0	3	48	4	4	0	20	86
04:00-05:00	12	0	8	0	4	79	3	26	0	15	146
05:00-06:00	24	1	21	0	7	100	3	76	1	22	253
Total	1652	52	940	39	115	2227	411	7060	42	959	13495

Station name: Dhulikhel
 Route: Kathmandu<->Barabise

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	67	0	38	1	2	144	19	280	0	30	581
7:00-8:00	92	0	65	4	8	110	14	431	2	43	769
8:00-9:00	131	0	82	5	3	104	22	437	4	65	853
9:00-10:00	146	0	91	12	7	87	11	507	2	47	910
10:00-11:00	124	0	67	3	2	88	19	410	4	46	763
11:00-12:00	125	1	63	4	7	117	21	525	5	54	922
12:00-13:00	125	4	68	2	5	115	20	558	2	58	957
13:00-14:00	181	2	68	1	6	146	21	622	0	44	1091
14:00-15:00	168	0	74	5	1	97	11	564	4	55	979
15:00-16:00	164	1	80	1	2	67	6	675	0	36	1032
16:00-17:00	144	0	83	12	3	90	19	606	1	41	999
17:00-18:00	170	0	77	2	13	126	20	670	0	38	1116
18:00-19:00	161	0	64	3	5	141	12	536	6	48	976
19:00-20:00	113	0	45	6	2	113	13	354	1	31	678
20:00-21:00	78	0	19	2	10	84	6	167	0	24	390
21:00-22:00	32	0	4	1	6	148	15	63	0	21	290
22:00-23:00	22	0	2	1	4	92	8	28	0	14	171
23:00-00:00	9	0	3	0	2	53	4	4	1	20	96
00:00-01:00	7	0	1	0	1	35	2	3	1	11	61
01:00-02:00	2	0	2	0	2	59	4	9	0	5	83
02:00-03:00	4	0	2	0	0	35	1	1	0	14	57
03:00-04:00	3	0	1	0	0	62	5	6	0	8	85
04:00-05:00	9	0	8	0	3	57	7	25	3	8	120
05:00-06:00	13	0	11	0	5	62	4	56	0	8	159
Total	2090	8	1018	65	99	2232	284	7537	36	769	14138

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
VEHICLE COUNT SURVEY - Kathmandu to Barabise and Barabise to Kathmandu

Surveyed and Supervised By: **Soil Test P.Ltd**

DHULIKHEL

Flow of Vehicles

a = Direction of the movement of vehicle from	KTM to Barabise
b = Direction of the movement of Vehicle from	Barabise to KTM

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Dhulikhel

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																														
			Truck				Bus						Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total		
			Multi-axle Truck		Heavy		Light		Big		Mini		Micro		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
13th June 2019	06:00	07:00	3	1	95	16	20	1	8	1	22	13	1	-	15	11	98	72	13	11	3	1	-	-	18	2	-	-	-	-	296	129	
	07:00	08:00	2	2	71	17	16	1	8	2	29	22	1	-	28	22	151	135	20	13	3	3	-	-	17	5	-	-	-	-	346	222	
	08:00	09:00	5	-	67	32	24	8	-	-	47	30	1	1	35	25	181	162	29	32	3	2	-	-	34	6	-	-	-	-	426	298	
	09:00	10:00	4	-	40	50	19	7	4	-	40	37	1	-	25	12	272	200	26	34	-	1	-	-	24	8	-	-	-	-	455	349	
	10:00	11:00	2	1	29	50	16	14	6	-	33	37	1	-	49	28	326	199	30	41	3	2	-	-	13	9	-	-	-	-	508	381	
	11:00	12:00	8	1	40	43	29	28	4	-	20	30	1	-	45	38	310	249	24	33	2	3	-	-	19	17	-	-	-	-	502	442	
	12:00	13:00	3	2	42	53	18	10	2	-	17	35	6	-	49	25	351	215	28	31	2	-	1	-	23	14	-	-	-	-	542	385	
	13:00	14:00	2	2	58	46	27	15	7	-	35	39	1	1	53	39	293	250	29	23	-	1	-	-	20	19	-	-	-	-	525	435	
	14:00	15:00	2	-	35	51	31	11	6	-	25	42	-	1	37	44	271	251	34	23	4	-	2	-	25	18	-	-	-	-	472	441	
	15:00	16:00	2	-	42	41	20	10	13	-	25	44	3	2	34	49	265	251	27	33	1	1	3	-	16	24	-	-	-	-	451	455	
	16:00	17:00	-	1	30	52	3	10	-	-	35	34	2	1	33	53	220	320	49	28	2	6	-	-	4	20	-	-	-	-	378	525	
	17:00	18:00	3	5	34	53	22	9	-	-	24	34	6	1	22	71	192	268	18	35	-	1	-	-	4	15	-	-	-	-	325	492	
	Sub Total 6:00-18:00 hrs			36	15	583	504	245	124	58	3	352	397	24	7	425	417	2,930	2,572	327	337	23	21	6	-	217	157	-	-	-	-	5,226	4,554
	14th June 2019	18:00	19:00	3	1	23	64	12	6	-	-	17	22	2	1	28	48	197	206	23	43	-	1	-	5	21	-	-	-	-	310	413	
		19:00	20:00	1	11	18	77	10	9	-	-	16	16	-	-	20	35	134	116	12	31	-	-	-	3	10	-	-	-	-	214	305	
		20:00	21:00	1	5	45	56	3	9	-	-	12	9	-	-	19	17	55	41	14	25	-	-	-	7	9	-	-	-	-	156	171	
		21:00	22:00	2	5	66	53	6	5	-	-	2	-	-	-	8	9	32	25	4	20	-	1	-	3	1	-	-	-	-	123	119	
		22:00	23:00	2	6	64	47	1	5	-	-	-	-	-	-	4	9	10	6	3	4	-	-	-	4	4	-	-	-	-	88	81	
23:00		00:00	2	3	35	34	-	-	-	-	-	-	-	-	1	4	3	3	3	14	-	-	-	2	1	-	-	-	-	46	59		
00:00		01:00	4	1	34	31	2	1	-	-	-	-	-	-	1	-	3	1	8	-	-	-	-	1	1	-	-	-	-	42	46		
01:00		02:00	2	4	17	34	2	2	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	1	-	-	-	-	-	22	45		
02:00		03:00	-	1	15	36	2	-	-	-	-	-	-	-	-	1	1	-	9	11	-	-	1	-	2	2	-	-	-	-	30	51	
03:00		04:00	-	-	22	21	1	5	-	-	3	1	-	-	1	1	2	-	6	15	-	-	-	1	1	-	-	-	-	36	44		
04:00		05:00	-	1	54	25	1	-	-	-	6	4	-	-	4	4	28	3	9	4	-	-	-	-	2	-	-	-	-	104	41		
05:00		06:00	2	5	55	35	3	-	-	1	14	11	-	-	14	2	38	26	18	7	-	-	-	3	1	-	-	-	-	147	88		
Sub Total 18:00-6:00 hrs			19	43	448	513	43	42	-	1	70	63	2	1	99	131	500	429	102	187	-	2	1	-	34	51	-	-	-	-	1,318	1,463	
Total Day1			55	58	1,031	1,017	288	166	58	4	422	460	26	8	524	548	3,430	3,001	429	524	23	23	7	-	251	208	-	-	-	-	6,544	6,017	
14th June 2019		06:00	07:00	4	1	100	12	6	5	2	-	27	16	1	-	18	14	141	80	23	7	1	1	-	-	17	5	-	-	-	-	340	141
		07:00	08:00	3	-	104	23	9	5	4	-	43	24	1	1	29	15	160	128	28	17	1	2	-	-	23	7	-	-	-	-	405	222
		08:00	09:00	7	-	63	32	10	16	6	-	52	31	-	1	35	17	210	155	35	23	1	1	-	-	16	7	-	-	-	-	435	283
		09:00	10:00	3	-	72	28	12	21	8	-	38	37	2	2	38	23	304	206	24	20	2	3	-	-	16	10	-	-	-	-	519	351
	10:00	11:00	5	1	68	50	12	4	6	-	30	43	2	-	55	24	296	237	27	28	-	-	1	-	20	10	-	-	-	-	522	397	
	11:00	12:00	4	2	60	66	11	8	1	-	29	40	2	1	58	34	325	271	25	22	3	-	-	-	17	10	-	-	-	-	535	454	
	12:00	13:00	4	6	55	63	10	12	-	4	37	34	2	-	53	42	332	299	31	35	-	1	-	-	15	18	-	-	1	-	540	514	
	13:00	14:00	1	5	55	51	20	7	-	5	37	30	2	1	63	40	311	275	30	19	4	2	-	-	14	12	-	-	-	-	537	447	
	14:00	15:00	2	1	67	77	11	7	-	2	39	43	1	3	58	53	314	320	38	32	-	-	-	-	15	9	-	-	-	-	545	548	
	15:00	16:00	3	1	59	62	11	6	-	4	40	34	-	-	52	40	328	340	31	27	1	1	-	-	10	26	-	-	-	-	535	541	
	16:00	17:00	2	2	52	57	9	19	-	-	48	36	4	1	57	55	316	315	22	42	1	1	-	-	17	10	-	-	-	-	528	539	
	17:00	18:00	2	6	35	89	4	8	-	-	27	35	4	7	62	52	372	298	28	28	-	-	-	-	17	14	-	-	-	-	551	537	
	Sub Total 6:00-18:00 hrs			40	25	790	610	125	118	27	15	447	403	21	17	578	409	3,409	2,924	342	300	14	13	1	2	197	138	-	-	1	-	5,992	4,974
	14th June 2019	18:00	19:00	2	6	33	86	12	12	-	-	32	38	1	-	60	50	341	243	38	29	2	1	-	-	10	17	-	-	-	-	531	482
19:00		20:00	1	1	24	124	3	9	-	-	16	16	1	1	38	45	211	131	21	23	1	3	-	-	15	-	-	-	-	-	316	368	
20:00		21:00	1	4	30	86	4	6	-	-	10	6	-	1	36	25	103	83	23	23	-	-	-	-	7	10	-	-	-	-	214	244	
21:00		22:00	2	4	52	49	1	13	-	-	4	-	-	-	15	18	37	23	8	17	-	-	-	-	1	7	-	-	-	-	120	131	
22:00		23:00	3	1	60	28	2	29	-	-	2	1	-	-	12	4	23	11	6	10	-	-	-	-	2	9	-	-	-	-	110	93	
23:00	00:00	1	2	52	28	-	11	-	-	-	-	-	-	1	2	3	5	8	2	7	-	-	-	-	2	-	-	-	-	-	64	60	

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
VEHICLE COUNT SURVEY - Kathmandu to Barabise and Barabise to Kathmandu

Surveyed and Supervised By: **Soil Test P.Ltd**

DHULIKHEL

Flow of Vehicles

a = Direction of the movement of vehicle from	KTM to Barabise
b = Direction of the movement of Vehicle from	Barabise to KTM

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)
 To : 6am on 16th June 2019 (Sunday)

Station Name: Dhulikhel

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																														
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total				
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
15th June 2019	00:00	01:00	-	1	15	30	7	6	-	-	-	-	3	5	7	7	13	3	2	-	1	-	1	-	-	-	-	-	-	-	49	52	
	01:00	02:00	2	1	31	9	-	-	-	-	-	-	1	1	6	4	6	3	-	-	-	-	1	-	-	-	-	-	-	47	18		
	02:00	03:00	-	2	20	8	-	-	-	-	-	-	1	-	-	-	20	5	-	-	-	-	-	-	-	-	-	-	41	15			
	03:00	04:00	2	3	34	18	1	-	-	-	-	-	1	4	1	5	10	9	-	-	-	-	2	1	-	-	-	-	-	51	40		
	04:00	05:00	4	2	32	46	2	3	-	-	2	4	-	-	1	3	3	17	6	11	-	-	-	-	2	8	-	-	-	52	94		
	05:00	06:00	2	5	96	14	2	1	-	-	-	-	11	6	-	-	12	5	75	12	11	7	1	-	-	-	-	-	-	219	52		
	Sub Total 18:00-6:00 hrs			20	32	479	526	34	90	-	-	77	71	2	3	182	163	812	544	164	147	6	4	1	-	37	69	-	-	-	1,814	1,649	
	Total Day2			60	57	1,269	1,136	159	208	27	15	524	474	23	20	760	572	4,221	3,468	506	447	20	17	2	2	234	207	-	-	1	-	7,806	6,623
	06:00	07:00	1	1	127	17	8	11	-	-	25	13	1	-	35	14	194	86	20	10	-	-	-	-	16	2	-	-	-	427	154		
	07:00	08:00	7	1	95	15	8	6	-	-	44	21	4	-	58	10	318	113	26	17	1	1	-	-	18	6	-	-	-	579	190		
	08:00	09:00	3	-	60	44	9	13	-	-	59	23	4	1	84	19	272	165	38	26	3	1	-	1	22	6	-	-	-	554	299		
	09:00	10:00	4	3	54	33	8	3	-	-	59	32	10	2	82	38	318	189	29	18	2	-	-	-	15	11	-	-	-	581	329		
	10:00	11:00	2	-	50	38	12	7	-	-	35	32	3	-	65	45	208	202	29	17	2	2	-	-	5	9	-	-	-	411	352		
	11:00	12:00	5	2	52	65	10	11	1	-	28	35	1	3	63	43	303	222	21	32	2	3	-	1	11	8	-	-	-	497	425		
12:00	13:00	-	5	45	70	11	9	1	3	29	39	1	1	49	60	320	238	23	35	-	2	-	-	6	10	-	-	-	485	472			
13:00	14:00	3	3	89	57	11	10	2	-	34	34	1	-	96	63	357	265	29	15	-	-	-	-	10	12	-	-	-	632	459			
14:00	15:00	-	1	55	42	6	5	-	-	39	35	2	3	78	63	276	288	32	23	3	1	-	-	12	15	-	-	-	503	476			
15:00	16:00	-	2	39	28	5	1	1	-	39	41	1	-	60	70	290	385	16	20	-	-	-	-	14	20	-	-	-	465	567			
16:00	17:00	1	2	22	68	13	6	-	-	36	47	-	12	35	81	240	366	21	20	1	-	-	-	6	22	-	-	-	375	624			
17:00	18:00	5	8	25	101	12	8	-	-	28	49	-	2	38	100	229	441	15	23	-	-	-	-	5	27	-	-	-	357	759			
Sub Total 6:00-18:00 hrs			31	28	713	578	113	90	5	3	455	401	28	24	743	606	3,325	2,960	299	256	14	10	-	2	140	148	-	-	-	5,866	5,106		
18:00	19:00	3	2	31	110	1	11	-	-	16	48	1	2	28	75	166	370	17	31	2	4	-	-	11	47	-	-	-	276	700			
19:00	20:00	-	2	15	98	1	12	-	-	12	33	1	5	22	51	126	228	12	19	-	1	-	-	13	27	-	-	-	202	476			
20:00	21:00	6	4	30	54	-	6	-	-	6	13	1	1	11	31	58	109	5	19	-	-	-	-	7	29	-	-	-	124	266			
21:00	22:00	-	6	71	77	1	14	-	-	2	2	-	1	5	10	29	34	8	13	-	-	-	-	5	12	-	-	-	121	169			
22:00	23:00	2	2	43	49	-	8	-	-	-	2	-	1	5	3	9	19	6	8	-	-	-	-	4	10	-	-	-	69	102			
23:00	00:00	2	-	30	23	-	4	-	-	-	3	-	-	4	1	3	4	16	-	1	-	-	-	5	-	-	-	-	37	59			
16th June 2019	00:00	01:00	1	-	15	20	-	2	-	-	1	-	-	1	5	1	2	4	7	-	1	-	-	1	-	-	-	-	23	38			
	01:00	02:00	2	-	19	40	1	3	-	-	-	2	-	-	1	5	4	5	-	-	-	-	-	-	-	-	-	-	28	55			
	02:00	03:00	-	-	9	26	1	-	-	-	-	2	-	-	-	2	-	1	3	11	-	-	-	2	-	-	-	-	15	42			
	03:00	04:00	-	-	20	42	4	1	-	-	-	1	-	-	-	2	-	6	8	-	-	-	-	-	1	-	-	-	24	61			
	04:00	05:00	2	1	33	24	5	2	-	-	5	3	-	-	3	1	15	10	5	3	1	2	-	-	5	-	-	-	74	46			
05:00	06:00	3	2	41	21	2	2	-	-	6	5	-	-	4	3	39	17	3	5	-	-	-	-	4	2	-	-	-	102	57			
Sub Total 18:00-6:00 hrs			21	19	357	584	16	65	-	-	47	115	3	10	80	188	449	803	67	145	3	9	-	-	52	133	-	-	-	1,095	2,071		
Total Day3			52	47	1,070	1,162	129	155	5	3	502	516	31	34	823	794	3,774	3,763	366	401	17	19	-	2	192	281	-	-	-	6,961	7,177		
Total			167	162	3,370	3,315	576	529	90	22	1,448	1,450	80	62	2,107	1,914	11,425	10,232	1,301	1,372	60	59	9	4	677	696	-	-	1	-	21,311	19,817	
Grand Total (a+b)			329		6,685		1,105		112		2,898		142		4,021		21,657		2,673		119		13		1,373		-		41,128				
Average Daily Traffic (ADT)			110		2,228		368		37		966		47		1,340		7,219		891		40		4		458		-		13,709				
Composition (%)			1%		16%		3%		0%		7%		0%		10%		53%		6%		0%		3%		0%		0%		0%				
Total ADT excl. MC & Rickshaws			6490																														
Composition excl. MC, Rickshaws (%)			2%		34%		6%		1%		15%		1%		21%		0%		14%		1%		0%		7%		0%		0%				
Average Annual Daily Traffic (AADT)			102		2,072		343		35		898		44		1,247		6,714		829		37		4		426		-		12,750				
AADT excl. MC, Rickshaws			102		2,072		343		35		898		44		1,247		-		829		37		4		426		-		6,036				
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00				
AADT in PCUs			408		6,217		514		104		2,246		66		1,247		3,357		829		55		3		426		-		15,471				
AADT in PCUs excl. MC & Rickshaws			408		6,217		514		104		2,246		66		1,247		-		829		55		3		426		-		12,114				

Station name: Dhulikhel
Route: Barabise<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	9	1	2	1	0	5	1	28	0	3	49
7:00-8:00	15	5	3	1	0	9	5	51	3	4	93
8:00-9:00	18	2	6	0	0	3	2	70	1	8	108
9:00-10:00	22	2	5	1	0	3	2	80	1	4	118
10:00-11:00	33	4	2	0	1	7	4	110	4	8	171
11:00-12:00	30	6	2	0	0	6	6	105	2	6	161
12:00-13:00	40	1	1	0	0	5	1	92	0	3	142
13:00-14:00	34	5	2	0	0	3	5	97	1	2	147
14:00-15:00	25	3	2	1	0	6	3	94	0	9	141
15:00-16:00	37	5	6	0	0	6	5	87	1	3	147
16:00-17:00	30	3	3	0	0	4	3	84	2	7	134
17:00-18:00	27	1	2	1	0	4	1	109	1	4	148
18:00-19:00	32	4	2	0	0	3	4	80	1	1	127
19:00-20:00	17	1	1	0	0	4	1	85	1	2	110
20:00-21:00	11	1	1	0	0	8	1	47	0	5	73
21:00-22:00	12	2	0	0	1	3	2	25	0	-1	42
22:00-23:00	4	2	0	0	0	2	2	7	0	1	16
23:00-00:00	2	0	0	0	0	2	0	14	0	1	18
00:00-01:00	3	0	0	0	0	3	0	5	0	1	12
01:00-02:00	4	0	0	0	0	1	0	2	0	2	9
02:00-03:00	2	1	1	0	0	1	1	0	0	2	6
03:00-04:00	2	0	0	0	0	3	0	0	0	1	5
04:00-05:00	1	1	0	0	0	2	1	2	0	1	7
05:00-06:00	3	0	1	0	0	7	0	10	0	2	23
Total	408	45	37	4	1	95	45	1278	16	73	2001

Station name: Dhulikhel
Route: Barabise<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	11	0	1	0	0	3	0	25	0	5	45
7:00-8:00	10	0	3	0	0	2	3	59	0	3	80
8:00-9:00	16	0	4	0	0	7	1	81	1	19	129
9:00-10:00	28	0	2	0	0	7	1	80	3	11	132
10:00-11:00	20	0	0	0	0	4	0	89	0	7	120
11:00-12:00	24	0	2	0	0	3	0	89	0	6	124
12:00-13:00	23	0	0	0	0	6	1	90	2	9	131
13:00-14:00	36	0	1	0	0	5	4	97	0	6	149
14:00-15:00	19	0	0	0	0	5	0	72	0	15	111
15:00-16:00	20	1	3	0	0	4	2	112	1	10	153
16:00-17:00	29	1	0	0	0	2	1	83	1	11	128
17:00-18:00	18	0	1	1	0	3	0	114	0	4	141
18:00-19:00	19	0	1	1	0	10	2	90	3	8	134
19:00-20:00	25	0	2	1	0	4	3	76	0	5	116
20:00-21:00	11	0	2	0	1	6	0	42	0	5	67
21:00-22:00	8	0	0	0	0	4	0	28	0	4	44
22:00-23:00	3	0	0	0	0	5	0	10	0	0	18
23:00-00:00	5	0	0	0	0	0	0	5	1	1	12
00:00-01:00	2	0	0	0	0	7	0	2	0	2	13
01:00-02:00	0	0	0	0	0	3	0	1	0	3	7
02:00-03:00	3	0	0	0	0	0	2	0	0	1	6
03:00-04:00	0	0	0	0	0	4	0	1	0	0	5
04:00-05:00	1	0	0	0	0	2	0	2	1	1	7
05:00-06:00	4	0	0	0	0	2	1	6	0	1	14
Total	335	2	22	3	1	98	21	1254	13	137	1886

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Surveyed and Supervised By: Soil Test P.Ltd

DHULIKHEL

VEHICLE COUNT SURVEY - Barabise to Sindhuli and Sindhuli to Barabise

Flow of Vehicles

a = Direction of the movement of vehicle from Barabise to Sindhuli
b = Direction of the movement of Vehicle from Sindhuli to Barabise

Data Source CCTV Camera
 Data Collection Period
 From : 6am on 13th June 2019 (Thursday)
 To : 6am on 16th June 2019 (Sunday)
 Station Name: Dhulikhel
 Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)
 DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																																
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total						
			Multi-axle Truck		Heavy		Light		Big		Mini		Micro		a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b			
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b			
15th June 2019	00:00	01:00	-	-	3	2	-	-	-	-	-	-	-	2	2	1	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	10
	01:00	02:00	-	-	2	-	-	-	-	-	-	-	-	2	1	1	2	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	9	3
	02:00	03:00	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
	03:00	04:00	-	-	1	1	-	-	-	-	-	-	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	
	04:00	05:00	-	-	-	2	2	-	-	-	-	-	-	-	-	3	-	1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	6	5	
	05:00	06:00	-	-	1	2	-	-	-	-	-	1	-	1	1	13	1	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	18	5	
	Sub Total 18:00-6:00 hrs			-	1	20	17	3	4	-	-	4	1	-	-	34	40	190	150	16	13	2	1	-	-	8	8	-	-	-	-	-	-	277	235
	Total Day2			1	1	49	42	32	23	1	1	25	16	1	5	180	171	782	580	60	59	12	5	-	-	40	30	-	-	-	-	-	-	1,183	933
	06:00	07:00	-	-	-	3	-	-	-	-	-	1	-	-	5	4	21	4	4	1	-	-	-	-	2	-	-	-	-	-	-	-	32	13	
	07:00	08:00	-	-	1	1	1	2	-	-	2	1	-	-	7	3	35	24	2	1	-	-	-	-	-	-	-	-	-	-	-	-	48	32	
	08:00	09:00	-	-	2	5	-	1	-	-	2	2	-	-	9	7	48	33	6	4	1	-	7	2	-	-	-	-	-	-	-	-	75	54	
	09:00	10:00	-	-	5	2	1	-	-	-	1	1	-	-	14	11	49	31	4	4	2	1	3	-	-	3	-	-	-	-	-	-	79	53	
	10:00	11:00	-	-	2	2	-	-	-	-	-	-	-	-	10	5	44	45	5	2	-	-	-	-	4	1	-	-	-	-	-	-	65	55	
	11:00	12:00	-	-	2	1	-	-	-	-	1	1	-	-	11	10	55	34	3	2	-	-	-	1	1	2	-	-	-	-	-	73	51		
	12:00	13:00	-	-	3	3	-	1	-	-	-	-	-	-	9	6	55	35	5	4	1	1	-	-	6	2	-	-	-	-	-	-	79	52	
	13:00	14:00	-	-	2	3	3	1	-	-	-	1	-	-	15	13	58	39	3	3	-	-	-	-	6	2	-	-	-	-	-	-	87	62	
	14:00	15:00	-	-	-	5	-	-	-	-	-	-	-	-	9	3	39	33	8	7	-	-	-	-	5	2	-	-	-	-	-	-	61	50	
	15:00	16:00	-	-	4	-	2	-	1	-	3	-	-	-	6	8	66	46	8	2	1	-	-	-	5	1	-	-	-	-	-	-	96	57	
	16:00	17:00	-	-	2	-	1	-	1	-	-	-	-	-	12	14	44	39	5	6	-	1	-	-	2	1	-	-	-	-	-	-	67	61	
	17:00	18:00	-	-	3	-	-	-	-	-	-	1	1	-	11	2	58	56	3	1	-	-	-	-	1	4	-	-	-	-	-	-	77	64	
	Sub Total 6:00-18:00 hrs			-	-	26	25	8	5	2	-	9	8	1	-	118	86	572	419	56	37	5	3	10	3	32	18	-	-	-	-	-	-	839	604
	18:00	19:00	0	0	6	4	-	2	-	-	1	-	1	-	6	7	42	48	5	3	1	2	-	-	4	2	-	-	-	-	-	-	66	68	
	19:00	20:00	-	-	2	2	3	-	-	-	2	-	-	1	13	7	52	24	3	2	-	-	-	-	1	4	-	-	-	-	-	-	76	40	
	20:00	21:00	-	1	6	-	-	-	-	-	2	-	-	-	4	6	22	20	3	2	-	-	-	-	-	1	-	-	-	-	-	-	37	30	
21:00	22:00	-	-	2	2	-	-	-	-	-	-	-	-	2	2	15	13	1	3	-	-	-	-	2	2	-	-	-	-	-	-	22	22		
22:00	23:00	-	-	2	3	-	-	-	-	-	-	-	-	1	-	6	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	11	7		
23:00	00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	4	1	-	-	1	-	-	2	2	-	-	-	-	-	-	4	8		
16th June 2019	00:00	01:00	-	-	4	3	-	-	-	-	-	-	-	1	-	1	1	2	-	-	-	-	-	1	-	-	-	-	-	-	-	8	5		
	01:00	02:00	-	-	3	-	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	5	2		
	02:00	03:00	-	-	-	-	1	1	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	2	4		
	03:00	04:00	-	-	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-		
	04:00	05:00	-	-	1	1	-	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	-	-	1	-	-	-	-	-	-	5	2		
	05:00	06:00	-	-	-	2	-	1	-	-	-	-	-	-	4	-	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	9	5		
	Sub Total 18:00-6:00 hrs			-	1	30	17	4	4	-	-	5	-	1	1	31	24	146	117	20	11	2	3	-	-	11	15	-	-	-	-	-	-	250	193
Total Day3			-	1	56	42	12	9	2	-	14	8	2	1	149	110	718	536	76	48	7	6	10	3	43	33	-	-	-	-	-	-	1,089	797	
Total			1	2	153	134	58	53	3	1	60	36	4	6	480	434	2,152	1,658	219	139	26	19	10	3	117	119	-	-	-	-	-	-	3,283	2,604	
Grand Total (a+b)			3		287		111		4		96		10		914		3,810		358		45		13		236						5,887				
Average Daily Traffic (ADT)			1		96		37		1		32		3		305		1,270		119		15		4		79						1,962				
Composition (%)			0%		5%		2%		0%		2%		0%		16%		65%		6%		1%		0%		4%		0%		0%		-				
Total ADT excl. MC & Rickshaws			692																																
Composition excl. MC, Rickshaws (%)			0%		14%		5%		0%		5%		0%		44%		-		17%		2%		1%		11%		0%		-		0%		-		
Average Annual Daily Traffic (AADT)			1		89		34		1		30		3		283		1,181		111		14		4		73						1,825				
AADT excl. MC, Rickshaws			1		89		34		1		30		3		283		-		111		14		4		73						644				
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00		2.00		-		
AADT in PCUs			4		267		52		4		74		5		283		591		111		21		3		73						1,487				
AADT in PCUs excl. MC & Rickshaws			4		267		52		4		74		5		283		-		111		21		3		73						896				

ANNEX-4.2 : MANGALTAR

Station name: Mangaltar
Route: Dhulikhel<->Khurkot

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	38	0	4	4	0	11	3	61	0	17	138
7:00-8:00	66	0	21	26	0	7	8	113	1	20	261
8:00-9:00	95	0	24	73	0	5	6	100	0	19	320
9:00-10:00	97	0	30	101	0	4	3	108	0	28	368
10:00-11:00	72	0	27	53	0	7	7	102	0	24	291
11:00-12:00	65	0	23	15	0	5	5	106	0	20	237
12:00-13:00	59	0	25	36	0	5	5	100	0	35	262
13:00-14:00	78	0	20	80	0	4	4	97	0	27	309
14:00-15:00	74	0	9	66	0	5	5	96	0	20	275
15:00-16:00	65	0	7	52	0	16	4	100	0	28	271
16:00-17:00	64	0	7	32	0	18	3	102	1	26	251
17:00-18:00	51	0	2	10	0	27	8	71	0	30	198
18:00-19:00	52	0	10	17	0	15	4	85	1	21	203
19:00-20:00	36	0	1	3	0	20	5	55	0	20	139
20:00-21:00	26	0	1	2	0	23	3	22	0	17	93
21:00-22:00	26	0	0	2	0	18	1	16	1	17	81
22:00-23:00	16	0	1	1	1	43	2	6	0	13	81
23:00-00:00	11	0	0	1	0	31	0	2	0	11	54
00:00-01:00	8	0	1	0	0	19	1	3	0	16	46
01:00-02:00	7	0	1	1	0	24	2	1	0	12	45
02:00-03:00	5	0	0	1	0	20	0	1	0	20	45
03:00-04:00	3	0	0	0	0	21	1	1	0	17	43
04:00-05:00	6	0	0	0	0	18	4	4	0	13	44
05:00-06:00	19	0	0	0	0	10	8	29	1	17	82
Total	1034	0	209	571	1	371	85	1375	3	483	4131

Station name: Mangaltar
 Route: Dhulikhel<->Khurkot

Roadside Traffic Count on Weekend											
Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total	
6:00-7:00	29	0	2	6	0	7	9	48	0	20	121
7:00-8:00	60	0	20	25	0	6	5	103	0	13	232
8:00-9:00	70	0	24	51	0	7	12	115	0	18	297
9:00-10:00	110	0	31	98	0	4	7	126	1	25	402
10:00-11:00	43	0	15	35	0	7	3	94	0	26	223
11:00-12:00	130	3	35	39	3	2	4	92	0	30	338
12:00-13:00	131	1	26	70	1	3	2	59	0	29	322
13:00-14:00	99	0	19	83	0	2	4	117	0	28	352
14:00-15:00	94	0	11	97	0	9	7	136	0	32	386
15:00-16:00	66	0	12	61	0	7	6	126	0	28	306
16:00-17:00	88	0	11	29	0	14	5	85	0	26	258
17:00-18:00	105	0	18	13	0	21	5	91	0	21	274
18:00-19:00	54	0	8	15	0	18	6	67	0	27	195
19:00-20:00	37	0	5	3	0	20	3	58	0	27	153
20:00-21:00	31	0	1	1	0	23	1	27	0	20	104
21:00-22:00	11	0	0	3	0	22	1	6	0	11	54
22:00-23:00	15	0	0	1	0	40	0	3	0	4	63
23:00-00:00	8	0	0	0	0	23	0	1	0	9	41
00:00-01:00	2	0	0	1	0	8	5	1	0	7	24
01:00-02:00	6	0	0	1	0	21	3	0	0	11	42
02:00-03:00	5	0	0	2	0	13	4	0	0	23	47
03:00-04:00	11	0	0	0	0	14	5	3	0	16	49
04:00-05:00	0	0	0	0	0	16	3	6	0	19	44
05:00-06:00	20	0	0	2	0	17	3	20	0	22	84
Total	1225	4	238	636	4	324	103	1384	1	492	4411

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Dhulikhel to Khurkot and Khurkot to Dhulikhel

Surveyed and Supervised By: Soil Test P.Ltd



MANGALTAR

Flow of Vehicles

a = Direction of the movement of vehicle from	Dhulikhel to Khurkot
b = Direction of the movement of Vehicle from	

Data Source CCTV Camera
 Data Collection Period
 From : 6am on 13th June 2019 (Thursday)
 To : 6am on 16th June 2019 (Sunday)
 Station Name: Mangaltar
 Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)
 DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																														
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total				
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b			
15th June 2019	00:00	01:00	-	-	10	5	-	-	-	-	-	-	-	-	1	1	1	2	12	-	-	-	-	2	4	-	-	-	-	-	-	15	23
	01:00	02:00	-	-	11	14	-	3	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	6	-	-	-	-	-	-	11	36	
	02:00	03:00	-	-	10	14	-	-	-	-	-	-	-	-	-	-	1	17	-	-	-	-	-	5	-	-	-	-	-	-	12	36	
	03:00	04:00	-	-	6	15	2	-	-	-	-	-	-	-	1	1	-	2	12	-	-	-	-	-	3	-	-	-	-	-	12	31	
	04:00	05:00	-	-	5	11	-	3	-	-	-	-	-	-	2	4	-	2	3	12	-	-	-	-	1	2	-	-	-	-	11	34	
	05:00	06:00	-	-	3	4	2	-	-	-	-	-	-	-	6	1	20	6	8	7	-	-	1	-	10	-	-	-	-	-	49	19	
	Sub Total 18:00-6:00 hrs			-	-	132	125	11	17	-	-	8	5	14	8	37	59	127	106	74	119	-	1	-	-	46	86	-	-	-	-	449	526
	Total Day2			-	-	196	179	37	43	-	-	113	90	307	323	193	195	800	748	247	244	2	1	-	-	343	400	-	-	-	-	2,238	2,223
	06:00	07:00	-	-	5	2	6	3	-	-	1	1	4	2	14	5	42	6	12	8	-	-	-	-	6	4	-	-	-	-	90	31	
	07:00	08:00	-	-	5	1	4	1	-	-	11	9	15	10	17	3	76	27	7	6	-	-	-	-	34	6	-	-	-	-	169	63	
	08:00	09:00	-	-	7	-	8	4	-	-	17	7	50	1	11	9	79	36	12	6	-	-	-	-	41	9	-	-	-	-	225	72	
	09:00	10:00	-	-	3	1	2	5	-	-	25	6	94	4	25	10	71	55	16	9	1	-	-	56	19	-	-	-	-	293	109		
	10:00	11:00	-	-	1	6	2	1	-	-	9	6	33	2	10	6	44	50	20	6	-	-	-	17	10	-	-	-	-	136	87		
	11:00	12:00	-	3	-	2	4	-	-	3	27	8	32	7	14	50	64	28	13	-	-	-	17	31	35	-	-	-	-	185	153		
	12:00	13:00	-	1	-	3	2	-	-	1	18	8	60	10	17	40	45	14	14	-	-	-	-	15	36	38	-	-	-	-	192	130	
	13:00	14:00	-	-	1	1	1	3	-	-	3	16	9	74	16	17	50	67	20	8	-	-	-	22	44	-	-	-	-	122	230		
	14:00	15:00	-	-	9	-	3	4	-	-	2	9	9	88	13	15	63	73	17	15	-	-	-	18	48	-	-	-	-	134	252		
	15:00	16:00	-	-	7	-	3	3	-	-	7	5	2	59	3	15	42	84	12	16	-	-	-	15	33	-	-	-	-	91	215		
	16:00	17:00	-	-	1	13	5	-	-	-	6	5	6	23	17	23	33	52	19	7	-	-	-	18	30	-	-	-	-	105	153		
	17:00	18:00	-	-	11	10	1	4	-	-	8	10	3	10	10	51	31	60	6	15	-	-	-	11	33	-	-	-	-	81	193		
	Sub Total 6:00-18:00 hrs			-	4	50	39	41	28	-	4	134	90	317	290	167	244	640	552	168	96	1	-	-	32	305	309	-	-	-	-	1,823	1,688
	18:00	19:00	-	-	6	12	1	5	-	-	5	3	13	2	5	21	20	47	20	7	-	-	-	4	24	-	-	-	-	###	121		
	19:00	20:00	-	-	12	8	2	1	-	-	-	5	-	3	5	18	18	40	18	9	-	-	-	2	12	-	-	-	-	57	96		
20:00	21:00	-	-	5	18	1	-	-	-	-	1	-	1	3	11	13	14	13	7	-	-	-	5	12	-	-	-	-	40	64			
21:00	22:00	-	-	11	11	-	1	-	-	-	11	-	3	1	2	1	5	1	10	-	-	-	1	7	-	-	-	-	15	39			
22:00	23:00	-	-	23	17	-	-	-	-	-	-	1	-	-	3	-	3	-	4	-	-	-	2	10	-	-	-	-	26	37			
23:00	00:00	-	-	12	11	-	-	-	-	-	-	-	-	1	1	1	-	1	8	-	-	-	-	6	-	-	-	-	15	26			
16th June 2019	00:00	01:00	-	-	6	2	-	5	-	-	-	-	1	1	-	1	-	1	6	-	-	-	1	-	-	-	-	-	10	14			
	01:00	02:00	-	-	3	18	-	3	-	-	-	-	1	1	3	-	-	-	11	-	-	-	-	2	-	-	-	-	4	38			
	02:00	03:00	-	-	-	13	-	4	-	-	-	-	2	-	1	-	-	-	23	-	-	-	-	4	-	-	-	-	-	47			
	03:00	04:00	-	-	3	11	-	5	-	-	-	-	-	-	2	1	-	3	-	16	-	-	-	1	7	-	-	-	-	6	43		
	04:00	05:00	-	-	3	13	-	3	-	-	-	-	-	-	-	4	2	4	15	-	-	-	-	-	-	-	-	-	11	33			
	05:00	06:00	-	-	5	12	2	1	-	-	-	-	1	1	4	3	13	7	13	9	-	-	-	8	5	-	-	-	-	46	38		
	Sub Total 18:00-6:00 hrs			-	-	89	146	6	28	-	-	5	9	15	14	23	64	71	121	71	125	-	-	-	24	89	-	-	-	-	304	596	
Total Day3			-	4	139	185	47	56	-	4	139	99	332	304	190	308	711	673	239	221	1	-	-	32	329	398	-	-	-	-	2,127	2,284	
Total			-	5	526	540	138	135	-	4	357	299	985	793	585	616	2,289	1,845	712	712	5	1	1	32	1,078	1,014	-	-	-	-	6,676	5,996	
Grand Total (a+b)			-	5	1,066	1,066	273	273	-	4	656	656	1,778	1,778	1,201	1,201	4,134	4,134	1,424	1,424	-	-	6	33	2,092	2,092	-	-	-	-	12,672	12,672	
Average Daily Traffic (ADT)			-	2	355	355	91	91	-	1	219	219	593	593	400	400	1,378	1,378	475	475	-	-	2	11	697	697	-	-	-	-	4,224	4,224	
Composition (%)			0%	0%	8%	8%	2%	2%	0%	0%	5%	5%	14%	14%	9%	9%	33%	33%	11%	11%	0%	0%	0%	0%	17%	17%	0%	0%	0%	0%	-	-	
Total ADT excl. MC & Rickshaws			2846																														
Composition excl. MC, rickshaws (%)			0%	0%	12%	12%	3%	3%	0%	0%	8%	8%	21%	21%	14%	14%	-	-	17%	17%	0%	0%	0%	0%	25%	25%	0%	0%	-	-	-	-	
Average Annual Daily Traffic (AADT)			-	2	330	330	85	85	-	1	203	203	551	551	372	372	1,282	1,282	441	441	-	-	2	10	649	649	-	-	-	-	3,928	3,928	
AADT excl. MC, Rickshaws			-	2	330	330	85	85	-	1	203	203	551	551	372	372	-	-	441	441	-	-	2	10	649	649	-	-	-	-	2,647	2,647	
PCU Factors			-	4.00	3.00	3.00	1.50	1.50	-	3.00	2.50	1.50	1.50	1.50	1.00	1.00	0.50	0.50	1.00	1.00	-	-	1.50	0.75	1.00	1.50	1.00	1.00	2.00	-	-	-	-
AADT in PCUs			-	6	991	991	127	127	-	4	508	508	827	827	372	372	641	641	441	441	-	-	3	8	649	649	-	-	-	-	4,577	4,577	
AADT in PCUs excl. MC & Rickshaws			-	6	991	991	127	127	-	4	508	508	827	827	372	372	-	-	441	441	-	-	3	8	649	649	-	-	-	-	3,936	3,936	

ANNEX-4.3 : **KHURKOT NEAR OLD BUS PARK**

Station name: Khurkot near Old Bus Park

Route: Dhulikhel<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	16	0	10	5	0	0	2	59	2	13	106
7:00-8:00	49	0	3	3	0	1	1	71	4	20	150
8:00-9:00	50	0	4	16	0	0	0	129	1	18	218
9:00-10:00	77	0	18	41	0	0	1	120	2	24	280
10:00-11:00	84	0	12	95	0	0	1	108	2	21	323
11:00-12:00	103	0	19	97	0	0	0	105	3	22	347
12:00-13:00	87	0	11	108	0	1	0	86	1	20	312
13:00-14:00	79	0	4	91	0	0	1	115	4	21	314
14:00-15:00	68	0	5	48	0	0	1	108	0	25	254
15:00-16:00	67	0	4	26	0	0	0	94	1	19	210
16:00-17:00	53	0	2	10	0	0	1	88	2	22	177
17:00-18:00	55	0	4	10	0	1	3	90	2	25	189
18:00-19:00	42	0	5	4	0	2	2	76	1	20	150
19:00-20:00	41	0	8	13	0	2	3	63	1	16	145
20:00-21:00	20	0	2	6	0	9	6	38	1	12	93
21:00-22:00	20	1	0	0	0	6	4	21	1	17	69
22:00-23:00	18	0	0	1	0	12	1	5	0	17	53
23:00-00:00	10	0	0	1	0	10	4	2	0	12	38
00:00-01:00	11	0	1	0	0	20	3	4	0	24	62
01:00-02:00	5	0	0	0	0	14	3	0	0	16	37
02:00-03:00	3	0	0	0	0	16	1	1	0	12	32
03:00-04:00	3	0	0	0	0	4	1	2	0	7	17
04:00-05:00	4	0	0	0	0	6	2	5	0	7	22
05:00-06:00	8	0	3	2	0	6	1	12	0	13	43
Total	968	1	113	574	0	107	36	1396	24	418	3635

Station name: Khurkot near Old Bus Park

Route: Dhulikhel<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	18	0	9	10	0	3	0	45	3	7	95
7:00-8:00	35	0	0	2	0	0	0	83	0	15	135
8:00-9:00	47	0	6	12	0	0	1	93	4	19	182
9:00-10:00	61	0	15	43	0	1	0	118	2	14	254
10:00-11:00	84	0	19	73	0	0	0	108	3	20	307
11:00-12:00	98	0	9	79	0	1	0	101	3	23	314
12:00-13:00	83	0	11	97	0	0	0	129	1	26	347
13:00-14:00	76	0	5	76	0	0	0	115	25	24	321
14:00-15:00	60	0	8	37	0	2	0	133	2	29	271
15:00-16:00	77	0	12	24	0	0	0	86	0	22	221
16:00-17:00	54	0	1	14	0	0	3	115	3	24	214
17:00-18:00	66	0	6	7	0	0	0	91	1	18	189
18:00-19:00	39	0	3	9	0	0	1	53	3	17	125
19:00-20:00	32	0	6	14	0	0	0	33	3	15	103
20:00-21:00	19	0	1	5	0	12	0	28	0	13	78
21:00-22:00	16	0	0	0	0	5	0	19	0	16	56
22:00-23:00	10	0	0	1	0	8	1	12	0	10	42
23:00-00:00	7	0	0	1	0	11	1	2	0	11	33
00:00-01:00	9	0	0	1	0	23	1	1	1	25	61
01:00-02:00	8	0	0	0	0	9	1	1	0	23	42
02:00-03:00	6	0	0	0	0	8	2	2	0	25	43
03:00-04:00	3	0	0	1	0	4	1	0	0	10	19
04:00-05:00	2	0	0	0	0	4	1	4	0	5	16
05:00-06:00	12	0	1	1	0	2	0	17	0	5	38
Total	922	0	112	507	0	93	13	1389	54	416	3506

KHURKOT NEAR OLD BUS PARK

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
VEHICLE COUNT SURVEY - Dhulikhel to Sindhuli and Sindhuli to Dhulikhel

Surveyed and Supervised By: **Soil Test P.Ltd**



Flow of Vehicles

a = Direction of the movement of vehicle from	Dhulikhel to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to Dhulikhel

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Khurkot near Old Bus Park

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total					
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
13th June 2019	06:00	07:00	-	-	-	0	1	1	-	-	-	11	-	5	-	-	24	28	4	9	1	-	1	1	7	8	-	-	-	-	-	38	63	
	07:00	08:00	-	-	1	-	-	-	-	-	1	2	1	-	6	2	43	26	5	4	-	2	4	3	10	13	-	-	-	-	-	71	52	
	08:00	09:00	-	-	-	-	-	-	-	-	3	2	15	3	14	2	74	48	11	6	-	-	2	1	23	12	-	-	-	-	-	142	74	
	09:00	10:00	-	-	-	-	-	-	-	-	13	2	42	3	12	2	66	52	11	10	-	-	2	2	39	15	-	-	-	-	-	185	86	
	10:00	11:00	-	-	-	-	-	-	-	-	4	3	77	10	10	3	56	40	15	3	-	2	-	1	40	27	-	-	-	-	-	202	89	
	11:00	12:00	-	-	-	-	-	-	-	-	6	13	59	41	15	13	45	61	12	9	-	2	-	-	48	48	-	-	-	-	-	185	187	
	12:00	13:00	-	-	-	1	-	-	-	-	4	8	25	79	8	12	38	49	13	7	-	-	1	1	16	43	-	-	-	-	-	105	200	
	13:00	14:00	-	-	-	-	-	-	-	-	1	2	7	81	7	21	35	79	12	8	3	1	1	1	18	28	-	-	-	-	-	84	221	
	14:00	15:00	-	-	-	-	-	-	-	-	2	3	8	32	6	18	37	52	18	6	-	-	1	-	8	29	-	-	-	-	-	80	140	
	15:00	16:00	-	-	-	-	-	-	-	-	4	2	7	11	6	17	42	45	7	6	-	-	1	-	19	19	-	-	-	-	-	86	100	
	16:00	17:00	-	-	-	-	-	1	-	-	2	1	6	3	7	13	53	46	14	3	-	1	-	-	14	11	-	-	-	-	-	96	79	
	17:00	18:00	-	-	-	-	1	1	-	-	3	-	10	1	11	9	47	43	5	10	1	1	2	4	11	22	-	-	-	-	-	91	91	
	Sub Total																																	
	6:00-18:00 hrs			-	-	1	1	2	3	-	-	43	49	257	269	102	112	560	569	127	81	5	9	15	14	253	275	-	-	-	-	-	1365	1382
	14th June 2019	18:00	19:00	-	0	0	2	-	-	-	-	5	-	4	-	2	14	31	31	6	5	-	-	3	2	10	6	-	-	-	-	-	61	60
		19:00	20:00	-	-	-	-	-	-	-	-	8	-	13	2	2	9	26	25	6	8	1	-	2	1	8	13	-	-	-	-	-	66	58
		20:00	21:00	-	-	-	2	9	1	-	-	3	0	4	1	2	3	11	15	7	4	1	-	1	-	11	4	-	-	-	-	-	49	30
		21:00	22:00	-	-	-	3	3	1	-	-	-	-	-	-	-	8	12	7	3	6	2	-	-	-	3	-	-	-	-	-	-	23	25
22:00		23:00	-	-	-	8	1	-	-	-	-	-	-	1	6	4	-	1	4	10	-	-	-	-	4	3	-	-	-	-	-	15	27	
23:00		00:00	-	-	2	3	2	2	-	-	-	-	1	1	1	-	1	1	5	5	-	-	-	-	8	1	-	-	-	-	-	20	13	
00:00		01:00	-	-	14	1	-	1	-	-	1	-	-	-	3	2	5	1	7	18	-	-	-	-	3	3	-	-	-	-	-	33	26	
01:00		02:00	-	-	6	7	1	1	-	-	-	-	-	-	3	-	-	-	4	13	-	-	-	-	-	2	-	-	-	-	-	14	23	
02:00		03:00	-	-	8	11	-	-	-	-	-	-	-	-	-	1	-	2	1	13	-	-	-	-	-	-	-	-	-	-	-	9	27	
03:00		04:00	-	-	1	6	-	1	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	2	-	-	-	-	-	1	15	
04:00		05:00	-	-	3	3	1	2	-	-	-	-	-	-	2	1	2	1	3	5	-	-	-	-	-	2	-	-	-	-	-	11	14	
05:00		06:00	-	-	3	2	1	-	-	-	-	3	-	1	-	-	4	2	12	3	9	-	-	-	1	2	-	-	-	-	-	10	33	
Sub Total																																		
18:00-6:00 hrs			-	-	37	48	18	9	-	-	17	3	22	6	21	46	90	96	49	102	4	-	6	3	48	38	-	-	-	-	-	312	351	
Total Day1			-	-	38	49	20	12	-	-	60	52	279	275	123	158	650	665	176	183	9	9	21	17	301	313	-	-	-	-	-	1677	1733	
14th June 2019		06:00	07:00	0	0	-	-	-	1	-	-	-	9	1	3	7	2	29	37	3	5	1	2	1	1	5	3	-	-	-	-	-	47	63
		07:00	08:00	-	-	-	-	1	-	-	-	2	1	1	4	15	14	32	40	11	6	3	3	3	3	24	14	-	-	-	-	-	92	85
		08:00	09:00	-	-	-	-	-	-	-	-	2	1	9	5	13	8	86	49	8	6	1	1	1	1	22	6	-	-	-	-	-	142	77
	09:00	10:00	-	-	-	-	1	-	-	-	12	8	33	3	19	6	73	48	11	9	1	2	1	1	41	19	-	-	-	-	-	192	96	
	10:00	11:00	-	-	-	-	1	1	-	-	12	5	91	12	14	9	67	53	17	6	1	1	-	-	40	24	-	-	-	-	-	243	111	
	11:00	12:00	-	-	-	-	-	-	-	-	8	11	50	43	13	5	54	49	10	12	1	2	-	-	36	28	-	-	-	-	-	172	150	
	12:00	13:00	-	-	-	-	-	-	-	-	3	7	31	80	15	16	34	51	9	6	1	-	1	2	18	45	-	-	-	-	-	112	207	
	13:00	14:00	-	-	-	-	-	1	-	-	4	1	11	83	7	15	36	79	13	4	1	3	2	1	20	41	-	-	-	-	-	94	228	
	14:00	15:00	-	-	-	-	1	-	-	-	5	-	7	48	8	18	44	83	9	12	-	-	2	2	14	35	-	-	-	-	-	90	198	
	15:00	16:00	-	-	-	-	-	-	-	-	1	1	13	21	9	23	52	48	13	11	1	-	-	-	15	25	-	-	-	-	-	104	129	
	16:00	17:00	-	-	-	-	1	-	-	-	-	-	9	2	13	11	43	34	22	5	-	2	-	-	15	21	-	-	-	-	-	103	75	
	17:00	18:00	-	-	1	1	4	-	-	-	2	3	7	2	12	14	53	36	16	9	1	1	-	3	18	13	-	-	-	-	-	114	82	
	Sub Total																																	
	6:00-18:00 hrs			-	-	1	1	9	3	-	-	51	47	263	306	145	141	603	607	142	91	12	17	11	14	268	274	-	-	-	-	-	1505	1501
14th June 2019	18:00	19:00	0	0	2	-	3	-	-	-	3	2	2	1	4	12	45	44	13	5	1	-	4	2	12	23	-	-	-	-	-	89	89	
	19:00	20:00	-	-	2	2	1	4	-	-	7	-	9	2	8	11	38	37	10	3	-	-	-	1	12	18	-	-	-	-	-	87	78	
	20:00	21:00	-	-	15	1	-	1	-	-	1	-	6	1	3	9	37	13	5	7	-	-	-	-	3	4	-	-	-	-	-	70	36	
	21:00	22:00	-	-	8	1	1	2	2	-	-	-	-	-	7	9	16	7	9	15	-	-	-	-	9	4	-	-	-	-	-	52	38	
	22:00	23:00	-	-	5	11	1	-	-	-	-	-	1	-	4	3	4	4	8	11	-	-	-	-	6	6	-	-	-	-	-	29	35	
	23:00	00:00	-	-	5	9	2	2	-	-	-	-	-	-	2	2	1	-	10	4	-	-	-	-	1	4	-	-	-	-	-	21	21	

Station name: Khurkot near Old Bus Park

Route: Manthali<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	3	0	2	1	0	16	1	13	2	3	39
7:00-8:00	2	0	0	0	0	5	0	11	1	2	21
8:00-9:00	3	0	0	1	0	2	0	16	1	2	25
9:00-10:00	3	0	3	1	0	1	0	19	1	2	29
10:00-11:00	3	0	1	1	0	1	0	14	1	3	22
11:00-12:00	3	0	1	1	0	0	0	18	0	3	26
12:00-13:00	3	0	1	1	0	0	0	17	0	2	24
13:00-14:00	5	0	1	1	0	0	0	14	1	3	24
14:00-15:00	4	0	1	1	0	1	0	15	1	3	25
15:00-16:00	2	0	1	1	0	0	0	19	0	3	26
16:00-17:00	2	0	1	1	0	0	0	18	0	4	25
17:00-18:00	4	0	0	1	0	0	0	19	0	3	28
18:00-19:00	2	0	0	0	0	1	0	13	1	2	19
19:00-20:00	4	0	0	0	0	0	0	12	1	4	20
20:00-21:00	2	0	0	0	0	9	1	11	1	2	25
21:00-22:00	1	0	0	0	0	20	5	2	0	1	30
22:00-23:00	1	0	0	0	0	6	1	4	1	1	12
23:00-00:00	1	0	0	0	0	11	3	1	0	1	16
00:00-01:00	2	0	0	1	0	9	0	6	0	2	18
01:00-02:00	2	0	1	1	0	4	0	5	0	1	13
02:00-03:00	2	0	1	1	0	5	0	4	1	1	13
03:00-04:00	1	0	0	0	0	4	0	4	0	1	10
04:00-05:00	1	0	0	0	0	11	1	7	0	1	21
05:00-06:00	2	0	0	0	0	11	1	7	0	1	21
Total	52	0	13	14	1	116	12	266	11	48	531

Station name: Khurkot near Old Bus Park

Route: Manthali<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	5	0	2	0	0	35	0	21	1	7	71
7:00-8:00	5	0	0	0	0	14	1	27	1	7	55
8:00-9:00	8	0	1	1	0	5	1	25	0	2	43
9:00-10:00	6	0	3	5	0	3	0	27	2	9	55
10:00-11:00	4	0	4	3	0	0	0	26	3	3	43
11:00-12:00	12	0	0	0	0	2	0	21	3	5	43
12:00-13:00	5	0	1	3	0	0	0	25	2	5	41
13:00-14:00	9	0	1	3	0	0	0	38	0	9	60
14:00-15:00	7	0	3	4	0	0	0	29	2	10	55
15:00-16:00	6	0	0	3	0	0	0	21	1	3	34
16:00-17:00	4	0	1	2	0	1	0	42	0	2	52
17:00-18:00	16	0	1	0	0	0	0	30	2	6	55
18:00-19:00	6	0	0	0	0	2	1	26	0	6	41
19:00-20:00	9	0	0	0	0	0	0	36	0	3	48
20:00-21:00	2	0	0	0	0	22	0	15	0	6	45
21:00-22:00	2	0	0	0	0	19	2	5	0	6	34
22:00-23:00	0	0	0	0	0	14	3	4	0	0	21
23:00-00:00	2	0	0	0	0	14	6	3	0	2	27
00:00-01:00	2	0	0	0	0	13	9	1	0	2	27
01:00-02:00	0	0	0	0	0	3	1	0	0	0	4
02:00-03:00	1	0	0	0	0	9	0	0	0	0	10
03:00-04:00	0	0	0	1	0	6	0	0	0	0	7
04:00-05:00	0	0	0	0	0	22	0	0	0	0	22
05:00-06:00	1	0	0	1	0	13	0	7	1	1	24
Total	112	0	17	26	0	197	24	429	18	94	917

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Manthali to Sindhuli and Sindhuli to Manthali

Surveyed and Supervised By: **Soil Test P.Ltd**



KHURKOT NEAR OLD BUS PARK

Flow of Vehicles

a = Direction of the movement of vehicle from	Manthali to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to Manthali

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Khurkot near Old Bus Park

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																																
			Multi-axle Truck		Truck Heavy		Light		Big		Bus Mini		Micro		Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total		
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a
13th June 2019	06:00	07:00	-	-	-	11	-	-	-	-	-	-	2	1	-	-	-	6	3	2	1	-	1	-	-	2	-	-	-	-	-	-	-	11	18
	07:00	08:00	-	-	-	9	-	-	-	-	-	-	-	-	-	1	7	9	-	1	1	2	2	2	3	-	-	-	-	-	-	-	13	24	
	08:00	09:00	-	-	-	4	-	-	-	-	-	-	-	-	-	2	1	16	11	1	4	-	-	2	1	5	-	-	-	-	-	-	26	21	
	09:00	10:00	-	-	-	2	-	-	-	-	-	-	3	2	3	-	1	14	15	2	3	-	-	-	1	1	1	-	-	-	-	-	24	25	
	10:00	11:00	-	-	1	-	-	-	-	-	-	1	-	2	1	-	5	17	14	2	1	1	-	1	-	1	1	-	-	-	-	-	26	22	
	11:00	12:00	-	-	-	-	-	-	-	-	-	-	1	-	1	2	3	23	15	3	4	-	-	1	-	2	2	-	-	-	-	-	31	26	
	12:00	13:00	-	-	1	-	-	-	-	-	-	1	1	-	2	-	1	14	18	3	-	-	-	-	2	2	-	-	-	-	-	-	21	24	
	13:00	14:00	-	-	1	-	-	-	-	-	-	1	1	2	2	2	1	13	9	2	5	-	2	-	-	6	3	-	-	-	-	-	27	23	
	14:00	15:00	-	-	2	-	-	-	-	-	-	2	2	1	1	4	-	14	11	3	1	1	-	2	1	5	2	-	-	-	-	-	34	18	
	15:00	16:00	-	-	-	-	-	-	-	-	-	-	2	1	-	1	1	11	15	2	2	-	-	-	1	-	-	-	-	-	-	-	16	20	
	16:00	17:00	-	-	-	-	-	-	-	-	-	-	-	1	1	1	15	14	5	3	-	-	1	1	2	-	-	-	-	-	-	-	26	19	
	17:00	18:00	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	21	12	4	2	-	-	-	-	2	3	-	-	-	-	-	28	19	
	Sub Total 6:00-18:00 hrs			-	-	5	26	-	-	-	-	9	11	11	10	14	14	171	146	29	27	3	5	9	6	32	14	-	-	-	-	-	-	283	259
	14th June 2019	18:00	19:00	0	-	3	-	-	-	-	-	-	-	-	1	1	-	11	18	1	2	-	-	-	-	3	-	-	-	-	-	-	16	24	
		19:00	20:00	-	-	-	-	-	-	-	-	-	-	-	-	2	-	13	9	2	1	-	-	-	-	2	2	-	-	-	-	-	19	12	
		20:00	21:00	-	1	33	1	1	-	-	-	-	-	-	-	-	-	10	13	2	1	-	-	-	1	1	2	-	-	-	-	-	47	19	
21:00		22:00	-	-	31	-	12	-	-	-	-	-	-	-	-	-	3	1	-	1	-	1	-	2	-	-	-	-	-	-	-	46	5		
22:00		23:00	-	1	10	1	1	-	-	-	-	-	-	-	1	-	4	5	-	-	-	-	-	1	-	4	-	-	-	-	-	16	12		
23:00		00:00	-	-	9	24	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	24		
00:00		01:00	-	-	5	13	-	-	-	-	-	-	-	-	-	-	2	2	1	1	-	-	-	-	1	1	-	-	-	-	-	9	17		
01:00		02:00	-	-	2	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	3	10		
02:00		03:00	-	-	3	10	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	5	11		
03:00		04:00	-	-	-	10	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	11		
04:00		05:00	-	-	15	15	4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	15		
05:00		06:00	-	-	8	23	1	1	-	-	-	-	-	-	-	-	4	1	-	1	1	-	-	-	-	-	-	-	-	-	-	14	26		
Sub Total 18:00-6:00 hrs			-	2	119	107	24	1	-	-	1	-	1	4	1	49	49	6	7	1	1	-	4	6	12	-	-	-	-	-	-	209	186		
Total Day1			-	2	124	133	24	1	-	-	9	12	11	11	18	15	220	195	35	34	4	6	9	10	38	26	-	-	-	-	-	492	445		
14th June 2019		06:00	07:00	0	0	-	20	-	1	-	-	-	2	-	-	-	-	12	4	2	-	3	-	1	-	3	-	-	-	-	-	21	27		
		07:00	08:00	-	-	1	11	-	-	-	-	-	-	1	-	1	-	13	15	2	1	1	-	-	-	2	-	-	-	-	-	19	29		
	08:00	09:00	-	-	-	4	-	-	-	-	1	-	3	-	-	-	18	19	-	1	2	2	-	1	2	-	-	-	-	-	25	28			
	09:00	10:00	-	-	1	2	-	-	-	-	3	2	2	-	3	1	19	29	1	-	1	2	-	-	2	2	-	-	-	-	30	38			
	10:00	11:00	-	-	2	-	-	-	-	-	1	1	2	-	-	-	13	10	4	2	-	2	-	-	2	1	-	-	-	-	24	16			
	11:00	12:00	-	-	-	-	-	-	-	-	1	1	1	2	2	-	21	14	-	4	-	-	-	-	2	-	-	-	-	-	25	23			
	12:00	13:00	-	-	-	-	-	-	-	-	-	1	-	1	-	1	20	17	3	2	-	-	-	-	1	4	-	-	-	-	24	26			
	13:00	14:00	-	-	-	-	-	-	-	-	1	-	1	-	2	-	15	18	1	1	-	-	1	2	3	-	-	-	-	-	23	24			
	14:00	15:00	-	-	-	-	-	-	-	-	-	1	1	1	-	-	17	17	2	1	1	1	1	1	6	-	-	-	-	-	28	21			
	15:00	16:00	-	-	-	-	-	-	-	-	1	2	1	3	1	-	32	18	2	2	-	-	-	2	2	3	-	-	-	-	39	30			
	16:00	17:00	-	-	-	-	1	-	-	-	1	1	-	-	-	3	19	23	2	3	-	-	1	-	1	1	-	-	-	-	25	31			
	17:00	18:00	-	-	1	-	-	-	-	-	-	-	1	2	3	2	25	19	2	1	-	1	2	-	1	3	-	-	-	-	35	28			
	Sub Total 6:00-18:00 hrs			-	-	5	37	1	1	-	-	9	11	13	8	12	7	224	203	21	18	8	8	6	5	19	23	-	-	-	-	318	321		
	18:00	19:00	0	0	-	-	-	1	-	-	1	-	-	-	-	-	12	10	3	-	2	1	1	1	1	1	-	-	-	-	20	14			
	19:00	20:00	-	-	-	-	-	1	-	-	-	-	-	-	1	-	13	12	4	5	1	2	1	2	1	2	-	-	-	-	22	28			
	20:00	21:00	-	-	-	-	-	1	-	-	-	-	-	-	-	2	8	13	1	4	1	1	-	-	1	-	-	-	-	-	11	21			
21:00	22:00	-	-	50	-	9	-	-	-	-	-	-	1	1	-	1	3	-	-	-	-	-	1	-	3	-	-	-	-	61	8				
22:00	23:00	-	-	9	2	-	1	-	-	-	-	-	-	-	-	2	3	-	1	1	1	-	-	-	-	-	-	-	-	12	8				
23:00	00:00	-	-	1	9	1	5	-	-	-	-	-	-	-	1	2	2	3	1	-	-	-	-	1	-	-	-	-	-	8	18				

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Manthali to Sindhuli and Sindhuli to Manthali

Surveyed and Supervised By: **Soil Test P.Ltd**



KHURKOT NEAR OLD BUS PARK

Flow of Vehicles

a = Direction of the movement of vehicle from	Manthali to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to Manthali

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Khurkot near Old Bus Park

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Multi-axle Truck		Truck Heavy		Light		Big		Bus Mini		Micro		Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total	
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
15th June 2019	00:00	01:00	-	-	-	16	-	-	-	-	-	-	2	-	1	-	20	-	4	-	1	-	-	-	2	1	-	-	-	-	-	-	30	17
	01:00	02:00	-	-	-	5	-	-	-	-	1	1	3	-	-	-	19	-	4	-	-	-	-	-	5	-	-	-	-	-	-	32	6	
	02:00	03:00	-	-	-	6	-	-	-	-	1	-	2	-	2	-	15	1	2	-	2	-	2	-	3	1	-	-	-	-	-	29	8	
	03:00	04:00	-	-	-	7	-	-	-	-	-	-	1	-	-	-	15	-	2	-	-	-	-	-	2	-	-	-	-	-	-	20	7	
	04:00	05:00	-	-	-	14	-	-	-	-	1	-	-	-	2	-	25	-	2	-	-	-	-	1	-	2	-	-	-	-	-	33	14	
	05:00	06:00	-	-	-	14	-	-	-	-	1	-	-	-	2	-	20	1	2	-	-	-	-	1	-	4	-	-	-	-	-	30	15	
	Sub Total 18:00-6:00 hrs			-	-	60	73	11	8	-	-	5	1	8	2	9	7	152	45	27	11	8	5	6	4	22	8	-	-	-	-	308	164	
	Total Day2			-	-	65	110	12	9	-	-	14	12	21	10	21	14	376	248	48	29	16	13	12	9	41	31	-	-	-	-	626	485	
	06:00	07:00	-	-	-	35	-	-	-	-	-	2	-	-	-	1	11	10	2	1	1	-	2	2	1	3	-	-	-	-	-	17	54	
	07:00	08:00	-	-	2	12	-	1	-	-	-	-	-	-	2	20	7	2	1	1	-	2	2	1	2	1	2	-	-	-	-	28	27	
	08:00	09:00	-	-	-	5	-	1	-	-	-	1	1	-	1	14	11	-	2	-	-	-	-	4	3	-	-	-	-	-	-	19	24	
	09:00	10:00	-	-	-	3	-	-	-	-	2	1	4	1	-	1	11	16	2	3	2	-	2	2	4	1	-	-	-	-	-	27	28	
	10:00	11:00	-	-	-	-	-	-	-	-	3	1	3	-	-	-	12	14	-	2	1	2	1	-	3	1	-	-	-	-	-	23	20	
	11:00	12:00	-	-	1	1	-	-	-	-	-	-	-	-	4	1	13	8	-	2	1	2	1	2	3	4	-	-	-	-	-	23	20	
	12:00	13:00	-	-	-	-	-	-	-	-	-	1	3	-	1	2	17	8	3	2	1	1	-	-	2	-	-	-	-	-	-	27	14	
	13:00	14:00	-	-	-	-	-	-	-	-	1	-	2	1	-	-	19	19	4	5	-	-	-	-	5	4	-	-	-	-	-	31	29	
	14:00	15:00	-	-	-	-	-	-	-	-	1	2	2	2	1	1	16	13	1	5	2	-	2	2	3	2	-	-	-	-	-	28	27	
	15:00	16:00	-	-	-	-	-	-	-	-	-	-	1	2	-	2	13	8	2	1	-	1	-	-	2	2	-	-	-	-	-	18	16	
	16:00	17:00	-	-	-	1	-	-	-	-	1	-	2	2	1	-	21	21	1	-	-	-	1	-	2	1	-	-	-	-	-	29	23	
	17:00	18:00	-	-	-	-	-	-	-	-	1	-	-	-	6	1	22	8	3	2	-	2	-	1	4	5	-	-	-	-	-	36	19	
Sub Total 6:00-18:00 hrs			-	-	3	57	-	2	-	-	9	8	18	6	13	12	189	143	20	26	9	8	11	11	34	28	-	-	-	-	306	301		
18:00	19:00	-	-	2	-	-	1	-	-	-	-	-	-	2	-	11	15	5	1	-	-	-	-	4	-	-	-	-	-	-	20	21		
19:00	20:00	-	-	-	-	-	-	-	-	-	-	-	-	4	2	20	16	1	1	-	-	1	-	1	2	-	-	-	-	-	27	21		
20:00	21:00	-	-	22	-	-	-	-	-	-	-	-	-	1	-	10	5	3	1	-	-	1	1	-	1	-	-	-	-	-	37	8		
21:00	22:00	-	-	19	-	2	-	-	-	-	-	-	-	-	-	3	2	3	1	-	-	1	1	2	-	-	-	-	-	-	30	4		
22:00	23:00	-	-	14	-	2	1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	18	3		
23:00	00:00	-	-	6	8	-	6	-	-	6	-	-	-	-	-	1	2	1	1	-	-	-	-	2	-	-	-	-	-	-	10	17		
16th June 2019	00:00	01:00	-	-	3	10	2	7	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	1	1	-	-	-	-	-	9	18		
	01:00	02:00	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3		
	02:00	03:00	-	-	5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	5	5		
	03:00	04:00	-	-	4	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2		
	04:00	05:00	-	-	13	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	9		
	05:00	06:00	-	-	7	6	-	-	-	-	-	-	1	-	-	-	7	-	-	1	1	-	-	-	1	-	-	-	-	-	17	7		
Sub Total 18:00-6:00 hrs			-	-	96	41	6	16	-	-	-	2	-	7	2	55	42	15	6	1	-	3	2	7	9	-	-	-	-	-	192	118		
Total Day3			-	-	99	98	6	18	-	-	9	8	20	6	20	14	244	185	35	32	10	8	14	13	41	37	-	-	-	-	498	419		
Total			-	2	288	341	42	28	-	-	32	32	52	27	59	43	840	628	118	95	30	27	35	32	120	94	-	-	-	-	1,616	1,349		
Grand Total (a+b)			2	2	629	629	70	70	-	-	64	64	79	79	102	102	1,468	1,468	213	213	57	57	67	67	214	214	-	-	-	-	2,965	2,965		
Average Daily Traffic (ADT)			1	1	210	210	23	23	-	-	21	21	26	26	34	34	489	489	71	71	19	19	22	22	71	71	-	-	-	-	988	988		
Composition (%)			0%	0%	21%	21%	2%	2%	0%	0%	2%	2%	3%	3%	3%	3%	50%	50%	7%	7%	2%	2%	2%	2%	7%	7%	0%	0%	0%	0%	-	-		
Total ADT excl. MC & Rickshaws			499																															
Composition excl. MC, rickshaws (%)			0%	0%	42%	42%	5%	5%	0%	0%	4%	4%	5%	5%	7%	7%	-	-	14%	14%	4%	4%	4%	4%	14%	14%	0%	0%	-	-	0%	0%		
Average Annual Daily Traffic (AADT)			1	1	195	195	22	22	-	-	20	20	24	24	32	32	455	455	66	66	18	18	21	21	66	66	-	-	-	-	919	919		
AADT excl. MC, Rickshaws			1	1	195	195	22	22	-	-	20	20	24	24	32	32	-	-	66	66	18	18	21	21	66	66	-	-	-	-	464	464		
PCU Factors			4.00	4.00	3.00	3.00	1.50	1.50	3.00	3.00	2.50	2.50	1.50	1.50	1.00	1.00	0.50	0.50	1.00	1.00	1.50	1.50	0.75	0.75	1.00	1.00	1.50	1.50	1.00	1.00	-	-		
AADT in PCUs			2	2	585	585	33	33	-	-	50	50	37	37	32	32	228	228	66	66	27	27	16	16	66	66	-	-	-	-	1,140	1,140		
AADT in PCUs excl. MC & Rickshaws			2	2	585	585	33	33	-	-	50	50	37	37	32	32	-	-	66	66	27	27	16	16	66	66	-	-	-	-	912	912		

Station name: Khurkot near Old Bus Park

Route: Dhulikhel<->Manthali

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	2	0	0	0	0	3	0	9	7	3	22
7:00-8:00	1	0	0	0	0	2	1	10	3	1	16
8:00-9:00	6	0	2	1	0	3	1	14	5	3	33
9:00-10:00	19	0	7	3	0	2	1	14	1	3	48
10:00-11:00	18	0	16	2	0	2	1	14	2	6	59
11:00-12:00	12	0	17	3	0	2	2	19	2	2	57
12:00-13:00	15	0	6	2	0	2	2	12	1	6	44
13:00-14:00	8	0	4	1	0	1	0	18	3	3	37
14:00-15:00	7	0	1	2	0	3	1	14	3	5	35
15:00-16:00	4	0	2	3	0	2	0	15	4	2	31
16:00-17:00	7	0	1	0	0	0	0	20	5	3	35
17:00-18:00	3	0	0	1	0	2	1	19	1	2	27
18:00-19:00	4	0	0	1	0	5	1	25	2	5	41
19:00-20:00	7	0	0	0	0	9	1	13	0	6	35
20:00-21:00	4	0	0	0	0	7	1	5	0	4	21
21:00-22:00	2	0	0	0	0	5	1	3	0	1	10
22:00-23:00	0	0	0	0	0	4	1	0	0	1	5
23:00-00:00	1	0	0	0	0	5	1	0	0	1	7
00:00-01:00	1	0	0	0	0	7	0	0	0	1	8
01:00-02:00	0	0	0	0	0	1	0	0	0	0	1
02:00-03:00	1	0	0	0	0	4	0	0	0	0	4
03:00-04:00	0	0	0	0	0	1	0	0	0	0	1
04:00-05:00	0	0	0	0	0	2	1	0	0	0	3
05:00-06:00	0	0	0	0	0	2	1	4	1	0	8
Total	117	0	53	17	0	69	14	224	37	53	582

Station name: Khurkot near Old Bus Park

Route: Dhulikhel<->Manthali

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	1	0	0	0	0	2	1	7	2	1	14
7:00-8:00	2	0	0	0	0	5	0	9	4	1	21
8:00-9:00	1	0	1	0	0	1	0	13	2	3	21
9:00-10:00	10	0	4	3	0	1	0	11	2	1	32
10:00-11:00	6	0	14	1	0	1	1	8	6	6	43
11:00-12:00	6	0	14	5	0	1	0	6	1	4	37
12:00-13:00	7	0	5	2	0	2	0	9	1	3	29
13:00-14:00	5	0	3	0	0	1	0	16	0	3	28
14:00-15:00	6	0	1	1	0	1	2	16	3	4	34
15:00-16:00	7	0	1	1	0	5	0	19	1	2	36
16:00-17:00	5	0	0	1	0	1	1	15	2	3	28
17:00-18:00	5	0	0	0	0	0	0	13	4	3	25
18:00-19:00	3	0	0	0	0	4	0	10	20	2	39
19:00-20:00	4	0	0	0	0	3	0	9	0	2	18
20:00-21:00	2	0	0	0	0	2	0	5	0	3	12
21:00-22:00	0	0	0	0	0	10	0	3	0	2	15
22:00-23:00	0	0	0	0	0	7	0	2	0	3	12
23:00-00:00	0	0	0	0	0	1	0	0	0	1	2
00:00-01:00	0	0	0	0	0	2	0	0	0	0	2
01:00-02:00	0	0	0	0	0	1	0	0	0	0	1
02:00-03:00	0	0	0	0	0	3	0	0	0	0	3
03:00-04:00	0	0	0	0	0	1	0	1	0	0	2
04:00-05:00	0	0	0	0	0	2	0	2	0	0	4
05:00-06:00	1	0	0	0	0	6	1	0	2	2	12
Total	71	0	43	14	0	63	6	174	50	49	470

KHURKOT NEAR OLD BUS PARK

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Dhulikhel to Manthali and Manthali to Dhulikhel

Surveyed and Supervised By: **Soil Test P.Ltd**



Flow of Vehicles

a = Direction of the movement of vehicle from	Dhulikhel to Manthali
b = Direction of the movement of Vehicle from	Manthali to Dhulikhel

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)
To : 6am on 16th June 2019 (Sunday)

Station Name: Khurkot near Old Bus Park

Location: Intersection of B.P. Hwy (H06) & Arniko Hwy(H03)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Truck Multi-axle		Truck Heavy		Truck Light		Big		Bus Mini		Micro		Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total	
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
15th June 2019	00:00	01:00	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	1	
	01:00	02:00	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-		
	02:00	03:00	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	4		
	03:00	04:00	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
	04:00	05:00	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1		
	05:00	06:00	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	3		
	Sub Total			-	-	22	35	4	-	-	-	-	-	-	-	3	2	30	19	6	7	2	1	3	-	7	5	-	-	-	-	77	69	
	Total Day2			-	-	35	52	6	3	-	-	25	26	10	7	8	7	115	104	20	25	20	15	3	-	55	54	-	-	-	-	297	293	
	06:00	07:00	-	-	2	-	1	-	-	-	-	-	-	-	-	-	3	4	1	-	1	1	-	-	-	1	-	-	-	-	8	6		
	07:00	08:00	-	-	5	-	-	-	-	-	-	-	-	-	-	-	4	5	1	-	1	3	-	-	1	1	-	-	-	-	12	9		
	08:00	09:00	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	5	8	1	2	1	1	-	-	-	-	-	-	-	-	10	11	
	09:00	10:00	-	-	1	-	-	-	-	-	3	1	1	2	-	-	5	6	1	-	1	1	-	-	6	4	-	-	-	-	18	14		
	10:00	11:00	-	-	-	1	-	1	-	-	5	9	1	-	1	-	3	5	3	3	3	3	-	-	4	1	-	-	-	-	20	23		
	11:00	12:00	-	-	-	1	-	-	-	-	8	6	5	-	-	-	2	4	2	2	2	1	-	-	3	3	-	-	-	-	21	16		
	12:00	13:00	-	-	1	1	-	-	-	-	5	6	5	1	1	-	2	7	2	1	1	1	-	-	4	3	-	-	-	-	16	13		
	13:00	14:00	-	-	-	1	-	-	-	-	2	1	-	-	-	-	8	8	1	2	-	-	-	-	3	2	-	-	-	-	14	14		
	14:00	15:00	-	-	-	1	-	2	-	-	-	1	1	-	-	1	8	8	1	3	2	1	-	-	3	2	-	-	-	-	15	19		
	15:00	16:00	-	-	-	5	-	-	-	-	1	-	-	1	-	1	11	8	1	1	-	1	1	-	2	4	-	-	-	-	15	21		
	16:00	17:00	-	-	-	1	-	1	-	-	-	-	1	-	1	-	10	5	1	-	1	1	1	1	1	4	-	-	-	-	15	13		
	17:00	18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	7	6	1	-	2	2	2	-	3	-	-	-	-	16	9		
	Sub Total			-	-	10	11	1	4	-	-	25	18	10	4	4	3	68	74	16	14	14	14	3	1	29	25	-	-	-	-	180	168	
18:00	19:00	-	-	2	2	-	-	-	-	-	-	-	-	-	1	-	5	5	2	-	20	-	-	2	-	-	-	-	-	32	7			
19:00	20:00	-	-	1	2	-	-	-	-	-	-	-	-	-	3	-	6	3	1	1	-	-	-	1	-	-	-	-	-	12	6			
20:00	21:00	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	4	1	1	2	-	-	-	1	-	-	-	-	-	9	3			
21:00	22:00	-	-	2	8	-	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	7	8			
22:00	23:00	-	-	4	3	-	-	-	-	-	-	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	9	3			
23:00	00:00	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	-			
16th June 2019	00:00	01:00	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1			
	01:00	02:00	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-			
	02:00	03:00	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2			
	03:00	04:00	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2			
	04:00	05:00	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	2			
	05:00	06:00	-	-	5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	-	-	1	-	-	-	7	5			
	Sub Total			-	-	22	20	1	-	-	-	-	-	-	-	5	-	20	12	10	5	21	1	-	-	4	1	-	-	-	83	39		
Total Day3			-	-	32	31	2	4	-	-	25	18	10	4	9	3	88	86	26	19	35	15	3	1	33	26	-	-	-	-	263	207		
Total			-	-	84	116	14	19	-	-	76	73	30	17	25	20	354	268	71	72	77	46	8	4	144	116	-	-	-	-	883	751		
Grand Total (a+b)			-	-	200		33		-		149		47		45		622		143		123		12		260		-		-		1,634			
Average Daily Traffic (ADT)			-	-	67		11		-		50		16		15		207		48		41		4		87		-		-		545			
Composition (%)			-	-	0%		12%		2%		0%		9%		3%		3%		38%		9%		8%		1%		16%		0%		0%		0%	
Total ADT excl. MC & Rickshaws			337																															
Composition excl. MC, rickshaws (%)			0%	20%	3%	0%	15%	5%	4%	-	14%	12%	1%	26%	0%	-	0%	-																
Average Annual Daily Traffic (AADT)			-	62	10	-	46	15	14	193	44	38	4	81	-	-	-	-																
AADT excl. MC, Rickshaws			-	62	10	-	46	15	14	-	44	38	4	81	-	-	-	-																
PCU Factors			4.00	3.00	1.50	3.00	2.50	1.50	1.00	0.50	1.00	1.50	0.75	1.00	1.50	1.00	2.00	-																
AADT in PCUs			-	186	15	-	115	22	14	96	44	57	3	81	-	-	-	-																
AADT in PCUs excl. MC & Rickshaws			-	186	15	-	115	22	14	-	44	57	3	81	-	-	-	-																
Total			-	186	15	-	115	22	14	-	44	57	3	81	-	-	-	-																

ANNEX-4.4 : **KHURKOT CAUSEWAY No. 3**

Station name: Khurkot Causeway
 Route: Sindhuli<->Dhulikhel

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	13	0	11	2	0	20	1	37	3	8	93
7:00-8:00	33	0	0	3	0	10	1	40	2	12	99
8:00-9:00	30	0	6	11	0	4	0	82	3	14	148
9:00-10:00	41	0	15	36	0	2	0	86	3	13	195
10:00-11:00	48	0	12	90	0	2	0	78	8	19	255
11:00-12:00	74	0	10	108	0	2	0	81	1	19	293
12:00-13:00	63	0	5	111	0	1	0	63	0	13	255
13:00-14:00	60	0	4	89	0	0	0	85	3	18	258
14:00-15:00	52	0	5	46	0	0	1	72	3	24	201
15:00-16:00	58	0	3	17	0	0	0	73	2	20	172
16:00-17:00	47	0	3	10	0	0	0	66	3	18	146
17:00-18:00	37	0	1	4	0	0	1	51	3	14	109
18:00-19:00	34	0	2	4	0	2	1	50	3	15	109
19:00-20:00	29	0	5	10	0	2	1	40	2	18	105
20:00-21:00	19	0	8	9	0	9	2	15	2	15	77
21:00-22:00	17	0	0	0	0	70	7	8	0	12	113
22:00-23:00	14	0	0	0	0	16	6	5	0	14	54
23:00-00:00	10	0	0	1	0	33	6	1	0	12	62
00:00-01:00	7	0	0	0	1	18	18	3	0	22	67
01:00-02:00	8	0	1	0	0	12	17	0	0	14	52
02:00-03:00	9	0	2	0	0	6	11	2	0	16	44
03:00-04:00	4	0	1	0	0	6	12	4	0	8	33
04:00-05:00	4	0	1	1	0	16	17	2	0	5	45
05:00-06:00	5	0	3	4	0	17	19	6	0	10	63
Total	710	0	93	551	1	243	116	944	37	347	3040

Station name: Khurkot Causeway
 Route: Sindhuli<->Dhulikhel

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	17	0	10	2	0	16	2	23	2	11	83
7:00-8:00	16	0	0	1	0	5	1	34	1	13	71
8:00-9:00	29	0	8	11	0	3	0	64	2	12	129
9:00-10:00	33	0	11	33	0	5	0	82	1	13	178
10:00-11:00	51	0	13	75	0	0	0	60	8	19	226
11:00-12:00	38	0	7	62	0	1	0	38	4	9	159
12:00-13:00	61	0	5	106	0	0	0	98	3	21	294
13:00-14:00	62	0	2	73	0	0	0	80	4	27	248
14:00-15:00	50	0	4	32	0	1	0	103	3	26	219
15:00-16:00	58	0	3	21	0	0	0	83	4	25	194
16:00-17:00	49	0	2	13	0	1	0	72	2	19	158
17:00-18:00	57	0	5	7	0	0	0	63	1	18	151
18:00-19:00	25	0	3	6	0	2	1	32	1	25	95
19:00-20:00	23	0	7	15	0	2	0	31	0	13	91
20:00-21:00	17	0	1	3	0	12	0	14	0	8	55
21:00-22:00	14	0	0	1	0	47	3	4	0	18	87
22:00-23:00	6	0	0	0	0	18	11	2	0	12	49
23:00-00:00	3	0	0	1	0	12	23	2	0	10	51
00:00-01:00	7	0	0	1	0	45	4	1	0	24	82
01:00-02:00	7	0	0	0	0	17	2	0	0	21	47
02:00-03:00	5	0	0	0	0	19	1	1	0	20	46
03:00-04:00	3	0	0	0	0	12	0	0	0	8	23
04:00-05:00	2	0	0	0	0	33	0	1	1	6	43
05:00-06:00	8	0	0	0	0	30	1	21	0	6	66
Total	641	0	81	463	0	281	49	909	37	384	2845

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Dhulikhel to Sindhuli and Sindhuli to Dhulikhel

Surveyed and Supervised By: Soil Test P.Ltd

KHURKOT CAUSEWAY

Flow of Vehicles

a = Direction of the movement of vehicle from	Dhulikhel to Sindhuli
b = Direction of the movement of Vehicle from	Sindhuli to Dhulikhel

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Khurkot (Andheri Khola)

Location: Khurkot, Causeway No. 3

DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus						Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total			
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b				
15th June 2019	00:00	01:00	-	-	1	14	17	-	-	8	-	-	-	-	2	2	2	1	4	18	-	-	-	-	1	1	-	-	-	-	23	48		
	01:00	02:00	-	-	-	15	7	-	-	3	-	-	-	1	-	-	-	-	3	9	-	-	-	-	2	5	-	-	-	-	23	25		
	02:00	03:00	-	-	-	4	6	-	-	1	-	-	-	1	3	1	1	3	10	-	-	-	-	3	2	-	-	-	-	15	21			
	03:00	04:00	-	-	-	3	8	-	-	1	-	-	-	1	-	1	3	1	1	7	-	-	-	-	-	3	-	-	-	8	21			
	04:00	05:00	-	-	-	15	15	-	-	-	-	-	-	1	-	1	-	3	1	3	-	-	-	-	2	-	-	-	-	19	22			
	05:00	06:00	-	-	-	11	19	3	-	-	-	-	-	3	-	5	-	2	1	7	-	-	-	1	-	-	-	-	-	15	43			
	Sub Total																																	
	18:00-6:00 hrs			-	1	138	107	32	15	-	-	18	6	18	10	28	51	68	61	56	98	3	4	4	4	40	55	-	-	-	-	405	412	
	Total Day2			-	1	143	144	34	18	-	-	46	49	270	293	133	180	472	492	162	168	11	23	10	11	215	250	-	-	-	-	1,496	1,629	
	15th June 2019	06:00	07:00	-	-	-	1	15	-	2	-	-	-	10	-	2	5	1	14	9	5	2	-	2	2	5	6	-	-	-	-	32	51	
		07:00	08:00	-	-	-	1	4	-	1	-	-	-	-	-	1	9	2	24	10	7	4	-	1	2	2	3	-	-	-	-	43	28	
		08:00	09:00	-	-	-	-	3	-	-	-	-	4	4	6	5	18	4	37	27	9	3	2	-	-	2	5	-	-	-	-	78	51	
		09:00	10:00	-	-	-	-	5	-	-	-	-	5	6	32	1	9	4	46	36	7	6	-	1	-	6	14	-	-	-	-	105	73	
		10:00	11:00	-	-	-	-	-	-	-	-	-	5	8	63	12	16	5	26	34	9	7	-	3	-	15	15	-	-	-	-	138	88	
		11:00	12:00	-	-	-	1	-	-	-	-	-	6	1	59	3	14	-	32	6	8	1	3	1	-	23	1	-	-	-	-	146	13	
		12:00	13:00	-	-	-	-	-	-	-	-	-	1	4	37	69	8	9	40	58	14	6	2	1	1	17	27	-	-	-	-	120	174	
		13:00	14:00	-	-	-	-	-	-	-	-	-	2	7	66	11	9	36	44	11	11	1	3	1	4	16	26	-	-	-	-	83	165	
		14:00	15:00	-	-	-	1	-	-	-	-	-	2	2	8	24	6	20	42	61	12	12	2	1	1	9	15	-	-	-	-	83	136	
		15:00	16:00	-	-	-	-	-	-	-	-	-	3	6	15	7	20	29	54	10	13	1	3	2	-	16	15	-	-	-	-	71	123	
		16:00	17:00	-	-	-	-	1	-	-	-	-	1	1	11	2	4	16	30	42	6	11	2	-	2	9	20	-	-	-	-	63	95	
		17:00	18:00	-	-	-	-	-	-	-	-	-	5	4	3	8	23	24	39	6	6	1	-	3	3	18	8	-	-	-	-	64	87	
		Sub Total																																
		6:00-18:00 hrs			-	-	4	28	-	3	-	-	24	46	233	203	115	113	380	420	104	82	15	20	13	14	138	155	-	-	-	-	1,026	1,084
		15th June 2019	18:00	19:00	-	-	-	2	-	-	1	-	-	2	1	5	1	5	11	20	12	12	6	-	1	4	3	6	3	-	-	-	-	56
19:00			20:00	-	-	-	2	-	-	-	-	7	-	13	2	6	3	14	17	4	7	-	-	1	1	2	12	-	-	-	-	49	42	
20:00			21:00	-	-	-	12	-	-	-	-	1	-	3	-	5	1	6	8	4	4	-	-	-	-	3	8	-	-	-	-	34	21	
21:00	22:00		-	-	-	47	-	1	2	-	-	-	-	1	4	2	3	1	10	8	-	-	-	-	-	8	8	-	-	-	-	65	22	
22:00	23:00		-	-	-	18	-	-	11	-	-	-	-	-	-	-	2	-	4	8	-	-	-	-	1	5	-	-	-	-	25	24		
23:00	00:00		-	-	-	9	3	-	23	-	-	-	-	1	-	1	-	1	1	5	5	-	-	-	2	-	-	-	-	-	19	32		
00:00	01:00		-	-	-	14	31	1	3	-	-	-	-	1	-	3	-	1	4	20	-	-	-	-	4	-	-	-	-	-	19	63		
01:00	02:00		-	-	-	3	14	2	-	-	-	-	-	-	-	3	2	-	-	3	18	-	-	-	-	2	-	-	-	-	11	36		
02:00	03:00		-	-	-	7	12	-	1	-	-	-	-	-	-	1	3	1	-	1	19	-	-	-	-	1	-	-	-	-	10	36		
03:00	04:00		-	-	-	6	6	-	-	-	-	-	-	-	-	1	-	-	-	1	7	-	-	-	-	2	-	-	-	-	7	16		
04:00	05:00	-	-	-	18	15	-	-	-	-	-	-	-	-	-	1	-	3	3	1	-	-	-	2	-	-	-	-	-	23	20			
05:00	06:00	-	-	-	6	24	-	1	-	-	-	-	-	2	1	6	15	2	3	-	-	-	1	-	5	-	-	-	-	16	50			
Sub Total																																		
18:00-6:00 hrs			-	-	144	105	4	42	-	-	10	1	22	5	27	27	54	55	53	108	1	1	5	5	14	52	-	-	-	-	334	401		
Total Day3			-	-	148	133	4	45	-	-	34	47	255	208	142	140	434	475	157	190	16	21	18	19	152	207	-	-	-	-	1,360	1,485		
Total			-	1	412	354	108	173	-	-	127	140	804	760	389	476	1,355	1,442	469	513	44	66	42	53	552	644	-	-	-	-	4,302	4,622		
Grand Total (a+b)																																		
Average Daily Traffic (ADT)																																		
Composition (%)																																		
Total ADT excl. MC & Rickshaws																																		
Composition excl. MC, rickshaws (%)																																		
Average Annual Daily Traffic (AADT)																																		
AADT excl. MC, Rickshaws																																		
PCU Factors																																		
AADT in PCUs																																		
AADT in PCUs excl. MC & Rickshaws																																		

Station name: Khurkot Causeway
 Route: Dhulikhel->Ghurmi

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	1	0	0	0	0	0	0	20	3	1	24
7:00-8:00	8	0	2	0	0	1	1	22	1	3	35
8:00-9:00	17	0	3	0	0	1	0	20	2	10	52
9:00-10:00	29	0	6	1	0	0	0	28	1	7	71
10:00-11:00	44	0	7	1	0	1	0	28	2	10	92
11:00-12:00	34	0	6	0	0	1	1	23	5	13	81
12:00-13:00	24	0	5	2	0	2	0	21	0	13	65
13:00-14:00	14	0	2	1	0	1	1	24	4	8	53
14:00-15:00	16	0	2	0	0	1	0	20	5	11	54
15:00-16:00	6	0	2	0	0	1	0	24	3	8	43
16:00-17:00	10	0	0	0	0	0	1	16	3	6	35
17:00-18:00	7	0	4	0	0	0	1	30	3	10	53
18:00-19:00	5	0	2	1	0	1	1	30	2	9	48
19:00-20:00	7	0	1	1	1	1	2	25	1	5	41
20:00-21:00	3	0	0	0	0	2	2	9	2	5	21
21:00-22:00	1	0	0	0	0	3	0	7	0	2	12
22:00-23:00	1	0	0	0	1	2	0	4	0	1	8
23:00-00:00	1	0	0	0	0	2	0	1	0	1	4
00:00-01:00	2	0	0	0	0	3	1	0	0	3	8
01:00-02:00	1	0	0	0	0	2	0	2	0	1	5
02:00-03:00	1	0	1	0	0	5	0	1	0	0	7
03:00-04:00	1	0	0	0	0	1	0	1	0	0	2
04:00-05:00	1	0	1	0	0	1	1	1	0	0	4
05:00-06:00	3	0	2	0	0	2	1	8	2	2	18
Total	230	0	42	6	1	28	8	357	36	125	831

Station name: Khurkot Causeway
Route: Dhulikhel<->Ghurmi

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	7	0	0	0	0	2	0	9	2	4	24
7:00-8:00	6	0	0	0	0	1	0	27	1	8	43
8:00-9:00	7	0	3	5	0	0	1	37	1	11	65
9:00-10:00	23	0	7	2	0	1	0	34	3	6	76
10:00-11:00	28	0	9	0	0	0	0	33	7	8	85
11:00-12:00	23	0	3	2	0	2	0	24	1	7	62
12:00-13:00	24	0	3	3	0	1	0	38	1	10	80
13:00-14:00	18	0	5	2	0	0	1	26	1	12	65
14:00-15:00	16	0	7	2	0	0	0	30	4	12	71
15:00-16:00	7	0	10	0	0	1	0	19	2	9	48
16:00-17:00	4	0	1	2	0	0	3	27	2	8	47
17:00-18:00	6	0	3	2	0	0	0	20	4	10	45
18:00-19:00	3	0	1	2	0	0	0	18	1	10	35
19:00-20:00	7	0	0	0	0	0	1	29	0	3	40
20:00-21:00	4	0	0	0	0	2	0	8	0	4	18
21:00-22:00	1	0	0	0	0	3	0	12	0	2	18
22:00-23:00	0	0	0	0	0	0	0	5	0	0	5
23:00-00:00	1	0	0	0	0	0	0	0	0	0	1
00:00-01:00	1	0	0	0	0	8	0	0	0	3	12
01:00-02:00	1	0	0	0	0	1	0	1	0	0	3
02:00-03:00	0	0	0	0	0	0	1	0	0	0	1
03:00-04:00	0	0	0	0	0	0	0	0	0	0	0
04:00-05:00	3	0	0	0	0	1	1	0	0	0	5
05:00-06:00	4	0	1	0	0	1	1	4	0	2	13
Total	194	0	53	22	0	24	9	401	30	129	862

Station name: Khurkot Causeway
 Route: Sindhuli<->Ghurmi

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	0	0	0	0	0	1	1	5	0	0	7
7:00-8:00	2	0	0	0	0	1	0	6	1	1	10
8:00-9:00	1	0	1	0	0	0	0	9	1	4	15
9:00-10:00	0	0	1	0	0	1	0	3	1	5	9
10:00-11:00	3	0	1	1	0	0	0	8	0	5	17
11:00-12:00	4	0	0	0	0	1	0	4	1	1	10
12:00-13:00	2	0	0	0	0	0	0	5	1	3	10
13:00-14:00	4	0	0	0	0	0	0	8	0	2	13
14:00-15:00	3	0	0	0	0	0	1	10	2	7	22
15:00-16:00	2	0	0	1	0	0	1	9	3	6	20
16:00-17:00	3	0	1	0	0	0	0	5	2	2	12
17:00-18:00	2	0	1	0	0	0	0	8	1	3	14
18:00-19:00	1	0	0	0	0	0	0	6	1	2	9
19:00-20:00	1	0	0	0	0	0	0	5	0	2	8
20:00-21:00	0	0	0	0	0	4	1	3	1	1	10
21:00-22:00	0	0	0	0	0	0	0	1	0	0	1
22:00-23:00	0	0	0	0	0	1	0	0	0	1	2
23:00-00:00	0	0	0	0	0	3	0	0	0	0	3
00:00-01:00	0	0	0	0	0	2	1	0	0	1	3
01:00-02:00	0	0	0	0	0	0	0	0	0	0	0
02:00-03:00	0	0	0	0	0	0	0	0	0	0	0
03:00-04:00	0	0	1	0	0	1	0	0	0	1	2
04:00-05:00	1	0	0	0	0	1	1	0	0	0	2
05:00-06:00	0	0	0	0	0	2	0	0	0	0	2
Total	26	0	3	1	0	14	5	93	12	41	194

Station name: Khurkot Causeway
 Route: Sindhuli<->Ghurmi

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	0	0	0	0	0	0	1	4	0	0	5
7:00-8:00	1	0	0	0	0	0	1	9	1	1	13
8:00-9:00	0	0	0	0	0	0	0	3	0	4	7
9:00-10:00	3	0	0	1	0	2	1	4	0	1	12
10:00-11:00	1	0	0	0	0	0	0	6	1	2	10
11:00-12:00	2	0	0	0	0	0	0	10	0	3	15
12:00-13:00	1	0	0	0	0	0	0	9	0	3	13
13:00-14:00	6	0	0	1	0	0	0	8	1	4	20
14:00-15:00	6	0	0	0	0	0	0	10	2	3	21
15:00-16:00	4	0	0	0	0	0	1	11	1	3	20
16:00-17:00	0	0	0	1	0	0	1	5	0	5	12
17:00-18:00	2	0	0	0	0	0	0	11	1	1	15
18:00-19:00	3	0	0	0	0	0	0	5	0	4	12
19:00-20:00	0	0	0	0	0	1	0	1	0	0	2
20:00-21:00	0	0	0	0	0	3	0	2	0	0	5
21:00-22:00	0	0	0	0	0	2	0	1	0	1	4
22:00-23:00	0	0	0	0	0	1	0	0	0	0	1
23:00-00:00	0	0	0	0	0	4	0	0	0	0	4
00:00-01:00	0	0	0	0	0	1	0	0	0	0	1
01:00-02:00	0	0	0	0	0	0	0	0	0	0	0
02:00-03:00	0	0	0	0	0	1	0	0	0	0	1
03:00-04:00	0	0	0	0	0	0	0	0	0	0	0
04:00-05:00	0	0	0	0	0	0	0	0	0	0	0
05:00-06:00	0	0	0	0	0	0	0	1	0	2	3
Total	29	0	0	3	0	15	5	100	7	37	196

ANNEX-4.5 : **SINDHULIMADI**

Station name: Sindhulimadi
Route: Bardibas<->Khurkot

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	12	0	2	1	5	15	9	73	9	27	151
7:00-8:00	24	0	6	1	7	6	5	106	7	49	210
8:00-9:00	31	0	7	3	6	7	2	137	6	50	247
9:00-10:00	52	0	8	29	3	4	2	186	9	52	342
10:00-11:00	54	0	12	95	6	5	2	197	9	47	426
11:00-12:00	50	1	7	149	3	6	2	182	7	55	460
12:00-13:00	64	0	8	115	3	8	1	209	5	63	474
13:00-14:00	63	0	6	72	4	6	2	183	8	52	394
14:00-15:00	51	0	4	20	4	6	1	151	8	46	288
15:00-16:00	52	0	4	10	3	8	0	182	8	47	312
16:00-17:00	37	0	4	9	2	7	0	159	10	51	278
17:00-18:00	43	0	5	9	4	6	1	144	8	45	263
18:00-19:00	39	0	2	9	4	7	3	140	8	41	251
19:00-20:00	32	0	2	1	4	18	1	122	5	40	224
20:00-21:00	24	0	4	5	1	17	1	64	2	27	143
21:00-22:00	13	0	4	9	3	15	7	22	1	14	85
22:00-23:00	11	0	0	3	2	28	5	15	1	17	80
23:00-00:00	10	0	1	1	1	19	3	6	0	21	60
00:00-01:00	8	0	1	2	1	14	4	4	0	17	51
01:00-02:00	9	0	2	5	1	17	3	2	0	13	51
02:00-03:00	9	0	2	0	1	13	2	2	0	10	37
03:00-04:00	4	0	1	0	1	9	2	1	0	6	21
04:00-05:00	6	0	8	1	2	17	6	6	1	6	52
05:00-06:00	7	0	2	2	1	16	8	32	2	14	82
Total	698	1	95	546	66	269	66	2320	111	805	4975

Station name: Sindhulimadi
Route: Bardibas<->Khurkot

Roadside Traffic Count on Weekend											
Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axle Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total	
6:00-7:00	18	0	0	2	3	1	23	65	16	41	169
7:00-8:00	22	0	2	1	12	6	11	132	9	38	233
8:00-9:00	37	0	6	2	3	3	6	137	6	58	258
9:00-10:00	40	0	8	13	3	3	3	174	11	58	313
10:00-11:00	48	0	8	81	6	1	4	199	8	53	408
11:00-12:00	55	0	8	124	3	4	4	170	11	52	431
12:00-13:00	67	0	9	111	1	6	3	180	6	47	430
13:00-14:00	62	0	6	62	3	9	0	179	6	53	380
14:00-15:00	59	0	1	17	4	7	1	175	4	45	313
15:00-16:00	61	0	1	6	3	11	0	154	7	48	291
16:00-17:00	44	0	6	12	1	8	0	173	9	39	292
17:00-18:00	47	0	0	11	3	5	2	147	7	46	268
18:00-19:00	30	0	1	9	3	10	4	104	1	21	183
19:00-20:00	24	0	1	5	1	11	1	104	9	28	184
20:00-21:00	18	0	7	6	0	19	1	54	1	30	136
21:00-22:00	18	0	4	17	1	38	4	24	2	16	124
22:00-23:00	8	0	0	1	1	29	2	9	0	20	70
23:00-00:00	9	0	0	1	0	16	1	6	0	25	58
00:00-01:00	5	0	1	1	0	9	1	1	0	24	42
01:00-02:00	5	0	1	3	1	14	0	1	0	15	40
02:00-03:00	3	0	0	0	0	12	0	2	0	8	25
03:00-04:00	3	0	0	0	0	6	0	1	0	8	18
04:00-05:00	6	0	1	0	3	23	1	9	0	4	47
05:00-06:00	6	0	3	1	4	16	1	37	5	14	87
Total	695	0	74	486	59	267	73	2237	118	791	4800

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
VEHICLE COUNT SURVEY - Khurkot to Bardibas and Bardibas to Khurkot

Surveyed and Supervised By: **Soil Test P.Ltd**



SINDHULI

Flow of Vehicles

a = Direction of the movement of vehicle from	Khurkot to Bardibas
b = Direction of the movement of Vehicle from	Bardibas to Khurkot
Data Source	CCTV Camera
Data Collection Period	
From :	6am on 13th June 2019 (Thursday)
To :	6am on 16th June 2019 (Sunday)
Station Name:	Sindhuli
Location:	B.P. Highway (Sindhulimadi)
DOR Seasonal	0.93

Date	Start Time	End Time	Volume of Vehicle																														
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total				
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b			
13th June 2019	06:00	07:00	2	2	11	-	8	-	-	-	1	2	-	2	1	2	45	24	2	4	2	1	12	13	4	6	5	-	-	-	-	93	56
	07:00	08:00	1	5	5	-	3	1	-	-	-	6	1	-	7	3	45	56	7	12	2	6	18	15	4	6	-	-	-	-	93	110	
	08:00	09:00	3	6	5	2	1	1	-	-	-	9	-	3	6	5	68	70	5	10	3	2	22	15	8	10	-	-	-	-	121	133	
	09:00	10:00	1	3	1	2	-	-	-	-	1	3	2	25	3	9	75	92	10	12	3	4	17	13	8	20	1	-	-	-	122	183	
	10:00	11:00	3	1	5	2	3	-	-	-	6	7	22	66	9	13	110	93	8	7	2	5	14	14	6	19	1	-	-	-	189	227	
	11:00	12:00	2	-	2	2	2	2	2	-	4	1	65	88	9	6	94	94	12	9	3	5	18	13	7	18	1	-	-	-	221	238	
	12:00	13:00	1	2	3	2	-	-	-	-	6	3	75	41	15	18	113	106	21	10	2	4	18	15	23	17	-	-	-	-	277	218	
	13:00	14:00	1	1	4	2	2	-	-	-	2	3	48	15	8	15	88	89	14	6	8	3	15	15	24	12	-	-	-	-	214	161	
	14:00	15:00	3	1	2	3	1	-	-	-	1	2	10	5	5	15	84	77	16	5	6	2	17	7	12	10	-	-	-	-	157	127	
	15:00	16:00	1	1	1	3	-	-	-	-	2	1	6	2	5	10	111	80	18	10	7	-	12	10	15	15	-	-	-	-	178	132	
	16:00	17:00	1	2	2	6	-	-	-	-	6	-	8	-	3	8	99	61	11	7	4	3	18	14	15	6	-	-	-	-	167	107	
	17:00	18:00	3	2	-	4	-	-	-	-	2	1	7	1	5	6	95	55	15	7	1	8	15	12	13	6	-	-	-	-	156	102	
	Sub Total 6:00-18:00 hrs			22	26	41	28	20	4	2	-	31	38	244	248	76	110	1,027	897	139	99	43	43	196	156	139	145	8	-	-	-	1,988	1,794
	14th June 2019	18:00	19:00	3	2	2	5	1	2	-	-	1	1	7	1	7	9	85	62	11	4	5	3	14	7	10	7	-	-	-	-	146	103
		19:00	20:00	3	1	1	13	-	2	-	-	-	-	2	-	11	3	65	55	8	8	-	3	11	9	13	8	-	-	-	-	114	102
		20:00	21:00	-	2	-	10	-	1	-	-	5	-	6	-	4	27	32	5	14	1	1	6	8	6	3	-	-	-	-	56	75	
		21:00	22:00	-	3	-	17	-	13	-	-	3	-	8	1	2	2	11	6	6	7	1	-	2	2	7	6	-	-	-	-	40	57
		22:00	23:00	-	-	10	14	1	7	-	-	-	-	1	-	-	4	3	7	6	15	-	-	-	1	2	3	-	-	-	-	23	51
		23:00	00:00	-	-	11	8	-	4	-	-	-	-	-	-	5	-	4	2	3	14	-	-	-	-	2	3	-	-	-	-	25	31
00:00		01:00	1	1	6	9	1	3	-	-	-	2	-	-	1	1	1	-	5	13	-	-	-	-	5	-	-	-	-	-	20	29	
01:00		02:00	1	-	6	11	-	-	-	-	-	-	-	4	2	2	1	-	4	5	-	-	-	-	3	2	-	-	-	-	17	24	
02:00		03:00	1	-	10	5	-	-	-	-	-	-	-	-	1	1	1	1	2	12	-	-	-	-	3	4	-	-	-	-	18	23	
03:00		04:00	-	-	3	4	-	1	-	-	-	1	-	-	1	-	-	-	-	3	-	-	-	-	2	3	-	-	-	-	6	12	
04:00		05:00	2	-	10	6	4	2	-	-	2	5	-	1	2	-	4	3	4	2	-	1	-	1	4	1	-	-	-	-	32	22	
05:00		06:00	-	1	21	-	6	1	-	-	1	1	1	1	1	1	22	13	2	2	1	-	1	4	2	4	-	-	-	-	58	28	
Sub Total 18:00-6:00 hrs			11	10	80	102	13	36	-	-	12	10	25	8	33	27	224	181	56	99	8	8	34	32	59	44	-	-	-	-	555	557	
Total Day1			33	36	121	130	33	40	2	-	43	48	269	256	109	137	1,251	1,078	195	198	51	51	230	188	198	189	8	-	-	-	2,543	2,351	
14th June 2019		06:00	07:00	-	5	17	1	7	3	-	-	1	-	-	-	1	1	39	37	6	1	6	3	6	9	1	8	-	-	-	-	84	68
		07:00	08:00	2	6	5	1	6	-	-	-	-	5	-	1	6	6	51	59	8	11	5	1	17	10	4	12	-	-	-	-	104	112
		08:00	09:00	-	2	6	1	1	-	-	-	0	4	1	1	10	10	73	62	11	9	3	4	13	15	6	7	-	-	-	-	124	115
		09:00	10:00	1	-	2	2	3	-	-	-	2	9	2	28	22	8	118	87	13	13	6	4	17	9	17	16	-	-	-	-	203	176
		10:00	11:00	6	2	1	1	1	-	-	-	5	5	23	79	9	10	121	70	9	9	3	7	20	13	10	32	-	-	-	-	208	228
	11:00	12:00	2	1	5	3	-	-	-	-	7	1	59	86	9	12	89	87	18	10	2	3	17	12	13	25	-	-	-	-	221	240	
	12:00	13:00	3	-	6	5	1	-	-	-	3	3	64	50	11	7	91	107	19	16	2	2	14	11	17	19	-	-	1	-	232	220	
	13:00	14:00	2	3	3	2	1	-	-	-	7	-	46	35	16	19	91	98	16	13	-	4	10	15	17	15	-	-	-	-	209	204	
	14:00	15:00	2	1	3	3	-	-	-	-	3	1	17	8	7	21	72	68	13	7	7	1	17	9	16	15	-	-	-	-	157	134	
	15:00	16:00	3	-	3	9	-	-	-	-	1	3	11	1	8	18	83	90	14	5	4	4	14	10	20	13	-	-	-	-	161	153	
	16:00	17:00	-	1	3	3	-	-	-	-	2	-	8	1	9	6	79	79	11	6	6	7	16	18	14	12	-	-	-	-	148	133	
	17:00	18:00	1	1	3	5	-	1	-	-	3	3	7	2	10	15	68	70	12	9	2	4	10	10	16	15	-	-	-	-	132	135	
	Sub Total 6:00-18:00 hrs			22	22	57	36	20	4	-	-	34	34	238	292	118	133	975	914	150	109	46	44	171	141	151	189	-	-	1	-	1,983	1,918
14th June 2019	18:00	19:00	0	3	3	4	2	-	-	-	1	8	1	15	9	76	56	13	16	4	4	12	5	13	7	-	-	-	-	146	106		
	19:00	20:00	2	2	2	20	-	-	-	-	3	-	-	6	13	63	61	11	11	4	3	13	8	7	2	-	-	-	-	108	123		
	20:00	21:00	-	-	3	21	-	-	-	-	3	-	3	-	14	5	34	35	7	11	1	-	2	1	10	5	-	-	-	-	77	78	
	21:00	22:00	-	2	-	13	-	-	-	-	5	-	8	-	4	-	15	11	4	5	-	-	1	-	2	2	-	-	-	-	39	33	
	22:00	23:00	2	2	11	21	1	-	-	-	-	-	3	1	4	3	10	10	1	10	-	1	-	-	5	1	-	-	-	-	37	49	
	23:00	00:00	-	1	4	15	-	1	-	-	-	2	1	-	-	3	3	2	8	16	-	-	-	-	4	3	-	-	-	-	20	43	

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Khurkot to Bardibas and Bardibas to Khurkot

Surveyed and Supervised By: Soil Test P.Ltd

SINDHULI

Flow of Vehicles

a = Direction of the movement of vehicle from	Khurkot to Bardibas
b = Direction of the movement of Vehicle from	Bardibas to Khurkot

Data Source CCTV Camera

Data Collection Period

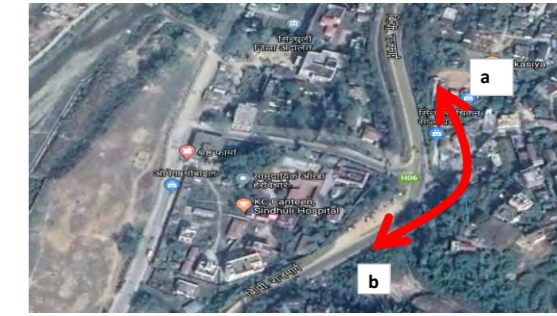
From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Sindhuli

Location: B.P. Highway (Sindhulimadi)

DOR Seasonal 0.93



Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total					
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
15th June 2019	00:00	01:00	-	-	7	6	-	3	-	-	-	-	-	4	1	1	4	3	3	13	-	-	-	-	4	3	-	-	-	-	-	-	19	33
	01:00	02:00	1	-	10	6	3	3	-	-	-	-	4	-	5	1	2	3	-	8	9	-	-	-	-	4	1	-	-	-	-	30	30	
	02:00	03:00	1	-	4	6	3	1	-	-	-	2	1	-	-	2	3	-	1	3	3	-	-	-	-	1	2	-	-	-	-	16	17	
	03:00	04:00	1	-	6	4	-	2	-	-	-	-	-	-	-	-	-	-	1	5	3	-	-	-	1	1	-	-	-	-	13	11		
	04:00	05:00	1	-	10	7	4	2	-	-	-	2	7	-	1	-	3	3	2	1	3	-	1	-	1	-	1	-	-	-	21	28		
	05:00	06:00	-	-	10	1	7	2	-	-	-	-	1	-	1	1	2	14	15	2	6	3	-	6	5	1	1	-	-	-	-	44	34	
	Sub Total																																	
	18:00-6:00 hrs			8	10	70	124	20	14	-	-	12	19	23	13	48	44	225	197	66	106	12	9	34	21	52	28	-	-	-	-	570	585	
	Total Day2			30	32	127	160	40	18	-	-	46	53	261	305	166	177	1,200	1,111	216	215	58	53	205	162	203	217	-	-	1	-	2,553	2,503	
	15th June 2019	06:00	07:00	1	2	-	1	22	1	-	-	-	-	2	3	7	35	30	9	7	11	5	14	11	2	6	-	-	-	-	97	72		
		07:00	08:00	4	8	4	2	10	1	-	-	2	-	1	3	7	72	60	5	9	7	2	21	3	6	6	-	-	-	-	134	99		
		08:00	09:00	-	3	1	2	2	4	-	-	-	6	-	2	8	11	68	69	15	16	-	6	14	13	5	13	-	-	-	-	113	145	
		09:00	10:00	1	2	2	1	2	1	-	-	2	6	2	11	13	7	80	94	12	10	6	5	21	15	6	14	-	-	-	-	147	166	
		10:00	11:00	3	3	1	-	2	2	-	-	3	5	15	66	7	11	104	95	11	10	2	6	15	17	14	16	-	-	-	-	177	231	
		11:00	12:00	3	-	1	3	2	2	-	-	7	1	46	78	6	1	86	84	10	10	4	7	21	11	12	36	-	-	-	-	198	233	
		12:00	13:00	1	-	5	1	1	2	-	-	7	2	77	34	16	13	78	102	13	14	5	1	9	11	25	13	-	-	-	-	237	193	
		13:00	14:00	3	-	5	4	-	-	-	-	3	3	41	21	6	23	87	92	18	16	3	3	10	9	18	15	-	-	-	-	194	186	
		14:00	15:00	2	2	4	3	1	-	-	-	1	-	13	4	13	19	87	88	14	12	1	3	14	5	15	12	-	-	-	-	165	148	
		15:00	16:00	2	1	5	6	-	-	-	-	1	-	6	-	11	23	89	65	16	10	3	4	12	10	10	17	-	-	-	-	155	136	
		16:00	17:00	1	-	2	6	-	-	-	-	1	5	8	4	6	10	109	64	13	8	8	1	9	9	21	7	-	-	-	-	178	114	
		17:00	18:00	3	-	2	3	-	2	-	-	-	-	10	1	11	11	96	51	11	10	2	5	11	14	14	11	-	-	-	-	160	108	
Sub Total																																		
6:00-18:00 hrs			24	21	32	32	42	15	-	-	27	28	218	224	103	143	991	894	147	132	52	48	171	128	148	166	-	-	-	-	1,955	1,831		
15th June 2019		18:00	19:00	2	1	6	4	3	1	-	-	1	-	7	2	5	4	63	41	8	3	1	-	6	4	13	8	-	-	-	-	115	68	
	19:00		1	-	2	9	-	1	-	-	1	-	4	1	7	2	61	43	11	4	5	4	9	4	9	6	-	-	-	-	110	74		
	20:00	21:00	-	-	1	18	1	-	-	-	6	1	5	1	2	4	37	17	8	11	-	1	8	3	3	9	-	-	-	-	71	65		
	21:00	22:00	1	-	11	27	-	4	-	-	4	-	17	-	10	2	14	10	10	5	1	-	-	1	5	1	-	1	-	-	73	51		
	22:00	23:00	-	1	17	12	1	1	-	-	-	-	-	1	3	3	6	3	7	11	-	-	-	2	-	2	-	-	-	-	34	36		
	23:00	00:00	-	-	4	12	-	1	-	-	-	-	-	1	1	3	5	1	4	20	-	-	1	-	1	4	-	-	-	-	16	42		
	16th June 2019	00:00	01:00	-	-	4	5	-	1	-	-	-	1	-	1	-	1	-	2	22	-	-	-	-	3	1	-	-	-	-	10	32		
		01:00	02:00	-	1	4	10	-	-	-	-	-	1	1	2	-	2	-	1	3	12	-	-	-	-	1	2	-	-	-	9	31		
02:00		03:00	-	-	6	6	-	-	-	-	-	-	-	-	1	-	1	1	3	5	-	-	-	-	2	-	-	-	-	11	14			
03:00		04:00	-	-	1	5	-	-	-	-	-	-	-	-	3	-	1	-	4	3	-	-	-	1	-	-	-	-	-	9	9			
04:00		05:00	1	2	19	4	1	-	-	-	-	1	-	-	-	-	5	4	1	3	-	-	-	-	1	5	-	-	-	28	19			
05:00		06:00	3	1	15	1	1	-	-	-	-	3	-	1	2	1	19	18	5	2	2	3	5	2	1	2	-	-	-	53	34			
Sub Total			8	6	90	113	7	9	-	-	12	7	34	10	34	22	213	139	66	101	9	8	29	17	37	42	-	1	-	-	539	475		
Total Day3			32	27	122	145	49	24	-	-	39	35	252	234	137	165	1,204	1,033	213	233	61	56	200	145	185	208	-	1	-	-	2,494	2,306		
Total			95	95	370	435	122	82	2	-	128	136	782	795	412	479	3,655	3,222	624	646	170	160	635	495	586	614	8	1	1	-	7,590	7,160		
Grand Total (a+b)			190		805		204		2		264		1,577		891		6,877		1,270		330		1,130		1,200		9		1		14,750			
Average Daily Traffic (ADT)			63		268		68		1		88		526		297		2,292		423		110		377		400		3		0		4,917			
Composition (%)			1%		5%		1%		0%		2%		11%		6%		47%		9%		2%		8%		8%		0%		0%		-			
Total ADT excl. MC & Rickshaws			2624																															
Composition excl. MC, Rickshaws (%)			2%		10%		3%		0%		3%		20%		11%		-		16%		4%		14%		15%		0%		-		0%			
Average Annual Daily Traffic (AADT)			59		250		63		1		82		489		276		2,132		394		102		350		372		3		0		4,573			
AADT excl. MC, Rickshaws			59		250		63		1		82		489		276		-		394		102		350		372		3		-		2,440			
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00		-			
AADT in PCUs			236		749		95		2		205		733		276		1,066		394		153		263		372		4		0		4,547			
AADT in PCUs excl. MC & Rickshaws			236		749		95		2		205		733		276		-		394		153		263		372		4		-		3,481			

ANNEX-4.6 : **BARDIBAS**

Station name: Bardibas
Route: Hetauda<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	19	0	6	2	4	16	0	124	0	34	204
7:00-8:00	19	0	2	2	4	17	2	112	3	45	204
8:00-9:00	27	0	9	6	4	17	2	156	6	65	289
9:00-10:00	40	0	8	21	5	9	0	203	8	55	347
10:00-11:00	35	0	6	16	6	5	4	180	6	73	328
11:00-12:00	16	0	3	2	5	11	1	205	4	54	299
12:00-13:00	35	0	6	2	4	10	2	208	6	49	320
13:00-14:00	31	0	5	5	3	7	0	210	1	50	310
14:00-15:00	41	0	6	10	7	6	1	182	6	48	304
15:00-16:00	26	0	5	1	3	7	1	164	4	49	258
16:00-17:00	33	0	3	2	4	6	1	161	2	53	263
17:00-18:00	25	0	4	2	4	9	0	178	8	50	279
18:00-19:00	23	0	4	3	6	14	0	229	7	50	335
19:00-20:00	24	0	1	2	4	2	8	191	6	32	267
20:00-21:00	15	0	1	1	4	14	1	97	2	24	158
21:00-22:00	13	0	1	0	2	12	0	57	1	12	96
22:00-23:00	8	0	0	0	1	12	1	24	0	6	50
23:00-00:00	6	0	0	0	1	9	1	7	0	6	28
00:00-01:00	4	0	1	0	1	7	2	5	1	7	27
01:00-02:00	2	0	0	0	1	4	1	2	0	3	12
02:00-03:00	2	0	0	1	4	1	2	2	0	3	14
03:00-04:00	2	0	0	0	1	3	1	0	0	2	7
04:00-05:00	2	0	2	0	2	2	3	6	0	4	19
05:00-06:00	7	0	3	1	5	7	2	43	0	17	83
Total	449	0	70	73	78	203	33	2741	67	785	4496

Station name: Bardibas
Route: Hetauda<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	11	0	5	1	9	9	2	95	2	23	157
7:00-8:00	22	0	1	2	5	12	6	173	3	55	279
8:00-9:00	25	0	10	2	12	18	2	179	5	62	315
9:00-10:00	33	0	6	13	0	8	2	210	9	58	339
10:00-11:00	48	0	3	11	9	11	1	175	5	61	324
11:00-12:00	49	0	5	7	4	10	1	187	7	78	348
12:00-13:00	39	0	5	2	12	2	2	191	1	56	310
13:00-14:00	31	0	2	5	3	3	3	190	0	69	306
14:00-15:00	38	0	8	11	5	2	7	190	2	70	333
15:00-16:00	24	0	4	5	2	6	4	177	9	66	297
16:00-17:00	29	0	1	1	6	4	2	201	5	79	328
17:00-18:00	23	0	6	2	4	6	4	207	2	75	329
18:00-19:00	40	0	1	4	4	4	8	198	3	65	327
19:00-20:00	38	0	0	1	6	5	10	202	9	46	317
20:00-21:00	17	0	1	2	2	5	7	88	0	30	152
21:00-22:00	11	0	5	2	1	4	5	34	0	21	83
22:00-23:00	11	0	0	0	2	4	6	18	0	16	57
23:00-00:00	6	0	0	0	3	1	5	7	1	12	35
00:00-01:00	1	0	0	0	1	1	4	3	0	3	13
01:00-02:00	0	0	0	1	0	1	4	2	0	5	13
02:00-03:00	0	0	0	0	1	0	1	0	0	1	3
03:00-04:00	3	0	1	0	3	3	3	1	0	1	15
04:00-05:00	1	0	1	1	1	3	2	11	1	2	23
05:00-06:00	10	0	2	0	6	7	8	53	0	16	102
Total	510	0	67	73	101	129	99	2792	64	970	4805

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Surveyed and Supervised By: **Soil Test P.Ltd**

BARDIBAS

VEHICLE COUNT SURVEY - Sindhuli to Hetauda and Hetauda to Sindhuli



Flow of Vehicles

a = Direction of the movement of vehicle from	Sindhuli to Hetauda
b = Direction of the movement of vehicle from	Hetauda to Sindhuli

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Bardibas

Location: Intersection of B.P. Hwy (H06) & East-West Highway(H01)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Multi-axle Truck		Truck Heavy		Truck Light		Big		Bus Mini		Micro		Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total	
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
15th June 2019	00:00	01:00	-	-	-	2	4	-	-	-	1	-	-	-	1	2	3	2	1	-	-	-	1	2	2	-	-	-	-	-	-	10	11	
	01:00	02:00	-	-	1	3	2	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	1	-	-	-	-	-	-	-	5	6		
	02:00	03:00	2	3	-	1	4	-	-	-	-	-	1	1	1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	11	9		
	03:00	04:00	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3	4		
	04:00	05:00	1	1	1	1	5	1	-	-	-	2	-	-	1	3	4	1	2	-	-	-	-	1	1	1	-	-	-	-	12	14		
	05:00	06:00	4	3	-	3	4	-	-	-	2	-	1	-	2	1	14	15	3	3	-	-	4	6	1	1	-	-	-	-	35	32		
	Sub Total 18:00-6:00 hrs		10	14	10	67	24	2	-	-	2	8	5	4	6	32	315	368	46	54	9	4	40	28	23	40	-	-	-	-	490	621		
	Total Day2		42	27	72	106	37	9	-	-	35	38	18	60	97	110	1,362	1,458	164	167	32	29	212	238	98	164	-	-	-	-	2,169	2,406		
	15th June 2019	06:00	07:00	1	8	8	1	2	-	-	2	3	-	1	3	2	34	61	3	8	2	-	7	5	3	3	-	-	-	-	65	92		
		07:00	08:00	1	4	7	5	6	-	-	1	-	1	1	4	7	81	92	10	6	1	2	16	23	2	9	-	-	-	-	130	149		
		08:00	09:00	7	5	16	2	2	-	-	8	2	1	1	2	8	84	95	6	13	2	3	13	30	6	9	-	-	-	-	147	168		
		09:00	10:00	-	-	7	1	1	1	-	-	2	4	-	13	6	4	89	121	9	7	5	3	16	26	11	12	-	1	-	-	146	193	
		10:00	11:00	6	3	7	4	1	-	-	1	2	-	11	10	13	77	98	8	13	3	2	17	23	11	14	-	-	-	-	141	183		
		11:00	12:00	4	-	6	4	-	1	-	-	5	1	6	11	14	84	103	7	12	4	3	22	37	7	17	-	-	-	-	146	202		
		12:00	13:00	9	3	2	-	1	1	-	-	3	2	-	2	11	9	89	102	10	6	1	-	19	21	6	13	-	-	-	-	151	159	
		13:00	14:00	2	1	1	2	-	3	-	-	1	1	4	1	4	11	86	104	11	10	-	-	24	24	7	9	-	-	-	-	140	166	
		14:00	15:00	3	2	2	-	1	6	-	-	7	1	10	1	4	13	93	97	5	17	1	1	22	26	8	13	-	-	-	-	156	177	
		15:00	16:00	-	2	4	2	2	2	-	-	3	1	4	1	4	3	89	88	12	13	4	5	19	22	8	9	-	-	-	-	149	148	
		16:00	17:00	4	2	1	3	-	2	-	-	1	0	1	-	7	3	103	98	19	14	3	2	19	27	10	9	-	-	-	-	168	160	
		17:00	18:00	3	1	3	3	-	4	-	-	3	3	1	1	3	5	99	108	11	10	-	2	29	24	7	8	-	-	-	1	160	169	
		Sub Total 6:00-18:00 hrs		40	31	64	27	16	20	-	-	32	24	23	39	69	92	1,008	1,167	111	129	26	23	223	288	86	125	-	1	-	-	1,699	1,966	
		15th June 2019	18:00	19:00	4	0	1	3	-	8	-	-	1	2	2	4	5	91	107	13	14	1	2	15	22	13	18	-	-	1	-	145	182	
	19:00		20:00	5	1	3	2	2	8	-	-	-	-	1	7	5	94	108	12	18	6	3	5	9	8	18	-	-	1	1	143	174		
	20:00		21:00	2	-	1	4	2	5	-	-	1	2	-	3	-	39	49	8	9	-	-	6	7	6	8	-	-	-	-	69	83		
21:00	22:00		0	1	-	4	2	3	-	-	3	2	2	-	3	2	13	21	3	9	-	-	7	2	4	2	-	-	-	-	37	46		
22:00	23:00		1	1	3	1	1	5	-	-	-	-	-	-	2	2	9	9	3	9	-	-	2	2	3	4	-	-	-	-	24	33		
23:00	00:00		1	2	-	1	-	5	-	-	-	-	-	-	1	-	5	2	2	8	-	1	2	-	3	2	-	-	-	-	14	21		
00:00	01:00		0	1	1	-	1	3	-	-	-	-	-	-	-	-	2	1	1	2	-	-	-	-	1	-	-	-	-	-	6	7		
01:00	02:00		0	-	1	-	3	1	-	-	-	-	-	1	-	-	-	2	2	2	-	-	-	1	-	-	-	-	-	-	6	7		
02:00	03:00	0	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3			
03:00	04:00	0	3	2	1	1	2	-	-	-	1	-	-	1	-	-	1	-	1	-	-	-	-	-	2	-	-	-	-	4	11			
04:00	05:00	0	1	2	1	1	1	-	-	-	1	-	1	-	-	6	5	2	-	-	1	-	-	-	1	-	-	-	-	11	12			
05:00	06:00	4	2	7	-	7	1	-	-	1	1	-	-	-	1	23	30	4	5	-	-	3	4	3	6	-	-	-	-	52	50			
Sub Total 18:00-6:00 hrs		17	13	21	17	20	43	-	-	4	7	6	5	21	15	282	335	50	78	7	7	40	47	41	61	-	-	2	1	511	629			
Total Day3		57	44	85	44	36	63	-	-	36	31	29	44	90	107	1,290	1,502	161	207	33	30	263	335	127	186	-	1	2	1	2,210	2,595			
Total		143	114	280	254	77	87	-	-	107	99	70	149	283	337	3,882	4,391	514	587	99	97	619	815	316	471	-	1	2	1	6,393	7,403			
Grand Total (a+b)		257		534		164		-		206		219		620		8,273		1,101		196		1,434		787		1		3		1		13,796		
Average Daily Traffic (ADT)		86		178		55		-		69		73		207		2,758		367		65		478		262		0		1		0		4,599		
Composition (%)		2%		4%		1%		0%		1%		2%		4%		60%		8%		1%		10%		6%		0%		0%		0%		-		
Total ADT excl. MC & Rickshaws		1840																																
Composition excl. MC, rickshaws (%)		5%		10%		3%		0%		4%		4%		11%		-		20%		4%		26%		14%		0%		-		0%		-		
Average Annual Daily Traffic (AADT)		80		166		51		-		64		68		192		2,565		341		61		445		244		0		1		0		4,277		
AADT excl. MC, Rickshaws		80		166		51		-		64		68		192		-		341		61		445		244		0		-		0		1,711		
PCU Factors		4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00		2.00		-		
AADT in PCUs		319		497		76		-		160		102		192		1,282		341		91		333		244		0		1		1		3,639		
AADT in PCUs excl. MC & Rickshaws		319		497		76		-		160		102		192		-		341		91		333		244		0		-		1		2,356		

Station name: Bardibas
Route: Janakpur<->Sindhuli

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	6	0	2	3	6	16	1	68	2	16	117
7:00-8:00	13	0	1	2	5	10	1	82	1	20	133
8:00-9:00	23	0	4	17	2	5	0	115	5	26	196
9:00-10:00	34	0	3	54	4	3	1	117	3	24	240
10:00-11:00	37	0	1	77	6	4	0	124	4	29	280
11:00-12:00	30	0	3	57	2	2	1	120	4	25	243
12:00-13:00	41	0	3	84	3	4	0	115	3	33	284
13:00-14:00	42	0	2	71	4	4	0	106	6	32	265
14:00-15:00	50	0	3	32	2	6	1	102	4	27	225
15:00-16:00	31	0	1	10	5	3	1	99	4	27	179
16:00-17:00	32	0	1	5	1	5	0	102	5	30	180
17:00-18:00	27	0	3	5	2	7	1	107	5	27	182
18:00-19:00	27	1	4	6	1	7	0	121	6	24	194
19:00-20:00	28	0	0	6	1	5	0	109	3	27	178
20:00-21:00	18	0	1	2	1	7	0	45	2	16	90
21:00-22:00	13	0	4	5	1	8	0	29	0	18	77
22:00-23:00	10	0	4	9	1	7	0	14	0	12	56
23:00-00:00	8	0	1	4	0	7	0	8	0	8	35
00:00-01:00	7	0	4	4	0	4	0	2	0	11	30
01:00-02:00	8	0	2	1	1	2	0	2	0	7	20
02:00-03:00	5	1	1	0	0	3	1	1	0	3	13
03:00-04:00	6	0	3	1	1	4	0	1	0	4	19
04:00-05:00	2	0	0	1	1	4	1	2	0	4	12
05:00-06:00	8	0	2	1	3	7	1	21	0	8	49
Total	501	1	47	451	46	131	6	1604	53	453	3292

Station name: Bardibas
Route: Janakpur<->Sindhuli

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	5	0	0	2	3	3	9	57	2	24	105
7:00-8:00	22	0	2	3	2	5	9	109	5	35	192
8:00-9:00	36	1	2	8	5	5	7	122	2	42	230
9:00-10:00	46	0	2	47	3	1	1	110	7	44	261
10:00-11:00	40	0	1	67	2	3	1	111	2	28	255
11:00-12:00	46	0	1	51	1	5	1	107	6	37	255
12:00-13:00	41	0	2	61	2	5	0	87	7	30	235
13:00-14:00	50	0	6	74	4	4	0	101	0	29	268
14:00-15:00	54	0	4	24	0	2	0	100	4	21	209
15:00-16:00	38	0	0	12	4	2	0	107	4	27	194
16:00-17:00	39	0	0	4	3	2	0	98	2	16	164
17:00-18:00	26	0	0	7	2	2	1	103	9	19	169
18:00-19:00	27	0	0	9	2	0	2	141	0	19	200
19:00-20:00	22	0	1	7	0	8	2	77	3	19	139
20:00-21:00	12	0	2	8	0	7	0	60	1	20	110
21:00-22:00	7	0	4	10	1	3	1	26	0	14	66
22:00-23:00	11	0	5	12	0	6	1	16	0	19	70
23:00-00:00	8	0	1	0	1	4	4	6	0	24	48
00:00-01:00	3	0	1	4	0	0	6	3	0	7	24
01:00-02:00	3	0	0	1	0	0	4	1	0	5	14
02:00-03:00	1	0	1	0	1	0	1	1	0	2	7
03:00-04:00	3	0	1	1	1	0	1	0	0	5	12
04:00-05:00	4	0	1	1	1	2	1	5	0	4	19
05:00-06:00	5	0	2	2	2	2	7	33	0	4	57
Total	549	1	39	415	40	71	59	1581	54	494	3303

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

Surveyed and Supervised By: Soil Test P.Ltd

BARDIBAS

VEHICLE COUNT SURVEY - Sindhuli to Janakpur and Janakpur to Sindhuli



Flow of Vehicles

a = Direction of the movement of vehicle from	Sindhuli to Janakpur
b = Direction of the movement of Vehicle from	Janakpur to Sindhuli

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Bardibas

Location: Intersection of B.P. Hwy (H06) & East-West Highway(H01)

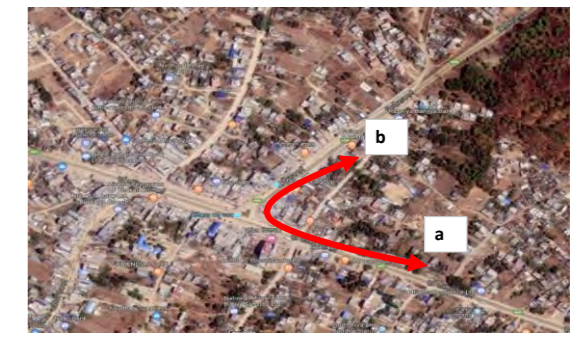
DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total					
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
13th June 2019	06:00	07:00	0	2	17	4	-	-	-	-	-	1	-	2	-	2	33	29	5	1	2	1	7	2	1	1	-	-	-	-	57	38		
	07:00	08:00	1	4	4	2	-	-	-	-	-	2	-	1	5	5	28	44	2	6	-	1	6	3	3	2	-	-	-	-	44	62		
	08:00	09:00	0	1	5	1	-	-	-	-	-	2	-	1	16	1	9	66	50	8	8	2	4	12	7	5	7	-	-	-	-	102	95	
	09:00	10:00	0	2	1	2	-	-	-	-	-	-	3	-	46	6	10	44	57	8	6	1	2	2	3	7	9	-	-	-	-	67	135	
	10:00	11:00	6	3	1	-	-	-	-	-	-	-	1	5	81	8	5	68	64	8	6	3	3	7	8	3	13	-	-	-	-	109	173	
	11:00	12:00	3	-	-	1	-	-	-	-	-	1	2	22	39	9	8	68	48	6	2	2	3	11	8	3	7	-	-	-	-	111	107	
	12:00	13:00	0	2	1	2	-	-	-	-	-	4	66	12	10	7	67	43	9	5	-	2	11	12	4	11	-	-	-	-	157	86		
	13:00	14:00	3	4	3	1	-	-	-	-	-	1	1	73	7	21	4	64	43	13	3	1	1	5	2	13	3	-	-	-	-	189	63	
	14:00	15:00	1	-	3	4	1	-	-	-	-	-	32	-	9	8	70	54	7	14	2	4	3	7	22	9	-	-	-	-	146	93		
	15:00	16:00	2	2	3	2	-	-	-	-	-	1	-	6	-	11	9	52	48	9	9	2	2	7	3	9	6	-	-	-	-	98	76	
	16:00	17:00	0	-	7	1	-	-	-	-	-	-	2	-	6	9	47	41	12	8	4	6	8	8	10	6	-	-	-	-	88	73		
	17:00	18:00	3	-	1	6	-	-	-	-	-	5	-	6	-	5	12	46	51	6	4	2	4	7	9	9	2	-	-	-	-	78	88	
	Sub Total																																	
	6:00-18:00 hrs			19	20	46	26	3	-	-	-	-	10	14	213	204	91	88	653	572	93	72	21	33	86	72	89	76	-	-	-	-	1,324	1,177
	14th June 2019	18:00	19:00	-	-	2	6	-	-	-	-	3	-	4	-	5	6	78	44	11	4	4	6	7	4	7	6	-	-	-	-	106	66	
19:00		20:00	-	-	-	10	-	-	-	-	-	-	6	1	6	4	53	39	7	5	-	3	6	7	5	7	-	-	-	-	71	66		
20:00		21:00	1	-	2	5	-	-	-	-	1	-	-	1	7	6	19	19	5	4	-	-	4	3	6	4	-	-	-	-	39	38		
21:00		22:00	1	-	1	4	-	-	-	-	4	-	6	1	2	4	11	8	2	13	-	-	1	1	5	4	-	-	-	-	25	33		
22:00		23:00	1	-	-	8	-	-	-	-	5	-	8	-	3	1	7	7	4	8	-	-	1	-	4	3	-	-	-	-	23	27		
23:00		00:00	-	-	2	8	-	-	-	-	-	1	1	-	2	1	3	6	2	5	-	-	-	-	2	1	-	-	-	-	11	22		
00:00		01:00	-	-	-	5	-	-	-	-	-	4	-	3	4	2	2	1	4	4	-	-	-	-	-	2	-	-	-	-	10	14		
01:00		02:00	1	-	1	-	-	-	-	-	-	-	-	-	2	2	1	-	1	6	-	-	-	-	4	2	-	-	-	-	7	10		
02:00		03:00	-	-	2	-	-	-	-	-	-	1	-	-	2	3	-	-	2	-	-	-	-	-	1	1	-	-	-	-	6	1		
03:00		04:00	-	1	5	-	-	-	-	-	-	1	-	-	1	-	-	1	2	2	-	-	-	-	4	-	-	-	-	-	12	3		
04:00		05:00	-	-	3	1	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-	-	2	-	-	-	-	-	6	3		
05:00		06:00	1	-	8	3	-	-	-	-	2	-	1	-	1	1	12	11	3	3	-	-	2	2	-	3	-	-	-	-	27	18		
Sub Total																																		
18:00-6:00 hrs			5	1	26	50	-	-	-	-	15	7	26	6	36	30	186	137	43	55	4	9	21	17	40	33	-	-	-	-	402	345		
Total Day1			24	21	72	76	3	-	-	-	25	21	239	210	127	118	839	709	136	127	25	42	107	89	129	109	-	-	-	-	1,726	1,522		
14th June 2019	06:00	07:00	0	9	9	1	-	-	-	-	-	2	1	3	2	34	39	4	3	-	-	4	5	1	3	-	-	-	-	55	67			
	07:00	08:00	-	5	14	-	-	-	-	-	-	-	-	2	2	4	31	60	7	2	1	-	9	4	2	2	-	-	-	-	66	79		
	08:00	09:00	2	1	3	1	-	-	-	-	3	2	-	17	6	4	56	57	2	8	1	2	4	3	3	11	-	-	-	-	80	106		
	09:00	10:00	5	-	-	2	-	-	-	-	1	2	1	61	9	6	66	67	7	5	2	-	8	8	6	14	-	-	-	-	104	166		
	10:00	11:00	1	2	4	2	-	-	-	-	-	-	5	62	9	14	69	47	9	6	1	1	6	7	4	17	-	-	-	-	108	158		
	11:00	12:00	1	-	1	2	-	1	-	-	-	2	18	35	6	11	72	51	7	8	2	1	6	2	6	10	-	-	-	-	119	123		
	12:00	13:00	1	3	-	4	-	-	-	-	1	1	55	34	15	17	64	56	9	6	1	2	7	7	6	11	-	-	-	-	159	141		
	13:00	14:00	-	-	1	3	-	-	-	-	1	1	59	3	9	8	66	38	15	12	6	4	8	5	13	12	-	-	-	-	178	86		
	14:00	15:00	2	1	2	3	-	-	-	-	2	4	30	1	14	18	39	40	8	5	1	-	5	5	12	8	-	-	-	-	115	85		
	15:00	16:00	2	3	-	1	2	-	-	-	-	-	13	1	8	4	54	43	9	7	2	1	5	5	11	4	-	-	-	-	106	69		
	16:00	17:00	-	1	2	-	-	-	-	-	1	1	7	-	5	11	63	53	7	8	-	-	5	4	11	6	-	-	-	-	101	84		
	17:00	18:00	-	-	-	7	1	-	-	-	1	-	3	1	9	5	63	53	8	10	1	2	6	4	6	6	-	-	-	-	98	88		
	Sub Total																																	
	6:00-18:00 hrs			14	25	36	26	3	2	-	-	9	15	192	220	94	104	677	604	92	80	18	13	73	59	81	104	-	-	-	-	1,289	1,252	
	18:00	19:00	1	-	1	5	-	-	-	-	1	4	-	6	1	15	4	64	55	5	4	-	2	3	10	7	3	-	-	-	-	106	85	
19:00	20:00	2	-	-	-	-	-	-	-	-	-	4	1	14	6	66	59	9	4	1	2	6	9	9	4	-	-	-	-	111	85			
20:00	21:00	-	-	1	5	-	-	-	-	-	-	3	-	4	-	32	20	3	3	2	1	3	7	6	3	-	-	-	-	54	39			
21:00	22:00	-	-	-	11	-	-	-	-	4	-	3	-	3	1	24	14	8	7	-	-	2	2	4	2	-	-	-	-	48	37			
22:00	23:00	-	-	-	5	-	-	-	-	3	-	9	1	1	2	2	12	4	6	-	-	1	-	6	-	-	-	-	-	26	26			
23:00	00:00	-	-	3	1	-	-	-	-	-	-	2	4	2	1	3	3	1	7	-	-	-	1	3	4	-	-	-	-	14	21			

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
VEHICLE COUNT SURVEY - Sindhuli to Janakpur and Janakpur to Sindhuli

Surveyed and Supervised By: **Soil Test P.Ltd**

BARDIBAS



Flow of Vehicles

a = Direction of the movement of vehicle from	Sindhuli to Janakpur
b = Direction of the movement of Vehicle from	Janakpur to Sindhuli

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)

To : 6am on 16th June 2019 (Sunday)

Station Name: Bardibas

Location: Intersection of B.P. Hwy (H06) & East-West Highway(H01)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Truck				Bus				Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total					
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b				
15th June 2019	00:00	01:00	-	-	1	2	-	-	-	-	-	3	-	4	-	2	-	1	4	9	-	-	-	-	2	1	-	-	-	-	-	7	22	
	01:00	02:00	-	-	1	2	-	-	-	-	-	3	-	1	-	1	-	1	4	2	-	-	-	-	2	1	-	-	-	-	-	9	11	
	02:00	03:00	-	-	1	3	1	-	-	1	-	-	-	-	-	-	-	1	-	2	1	-	-	-	2	1	-	-	-	-	-	7	6	
	03:00	04:00	-	-	1	2	-	-	-	-	1	3	1	-	3	3	-	1	1	2	-	-	-	1	1	-	-	-	-	-	-	8	12	
	04:00	05:00	-	1	3	-	-	-	1	-	-	-	-	1	-	1	-	1	4	2	-	-	-	-	-	-	-	-	-	-	-	8	7	
	05:00	06:00	3	1	3	-	1	-	-	-	1	1	-	-	2	4	10	8	3	1	-	-	1	1	2	3	-	-	-	-	-	26	19	
	Sub Total 18:00-6:00 hrs			6	2	15	36	2	1	-	2	13	10	28	13	45	25	204	175	48	48	3	5	16	31	44	22	-	-	-	-	424	370	
	Total Day2			20	27	51	62	5	3	-	2	22	25	220	233	139	129	881	779	140	128	21	18	89	90	125	126	-	-	-	-	1,713	1,622	
	06:00	07:00	0	3	2	1	9	-	-	-	-	1	1	-	2	26	31	2	3	2	-	7	12	1	2	-	-	-	-	-	-	50	55	
	07:00	08:00	-	2	1	4	8	1	-	-	-	2	-	3	3	5	40	69	5	4	1	4	13	13	7	7	-	-	-	-	-	78	114	
	08:00	09:00	-	5	4	1	6	1	1	-	-	2	1	7	6	9	54	68	7	4	1	1	15	16	5	16	-	-	-	-	-	100	130	
	09:00	10:00	1	2	1	-	1	-	-	-	-	2	1	46	10	16	46	64	6	5	4	3	24	9	7	13	-	-	-	-	-	101	160	
	10:00	11:00	1	1	2	1	-	1	-	-	-	1	2	65	10	4	52	59	8	7	1	1	6	7	7	19	-	-	-	-	-	89	166	
	11:00	12:00	-	1	2	3	-	1	-	-	-	1	13	38	8	7	49	58	2	8	2	4	16	11	13	18	-	-	-	-	-	105	150	
	12:00	13:00	1	1	2	3	-	-	-	-	2	-	46	15	12	17	38	49	8	13	3	4	4	4	9	3	-	-	-	-	1	125	110	
	13:00	14:00	2	2	3	1	-	-	-	-	2	4	72	2	11	12	46	55	7	8	-	-	10	4	20	7	-	-	-	-	-	173	95	
	14:00	15:00	-	-	1	1	-	-	-	-	2	2	24	-	12	17	53	47	7	3	1	3	9	2	14	11	-	-	-	-	-	123	86	
	15:00	16:00	4	-	-	2	-	-	-	-	-	9	3	10	12	54	53	14	8	2	2	1	4	13	3	-	-	-	-	-	107	87		
	16:00	17:00	-	3	1	1	-	-	-	-	-	3	1	9	10	49	49	6	6	2	2	2	2	9	11	-	-	-	-	-	79	85		
	17:00	18:00	2	-	-	2	-	1	-	-	-	7	-	-	5	2	64	39	6	5	4	5	6	2	14	5	-	-	-	-	-	108	61	
	Sub Total 6:00-18:00 hrs			11	20	19	20	24	5	1	-	6	14	179	181	96	113	571	641	78	74	21	29	113	86	119	115	-	-	-	-	1	1,238	1,299
	18:00	19:00	1	1	-	-	1	1	-	-	-	8	1	4	6	93	48	7	3	-	-	5	4	9	8	-	-	-	-	-	128	72		
	19:00	20:00	-	-	2	6	1	1	-	-	1	-	5	2	6	3	43	34	7	5	-	3	5	2	8	5	-	-	-	-	-	78	61	
20:00	21:00	-	-	-	7	-	-	-	-	2	-	5	3	4	1	29	31	6	10	-	1	4	-	6	1	-	-	-	-	56	54			
21:00	22:00	-	1	-	3	-	1	-	-	4	-	7	3	3	-	17	9	1	9	-	-	2	2	2	2	-	-	-	-	36	30			
22:00	23:00	-	-	1	5	-	1	-	-	4	1	9	3	4	1	11	5	3	13	-	-	2	1	3	3	-	-	-	-	37	33			
23:00	00:00	-	1	1	3	2	2	-	-	-	1	-	-	2	1	2	4	6	17	-	-	-	1	2	3	-	-	-	-	15	33			
16th June 2019	00:00	01:00	-	-	-	-	1	5	-	-	1	-	4	-	2	3	-	3	4	-	-	-	-	1	-	-	-	-	-	8	16			
	01:00	02:00	-	-	-	-	1	3	-	-	-	1	-	-	-	1	-	1	4	-	-	-	-	1	2	-	-	-	-	5	9			
	02:00	03:00	1	-	-	-	-	1	-	-	-	1	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-	-	3	4				
	03:00	04:00	-	1	-	-	1	-	-	-	1	-	1	-	-	-	-	4	1	-	-	-	-	1	2	-	-	-	-	6	6			
	04:00	05:00	1	-	1	1	-	1	-	-	-	1	1	-	2	-	-	5	2	2	-	-	-	-	2	-	-	-	-	9	10			
	05:00	06:00	2	-	-	2	7	-	-	-	1	1	1	1	-	1	10	23	2	2	-	-	-	-	1	3	-	-	-	24	33			
Sub Total 18:00-6:00 hrs			5	4	5	27	14	16	-	-	12	7	37	18	26	15	209	160	43	71	-	4	18	10	36	29	-	-	-	-	405	361		
Total Day3			16	24	24	47	38	21	1	2	18	21	216	199	122	128	780	801	121	145	21	33	131	96	155	144	-	-	-	-	1	1,643	1,660	
Total			60	72	147	185	46	24	1	2	65	67	675	642	388	375	2,500	2,289	397	400	67	93	327	275	409	379	-	-	-	-	1	5,082	4,804	
Grand Total (a+b)			132		332		70		3		132		1,317		763		4,789		132		160		602		788		-		1		9,886			
Average Daily Traffic (ADT)			44		111		23		1		44		439		254		1,596		266		53		201		263		-		0		3,295			
Composition (%)			1%		3%		1%		0%		1%		13%		8%		48%		8%		2%		6%		8%		0%		0%		0%			
Total ADT excl. MC & Rickshaws			1699																															
Composition excl. MC, rickshaws (%)			3%		7%		1%		0%		3%		26%		15%		-		16%		3%		12%		15%		0%		-		0%			
Average Annual Daily Traffic (AADT)			41		103		22		1		41		408		237		1,485		247		50		187		244		-		-		0		3,065	
AADT excl. MC, Rickshaws			41		103		22		1		41		408		237		-		247		50		187		244		-		-		0		1,580	
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00		-		-	
AADT in PCUs			164		309		33		3		102		612		237		742		247		74		140		244		-		-		1		2,908	
AADT in PCUs excl. MC & Rickshaws			164		309		33		3		102		612		237		-		247		74		140		244		-		-		1		2,165	

Station name: Bardibas
Route: Hetauda<->Janakpur

Roadside Traffic Count on Weekdays (Average of two days)											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	37	4	26	5	55	22	7	218	10	38	420
7:00-8:00	48	0	22	7	55	28	9	258	14	51	490
8:00-9:00	83	0	31	9	48	30	4	365	15	90	673
9:00-10:00	72	0	33	12	45	22	7	403	15	86	693
10:00-11:00	88	0	31	15	38	19	6	398	16	117	726
11:00-12:00	87	0	34	7	29	16	5	522	15	115	829
12:00-13:00	100	0	27	9	30	15	5	553	14	117	868
13:00-14:00	82	0	28	14	30	14	4	466	13	120	769
14:00-15:00	88	0	33	9	26	17	7	429	13	109	729
15:00-16:00	78	0	28	10	34	17	5	424	16	92	702
16:00-17:00	82	0	27	12	34	18	4	375	22	83	654
17:00-18:00	95	0	17	12	37	15	3	477	16	84	755
18:00-19:00	96	0	24	11	38	22	3	500	20	80	792
19:00-20:00	91	2	23	10	49	26	2	363	14	53	631
20:00-21:00	76	0	24	4	53	14	1	240	7	35	453
21:00-22:00	53	0	28	4	51	15	1	86	7	30	272
22:00-23:00	34	0	47	2	44	17	1	38	1	21	202
23:00-00:00	27	0	33	0	33	13	0	18	1	14	137
00:00-01:00	16	5	18	1	39	12	2	10	2	15	116
01:00-02:00	12	1	21	0	39	13	1	7	1	10	103
02:00-03:00	27	0	14	1	37	8	1	5	0	9	101
03:00-04:00	19	0	44	1	27	12	2	9	0	4	116
04:00-05:00	12	0	53	1	47	16	1	12	1	8	149
05:00-06:00	16	0	17	1	62	25	2	65	3	22	212
Total	1413	12	678	152	973	422	77	6234	230	1396	11584

Station name: Bardibas
Route: Hetauda<->Janakpur

Roadside Traffic Count on Weekend											
	Car/Jeep/ Taxi/4WD	Large Bus	Mini Bus	Micro Bus	Multi Axile Truck	Heavy Truck	Light Truck	Moterbike	Tractor+ Power Tiller	Others	Total
6:00-7:00	30	5	14	5	75	26	12	166	23	51	407
7:00-8:00	56	9	17	15	46	26	9	370	19	102	669
8:00-9:00	72	5	23	12	35	23	9	469	26	121	795
9:00-10:00	87	7	22	11	53	23	9	401	17	108	738
10:00-11:00	80	8	22	10	39	14	9	402	19	93	696
11:00-12:00	77	8	18	11	31	21	6	384	12	115	683
12:00-13:00	71	0	16	9	30	27	1	212	10	95	471
13:00-14:00	81	0	24	17	33	17	2	289	8	99	570
14:00-15:00	77	0	26	1	28	17	2	199	9	65	424
15:00-16:00	62	0	25	5	29	12	1	335	13	80	562
16:00-17:00	77	0	26	11	32	35	4	400	20	98	703
17:00-18:00	99	0	15	7	43	24	2	362	16	105	673
18:00-19:00	93	0	14	8	39	20	9	473	19	100	775
19:00-20:00	71	5	17	8	31	17	6	419	10	81	665
20:00-21:00	48	4	15	2	34	15	14	216	4	51	403
21:00-22:00	47	0	24	3	24	11	6	86	6	18	225
22:00-23:00	19	5	37	2	36	8	8	58	2	28	203
23:00-00:00	29	7	23	0	29	11	2	18	0	18	137
00:00-01:00	13	7	2	1	33	10	4	10	0	8	88
01:00-02:00	9	20	5	1	27	3	6	6	0	8	85
02:00-03:00	2	21	12	1	46	4	2	3	0	3	94
03:00-04:00	11	20	6	0	43	5	3	3	0	9	100
04:00-05:00	7	15	5	0	29	6	5	17	0	7	91
05:00-06:00	15	10	4	0	52	11	2	100	8	24	226
Total	1233	156	412	140	897	386	133	5398	241	1487	10483

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2

VEHICLE COUNT SURVEY - Janakpur to Hetauda and Hetauda to Janakpur

Surveyed and Supervised By: Soil Test P.Ltd

BARDIBAS

Flow of Vehicles

Table defining flow directions: a = Direction of the movement of vehicle from Janakpur to Hetauda; b = Direction of the movement of vehicle from Hetauda to Janakpur.

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)
To : 6am on 16th June 2019 (Sunday)

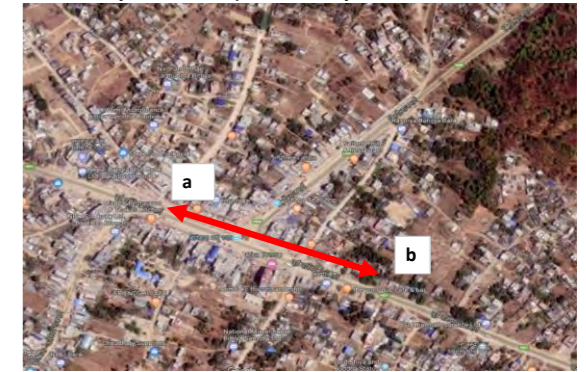
Station Name: Bardibas
Location: Intersection of B.P. Hwy (H06) & East-West Highway(H01)
DOR Seasonal 0.93



Main data table with columns for Date, Start Time, End Time, and Volume of Vehicle. The Volume of Vehicle section includes categories like Multi-axle Truck, Heavy, Light, Big, Bus Mini, Micro, Car/Taxi, Motorcycle, Utility Vehicles, Tractor, Motorised Three Wheeler, Four Wheel Drive, Power Tiller, Rickshaws, and Bullock Cart/Tanga. It provides detailed counts for each direction (a and b) across various time intervals for 13th and 14th June 2019.

THE PROJECT FOR THE OPERATION AND MAINTENANCE OF THE SINDHULI ROAD PHASE 2
 VEHICLE COUNT SURVEY - Janakpur to Hetauda and Hetauda to Janakpur

Surveyed and Supervised By: Soil Test P.Ltd



BARDIBAS

Flow of Vehicles

a = Direction of the movement of vehicle from	Janakpur to Hetauda
b = Direction of the movement of vehicle from	Hetauda to Janakpur

Data Source CCTV Camera

Data Collection Period

From : 6am on 13th June 2019 (Thursday)
 To : 6am on 16th June 2019 (Sunday)

Station Name: Bardibas

Location: Intersection of B.P. Hwy (H06) & East-West Highway(H01)

DOR Seasonal 0.93

Date	Start Time	End Time	Volume of Vehicle																															
			Multi-axle Truck		Truck Heavy		Light		Big		Bus Mini		Micro		Car/Taxi		Motorcycle		Utility Vehicles		Tractor		Motorised Three Wheeler		Four Wheel Drive		Power Tiller		Rickshaws		Bullock Cart/Tanga		Total	
			a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
15th June 2019	00:00	01:00	14	24	8	9	1	2	-	-	15	11	1	-	4	1	6	4	10	3	1	1	-	-	5	6	-	-	-	-	-	-	65	61
	01:00	02:00	26	19	5	6	1	-	-	-	3	14	-	-	-	1	5	2	6	4	-	1	-	-	5	6	-	-	-	-	51	53		
	02:00	03:00	19	18	2	5	1	-	-	-	3	3	-	1	3	8	1	1	8	4	-	-	-	10	7	-	-	-	-	-	-	47	47	
	03:00	04:00	20	9	6	6	1	2	-	-	-	37	-	-	1	2	6	3	2	2	-	-	-	-	2	9	-	-	-	-	38	70		
	04:00	05:00	22	23	5	13	-	1	-	-	2	61	-	1	-	-	-	9	3	1	-	-	2	-	6	7	-	-	-	-	40	116		
	05:00	06:00	28	38	17	10	4	-	-	-	3	15	-	2	5	6	29	34	4	11	1	1	9	5	9	4	-	-	-	-	109	126		
	Sub Total 18:00-6:00 hrs			216	292	101	105	17	8	-	-	163	176	30	13	80	115	717	600	122	98	32	21	55	49	175	129	-	-	-	-	1,708	1,606	
	Total Day2			457	487	187	217	64	38	-	-	328	341	95	66	320	365	3,104	2,939	381	362	122	108	312	334	408	356	-	-	-	-	5,778	5,613	
	06:00	07:00	37	38	19	7	7	5	5	-	4	10	2	3	9	10	100	66	9	5	11	12	22	15	9	2	-	-	-	-	234	173		
	07:00	08:00	26	20	12	14	6	3	9	-	7	10	7	8	18	10	205	165	24	11	9	10	42	25	17	11	-	-	-	-	382	287		
	08:00	09:00	13	22	13	10	9	-	5	-	6	17	7	5	13	18	290	179	24	26	18	8	48	23	27	14	-	-	-	-	473	322		
	09:00	10:00	32	21	14	9	4	5	7	-	5	17	9	2	16	13	232	169	27	14	8	9	46	21	33	25	-	-	-	-	433	305		
	10:00	11:00	19	20	10	4	7	2	8	-	6	16	4	6	24	14	221	181	13	35	7	12	25	20	27	15	-	-	-	-	371	325		
	11:00	12:00	14	17	11	10	2	4	-	8	11	7	4	7	19	22	209	175	23	22	7	5	40	30	21	15	-	-	-	-	361	322		
	12:00	13:00	22	8	7	20	1	-	-	-	8	8	7	2	19	23	160	52	15	20	5	5	30	30	16	13	-	-	-	-	290	181		
	13:00	14:00	19	14	7	10	-	2	-	-	11	13	7	10	12	31	148	141	19	25	4	4	25	30	21	17	-	-	-	-	273	297		
	14:00	15:00	18	10	7	10	-	2	-	-	13	13	1	-	18	20	83	116	8	16	5	4	16	25	18	21	-	-	-	-	187	237		
	15:00	16:00	13	16	5	7	-	1	-	-	14	11	3	2	11	8	168	167	17	20	7	6	25	18	20	23	-	-	-	-	283	279		
	16:00	17:00	25	7	18	17	3	1	-	-	11	15	7	4	18	13	216	184	17	18	10	10	37	26	24	22	-	-	-	-	386	317		
	17:00	18:00	28	15	7	17	2	-	-	-	8	7	3	4	19	21	240	122	19	23	8	8	38	25	22	37	-	-	-	-	394	279		
	Sub Total 6:00-18:00 hrs			266	208	130	135	41	25	34	8	104	144	61	53	196	203	2,272	1,717	215	235	99	93	394	288	255	215	-	-	-	-	4,067	3,324	
	18:00	19:00	17	22	12	8	5	4	-	-	8	6	5	3	20	20	253	220	23	22	7	10	26	27	30	23	2	-	2	-	410	365		
	19:00	20:00	13	18	6	11	5	1	5	-	15	2	4	4	18	22	198	221	21	15	2	1	33	11	16	15	7	-	1	-	344	321		
20:00	21:00	10	24	7	8	12	2	4	-	14	1	1	1	13	14	92	124	19	17	-	2	8	7	17	4	2	-	-	-	199	204			
21:00	22:00	5	19	6	5	6	-	-	-	23	1	1	2	12	12	43	43	7	4	1	2	4	3	14	9	3	-	-	-	125	100			
22:00	23:00	9	27	6	2	8	-	5	-	33	4	1	1	7	2	23	35	12	10	-	1	4	2	5	5	1	-	-	114	89				
23:00	00:00	7	22	3	8	2	-	7	-	17	6	-	-	4	3	9	9	11	3	-	-	2	2	11	11	-	-	-	-	73	64			
16th June 2019	00:00	01:00	9	24	4	6	1	3	2	5	2	-	-	4	3	2	8	4	3	-	-	-	1	3	3	-	-	-	-	31	57			
	01:00	02:00	15	12	1	2	2	4	3	17	-	5	1	-	-	17	2	4	2	5	-	-	1	-	4	5	-	-	-	31	54			
	02:00	03:00	26	20	1	3	1	1	2	19	0	12	-	1	-	1	-	3	2	1	-	-	-	-	1	-	-	-	-	32	62			
	03:00	04:00	23	20	1	4	1	2	-	20	-	6	-	-	-	1	1	2	2	7	-	-	-	-	2	8	-	-	-	30	70			
	04:00	05:00	17	12	3	3	2	3	-	15	2	3	-	-	1	3	9	8	5	2	-	-	-	-	1	2	-	-	-	40	51			
	05:00	06:00	27	25	5	6	1	1	1	9	3	1	-	-	7	5	52	48	7	4	4	4	5	8	3	-	-	-	-	115	111			
Sub Total 18:00-6:00 hrs			178	245	55	66	46	21	29	85	117	47	13	13	86	86	684	725	115	93	14	20	83	61	106	86	15	-	3	-	1,544	1,548		
Total Day3			444	453	185	201	87	46	63	93	221	191	74	66	282	289	2,956	2,442	330	328	113	113	477	349	361	301	15	-	3	-	5,611	4,872		
Total			1,372	1,470	602	627	180	106	71	108	881	886	262	182	970	971	9,444	8,422	1,089	1,034	355	329	1,141	1,011	1,141	977	15	2	3	-	17,526	16,125		
Grand Total (a+b)			2,842		1,229		286		179		1,767		444		1,941		17,866		2,123		684		2,152		2,118		17		3		33,651			
Average Daily Traffic (ADT)			947		410		95		60		589		148		647		5,955		708		228		717		706		6		1		11,217			
Composition (%)			8%		4%		1%		1%		5%		1%		6%		53%		6%		2%		6%		6%		0%		0%		0%			
Total ADT excl. MC & Rickshaws			5261																															
Composition excl. MC, rickshaws (%)			18%		8%		2%		1%		11%		3%		12%		-		13%		4%		14%		13%		0%		-		0%			
Average Annual Daily Traffic (AADT)			881		381		89		55		548		138		602		5,538		658		212		667		657		5		1		10,432			
AADT excl. MC, Rickshaws			881		381		89		55		548		138		602		-		658		212		667		657		5		-		4,892			
PCU Factors			4.00		3.00		1.50		3.00		2.50		1.50		1.00		0.50		1.00		1.50		0.75		1.00		1.50		1.00		-			
AADT in PCUs			3,524		1,143		133		166		1,369		206		602		2,769		658		318		500		657		8		1		12,055			
AADT in PCUs excl. MC & Rickshaws			3,524		1,143		133		166		1,369		206		602		-		658		318		500		657		8		-		9,285			

Photographs

Photos for Traffic Survey Program (June 2019)

Road Side OD Survey at Bardibas (13th June 2019)



Road Side OD Survey at Bardibas (13th June 2019)



Road Side OD Survey at Bardibas (13th June 2019)



Road Side OD Survey at Bardibas (13th June 2019)



Road Side OD Survey at Khurkot (14th June 2019)



Road Side OD Survey at Khurkot (14th June 2019)



Road Side OD Survey at Khurkot (14th June 2019)



Road Side OD Survey at Khurkot (14th June 2019)



Road Side OD Survey at Dhulikhel (17th June 2019)



Road Side OD Survey at Dhulikhel (17th June 2019)



Camera Stationed at **Dhulikhel** (June 2019)

Camera Here



Camera Stationed at **Mangaltar** (June 2019)

Camera Here



Camera Stationed at **Khurkot Old Bus Park**
(June 2019)

Camera Here



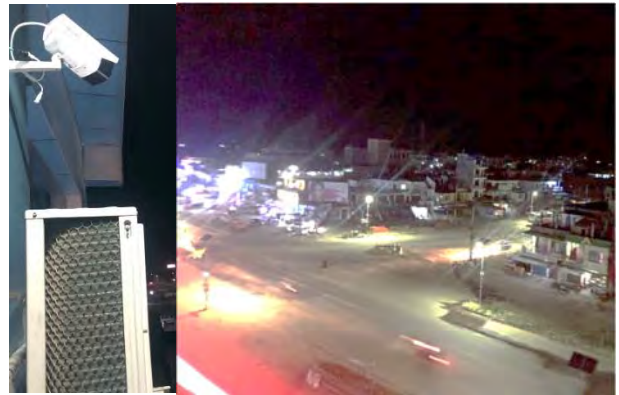
Camera Stationed at **Khurkot-Causeway3**
(June 2019)



Camera Stationed at **Sindhuli Bazar** (June 2019)



Camera Stationed at **Bardibas** (June 2019)



Travel speed survey at starting point-Maitighar



Travel speed survey at Mungling



Traffic survey count at office, Sanepa, Lalitpur.



Traffic survey count at office, Sanepa, Lalitpur.



The Project for the Operation and Maintenance of
The Sindhuli Road Phase 2

Technical Report (Draft)

Pre F/S of Rest Area

in Sindhuli Road

September 2019

Kiyoshi Narita

JICA Expert Team

Contents

Chapter 1 Concept of Pre-F/S for Rest-Area

- 1-1 Current Situation in Sindhuli Road
- 1-2 Concept of Pre-F/S for Rest-Area

Chapter 2 Contents of the Plan

- 2-1 Development Plan
- 2-2 Necessary Procedures
 - 2-2-1 Necessary Procedures of Step1 in Main Plan
 - 2-2-2 Necessary Procedures of Step 2 in Main Plan
 - 2-2-3 Necessary Procedures in Sub Plan
- 2-3 Candidate Sites in Main Plan
- 2-4 Model Case of Main Plan Candidate Site
- 2-5 Implementation Plan (Tentative)

Chapter 3 Conclusion

Chapter 4 Recommendation

Chapter 1 Concept of Pre-F/S for Rest-Area

1-1 Current Situation in Sindhuli Road

Table 1 shows the change from before the whole line opening (2012) to after the whole line opening (2015) for the main indicators based on the socioeconomic survey along Sindhuli Road. In terms of social indicators, the number of houses has increased by 93% compared to before the opening of all lines, and the number of schools and hospital facilities that accompany them has also increased.

Also, there is a 31% increase in restaurants for economic indicators.

Furthermore, for household indicators, land prices increased by 56% and income per household increased by 104%.

Thus, the opening of Sindhuli Road has developed the socioeconomic situation of the roadside area.

Additionally, as shown in Table 2, the population along Sindhuli Road before the opening of lines was smaller than that of other toll roads, so further development of the roadside area is expected.

Table 1 Remarkable Changes by Major Indicators of the Socioeconomic Survey

	unit	BLS. 2012	ELS. 2015	Change
1. Land use within 100m both sides				
a) Social indicator				
Access roads to villages	no.	70	135	93%
House/building	no.	1,938	3,327	72%
School	no.	11	23	109%
Hospital/clinic	no.	1	11	1000%
b) Economic Indicator				
Agro-vet	no.	4	21	425%
Gas store (LPG)	no.	0	11	-
Tea shop/restaurant	no.	284	372	31%
2. Household Indicator				
Land price	Rs. million/ha	12.1	18.9	56%
Income per household	Rs.	119,815	244,308	104%
Share of agriculture to income	%	26.7	39.9	13.2pp
Expenditure per household	Rs.	110,020	154,969	41%
Food sufficiency less than 3 months	%	23.5	12.2	11.3pp
Penetration ratio of mobilephone	%	78	95	17pp
Solar power	%	17	30	13pp
Dish home (parabola antenna)	%	16	32	16pp

Source: JICA Expert Team

Table 2 Population of Each District at 2011

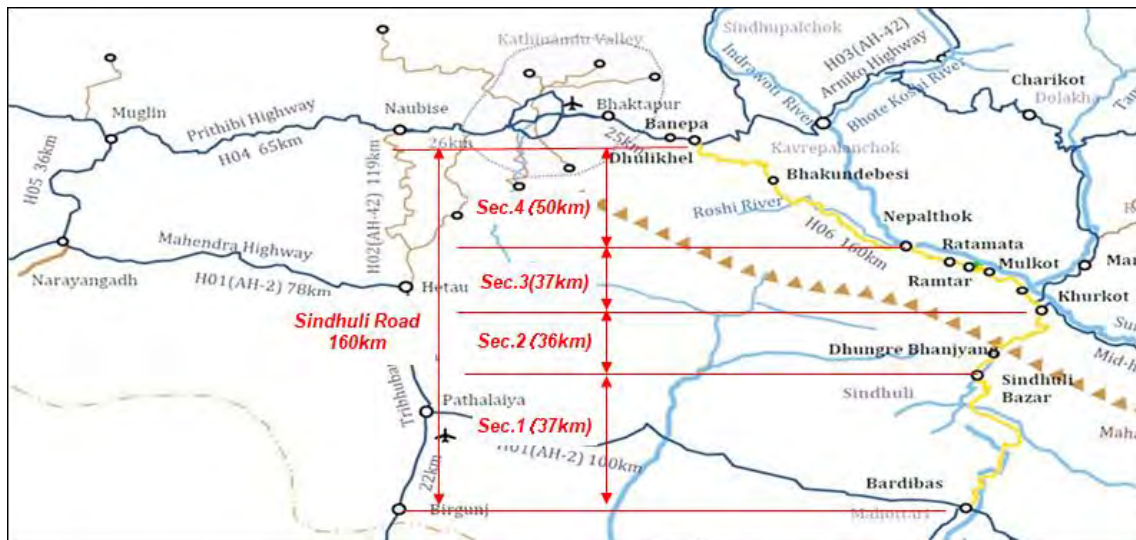
District	Population	
Around Sindhuli Road	Kavrepalanchok	381,937
	Ramechhap	202,646
	Dolakha	186,557
	Sindhuli	296,192
	Mahottari	627,580
Around Naubise – Mugling section and Hetauda-Narayanghat section	Makwanpur	420,477
	Chitawan	579,984
	Dhading	336,067

Source: 2017 Statistical Year Book Nepal (Central Bureau of Statistics)

As shown in Figure1, in addition to Bardibas as the starting point and Dhulikhel as the end point, villages, stores, restaurants and gas stations are located at regular intervals along the Sindhuli Road, and there are economic activities by the private sector.

Furthermore, since the main road and the roadside are not separated, it is easy to access existing stores from the main road.

Therefore, there are already many facilities along the Sindhuli Road where users can rest.





Bhakundebesi (Section 4)



Khurkot (Section 3)



Sindhuli Bazar
(Section 1~Section 2)



Stores (Section 2)



Restaurant (Section 3)



Gas Station (Section 4)

Figure1 Roadside Situation in Sindhuli Road

Source: JICA Expert Team

Despite functional economic activity by the private sector, there is no public parking along Sindhuli Road.

Although there are spaces available for parking on unused land along Sindhuli Road, no one manages.

The worse thing is absence of management causes garbage scattering and unusual odor in some places.

Moreover, restaurants and gas stations have toilets inside, yet there are few high-quality toilets available for women, travelers and foreigners. This causes some users urinating on the roadside. Figure 2 shows these situations.



Roadside Garbage
(Section2)

Public Toilet Sign
(Mugling-Naubise toll road)

Users Urinating on the
Roadside
(Section2)

Figure 2 Roadside Situation in Sindhuli Road and Other Toll Road

Source: JICA Expert Team

1-2 Concept of Pre-F/S for Rest Area

Considering the current situation where there are many resting facilities along the road, the concept about rest area in Sindhuli Road is the following three. The image is shown in Figure 3.

- 1 Provide high quality resting facilities as road traffic safety facilities for road users considering foreigners and gender.
- 2 In Step 1, parking lots and toilets are provided as a road traffic safety facility. For the future, as Step 2, stores or restaurants are provided as profitable facilities.
- 3 Department of Roads (DOR), local governments and private companies perform operation and maintenance of the installation.

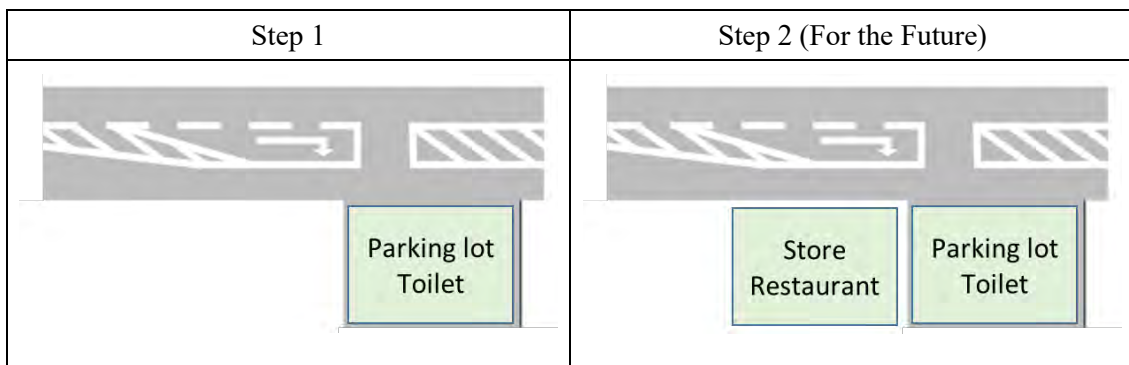


Figure3 Concept of Pre-F/S for Rest-Area

Source: JICA Expert Team

Chapter2 Contents of the Plan

2-1 Development Plan


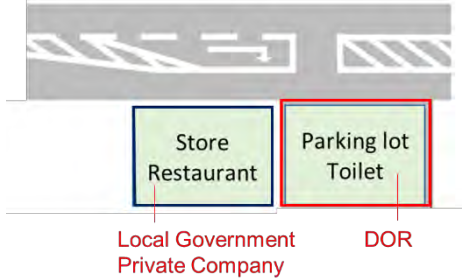
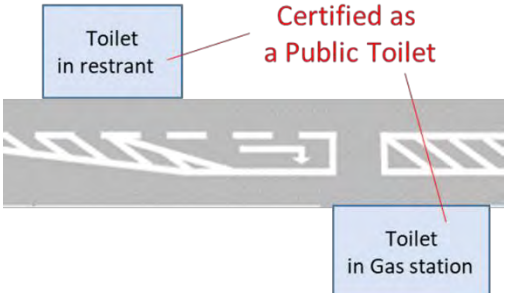
Development plan of rest area is shown in Table3.

In the main plan, as the road traffic safety facility, DOR builds and maintains free parking and quality toilets in Step 1.

Next, in Step 2, adjacent to parking lot and toilet built in Step 1, the local government builds and operates a store in cooperation with a private company.

In the sub plan, DOR provides subsidies to private companies that upgrade to high-quality toilets. Moreover, DOR designates these toilets as public toilets.

Table 3 Development Plan

	Step 1	Step 2 (For the Future)
Main Plan	<p>As the road traffic safety facility, DOR builds and maintains free parking and quality toilets.</p> 	<p>Adjacent to parking lot and toilet built in Step 1, the local government builds and operates a store in cooperation with a private company.</p> 
Sub Plan	<p>DOR provides subsidies to private companies that upgrade to high-quality toilets. Moreover, DOR designates these toilets as public toilets.</p> 	

Source: JICA Expert Team

2-2 Necessary Procedures

The necessary procedures are shown in Table 4.

In the main plan, it requires four procedures in both Step 1 and the future Step 2.

In the sub plan, it requires two procedures.

Details of each procedure are explained in 2-2-1 and later.

Table 4 Necessary Procedures

	Step 1	Step 2 (For the Future)
Main Plan	1 Addition of DOR's regulations and securing budget 2 Design 3 Construction 4 Operation and Maintenance	1 Organizing the method of cooperation between local governments and private companies 2 Arrangement of store installation rules and Management contract 3 Design and Construction 4 Select operator and start operation
Sub Plan	1 Addition of DOR's regulations and securing subsidy budget 2 System operation	

Source: JICA Expert Team

2-2-1 Necessary Procedures of Step1 in Main Plan

2-2-1-1 Addition of DOR's Regulations and Securing of Budget

- As a facility for road traffic safety, DOR's internal regulations are established so that public road managers can install parking lots and toilets along the road.
- After establishment of regulations, DOR secures the budget for construction for parking lots and toilets.

2-2-1-2 Design

As a quality toilet, it is desirable to be separated for each gender, to be western style, and to be regularly cleaned. Figure 4 shows a quality toilet along the Sindhuli Road.



Figure 4 Image of a Quality Toilet (in section 3)

Source: JICA Expert Team

2-2-1-3 Construction and Operation and Maintenance

Maintenance work is implemented as part of current road maintenance.

2-2-2 Necessary Procedures of Step 2 in Main Plan

2-2-2-1 Organizing the Method of Cooperation between Local Governments and Private Companies

As shown in Table 5, there are two options of management methods.

In option A, local government does everything.

In option B, private company carries out construction, operation and maintenance, and local government is in charge of site acquisition.

Option B is recommended because efficiency should be considered in building construction and operation.

Table 5 Organizing the Method of Cooperation between Local Governments
and Private Companies

Items	Option A	Option B (Recommended)
Planning / design	Local Government	Local Government
Secure land	Local Government	Local Government
Construction	Local Government	Private company (Decided by bid)
Operation/ maintenance	Local Government	Private company (Decided by bid)
Merit	Local Government can do it systematically because everything is done at their own risk.	The burden on local Government is reduced.
Demerit	<ul style="list-style-type: none"> • Need financial resources for land acquisition, construction and maintenance • Necessary to build a system for operation and maintenance 	<ul style="list-style-type: none"> • Financial resources needed to secure land • Possibility that bidding companies may not appear

Source: JICA Expert Team

2-2-2-2 Arrangement of Store Installation Rules and Management Contract

Table 6 shows items and main contents of rules. When a private company conducts construction and operation and maintenance, it is necessary to establish rules for the rest area installation plan and to establish an implementation contract with the management company.

Table 6 Rules

Items	Main Contents
Rest area installation rules	<ul style="list-style-type: none"> • Name and position • Necessary facilities • Private company's selection method • Business content of the private company • Maintenance standards • Amount of usage fees paid to local government
Management contract	<ul style="list-style-type: none"> • General rules : purpose, fair and equitable principle, managed property, management period • Scope of work : scope of management work, scope of work performed by local government

	<ul style="list-style-type: none"> • Implementation requirements: Personnel assignment, preparation for start of work, management of information • Handling equipment • Confirmation items related to business implementation : submission of implementation plans and reports • Payment to local government • Compensation for damages and force majeure • End of contract period
--	--

Source: JICA Expert Team

2-2-3 Necessary Procedures in Sub Plan

2-2-3-1 Addition of DOR’s Regulations and Securing of Subsidy Budget

DOR establishes internal regulation as DOR provides subsidies to private companies that upgrade to high-quality toilets and recognizes them as “Public Toilets.”

After establishment of regulations, DOR secures budget for subsidy payment.

When constructing a new facility, DOR prepares the budget including the maintenance cost.

DOR also is responsible for the maintenance itself.

However, in order to construct a new facility on Sindhuli Road, which is a mountain road, site acquisition including construction work is necessary.

Therefore, in order to enhance high-quality resting facilities, it is desirable to create a system in which DOR grants part of the facility renovation costs as subsidies as shown in Figure 5.

In addition, in order to make it easy for users to use existing facilities, it is desirable to create a system in which facilities meet the conditions recognized by the DOR as “Public Toilets,” and the facilities clearly show the sign along the road as shown in Figure 6.

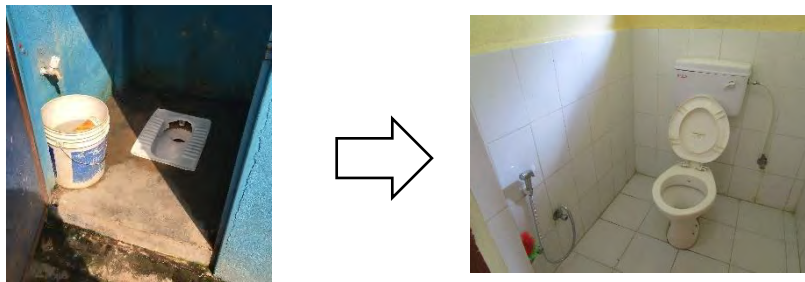


Figure 5 Toilet Renovation (image)

Source: JICA Expert Team



Figure 6 Roadside Signage (image)

Source: JICA Expert Team

2-2-3-2 Summary of Rules

A Purpose

In Sindhuli Road, the public toilets along the road is enhanced in cooperation with private companies to ensure the safety and security of road users.

B Requirements for quality public toilets eligible for subsidies (example)

- Divided by gender
- Western-style toilet
- Regular cleaning

C Procedure flow

It is as shown in Figure 7.

If applicants refurbish the facility to high-quality public toilets, they can apply for subsidies to DOR.

If an applicant meets DOR's requirements, his/her facility is recognized as a "Public Toilet," and DOR provides subsidies to him/her if the renovation is done properly.

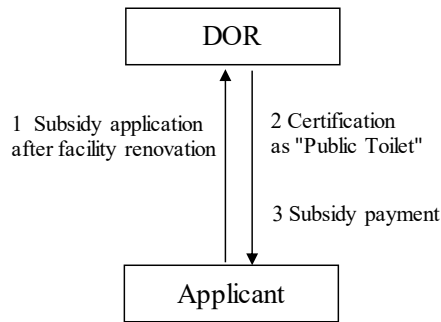


Figure 7 Procedure flow

Source: JICA Expert Team

2-3 Candidate Sites in Main Plan

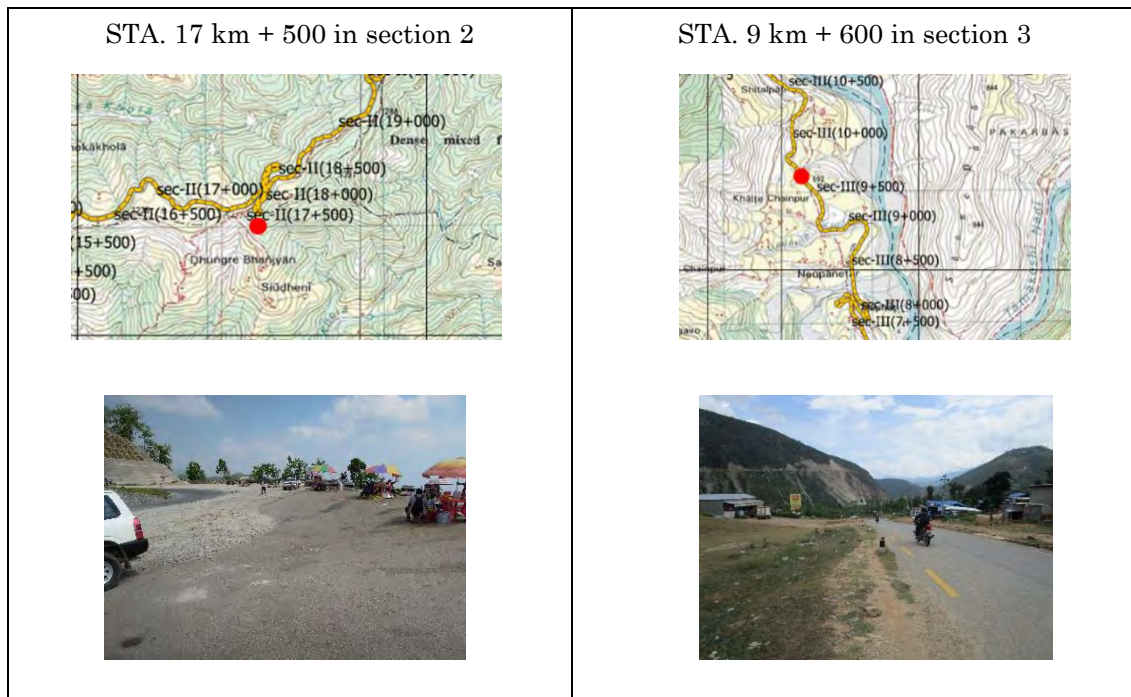
As shown in Figure 8, candidate sites are selected from each section 2, section 3 and section 4 that have steep roads.

STA. 17 km + 500 in section 2 has a good view.

STA. 9 km + 600 in section 3 is located near the toll plaza candidate site. Therefore, the working environment of the toll collection staff is expected to improve.

STA. 18 km + 400 in section 4 has a good view.

STA. 30k m + 400 in section 4 is located near the gas station. Therefore, it is expected to improve the function of the rest area.



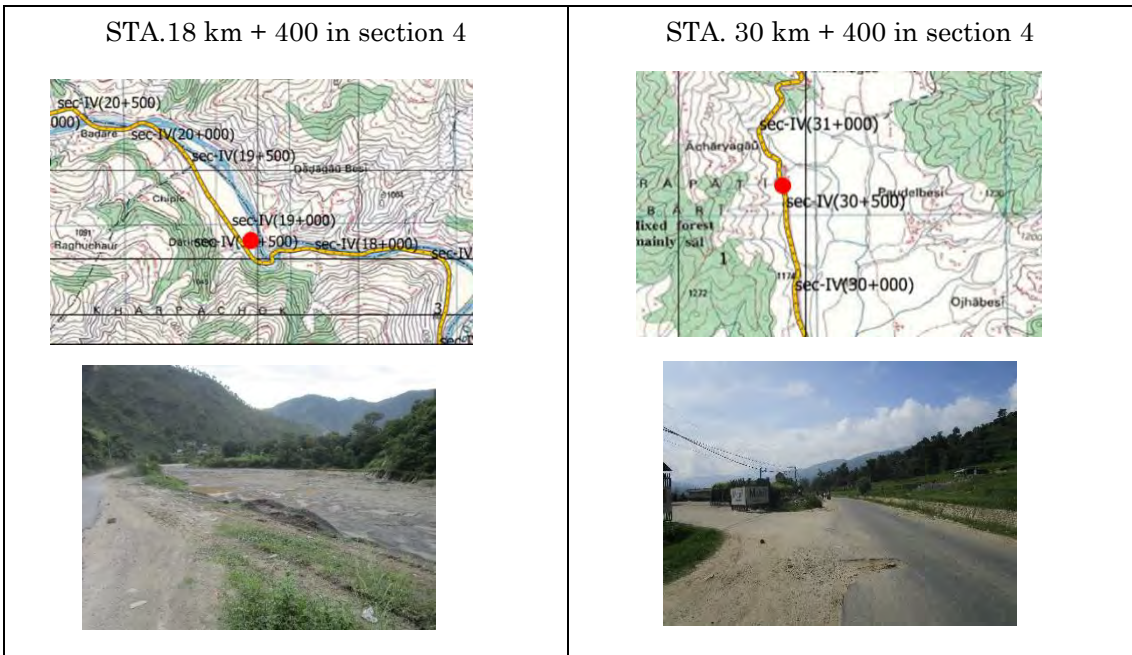


Figure 8 Candidate Sites in Main Plan

Source: JICA Expert Team

2-4 Model Case of Main Plan Candidate Site

Among these four candidate sites, STA. 17 km + 500 in section 2 is selected as a model case to examine details.

The details of the location of STA. 17 km + 500 in section 2 are as shown in Figure 9. In this section, slopes and curves continue.

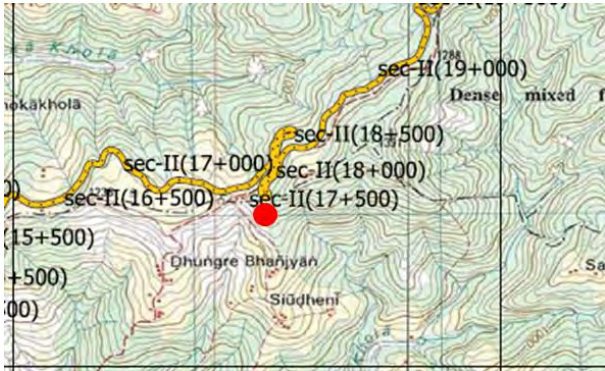




Figure 9 Model Case of Main Plan Candidate Site

Source: JICA Expert Team

2-4-1 Plan Overview

The area is 2,113.15m², the paving is the same as the main road, and a fall prevention fence is installed.

2-4-2 Parking Scale

The parking scale is calculated based on roadside traffic.

Table 7 shows the traffic volume by vehicle type for 2019 based on the traffic volume survey.

The number of vehicles per day (VPD) is classified into vehicle types and sections because toll road charges are classified into three types of vehicles according to the existing toll roads.

The traffic volume of Khurkot near the candidate site is 4,010 cars per day.

In consideration of future traffic increase, the number of vehicles per day becomes 5,000 for this study.

Table 7 Traffic Volume by Section in Sindhuli Road in 2019

Location by Section	Dhulikhel		Khurkot		Bardibas	
	VPD	%	VPD	%	VPD	%
a) Bus, Mini-Bus, Truck, Mini-Truck and Heavy Machinery Equipment	2,186	19%	1,074	27%	1,122	14%
b) Car, Jeep, Pickup Van and Tractor	2,513	22%	1,013	25%	1,105	14%
c) Three-Wheeler Tempo and Motorcycle L	6,746	59%	1,923	48%	5,667	72%
Total	11,445	100%	4,010	100%	7,894	100%

Source: JICA Expert Team

Eight parking spaces is secured based on roadside traffic, parking rate, peak rate, and turnover rate. The area is 400 m².

2-4-3 Toilet Scale

Based on parking scale, the area is 100 m². Three toilet stalls are for males and two for female.

2-4-4 Store Scale

The area is 100 m².

2-4-5 Layout Drawing

It is as shown in Figure 10 based on the parking scale, the toilet scale and the store sale.



Figure10 Layout of Rest Area

Source: JICA Expert Team

2-4-6 Financial Resources and Maintenance

This project should be implemented as a reconstruction project of DOR.

Maintenance should be carried out by routine maintenance as part of the road.

2-5 Implementation Plan (Tentative)

Implementation plan is as shown Figure 11.

2-5-1 Main Plan

For Step 1, assuming operations begins in 2021, internal regulations are set, and budgets are secured in 6 months. After that, design and construction take place for 20 months.

For Step 2, the internal regulations are enacted after 2022.

2-5-2 Sub Plan

Internal regulations are set, and budgets are secured in 6 months. After that, the system operation starts.

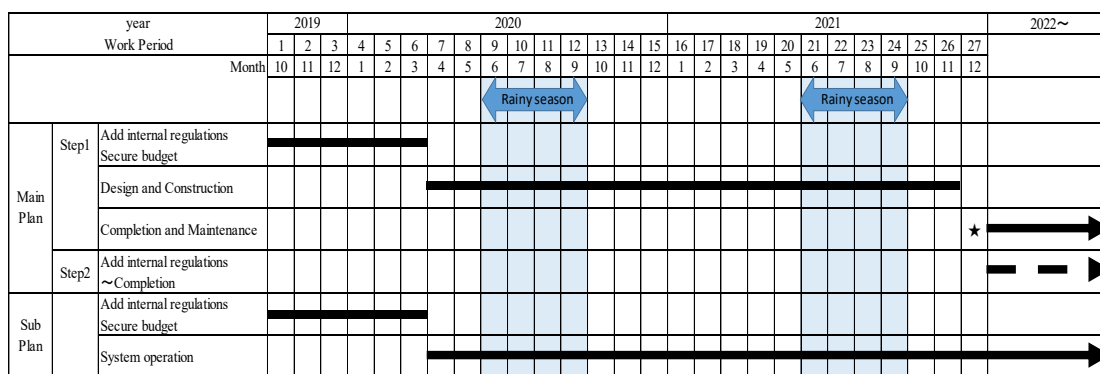


Figure 11 Implementation plan (Tentative)

Source: JICA Expert Team

Chapter 3 Conclusion

- Concept of Rest Area is the following three.
 - 1 Provide high quality resting facilities as road traffic safety facilities.
 - 2 In Step1, parking lots and toilets are provided as a road traffic safety facility. For the future, as Step 2, stores or restaurants are provided as profitable facilities.
 - 3 DOR, local governments and private companies perform operation and maintenance of the installation together.

- First, DOR establishes regulation and installation of a parking lot and toilet as a road traffic safety facility.

Chapter 4 Recommendation

For the future, it is recommended to install “Michi-No-Eki” along Sindhuli Road.

“Michi-no-Eki” is a multi-purpose facility that serves not only for tourists but also for social and economic activities in the local community.

The major facilities required are below.

- Information Office of Traffic and Disasters
- Maintenance Office of the Road
- Administrative Information Desks
- Police Box
- Meeting Rooms for Community
- Tenancy Spaces for Shops or Cafe Restaurants
- Toilets
- Gas Station

The potential site of “Michi-no-Eki” is Khurkot bus terminal. It is an important traffic location near the intersection of Sindhuli Road, Khurkot Manthali Road and Khurkot-Ghurmi Madhya Pahadi Highway.

In addition, the surplus soil in the Sunkoshi Marin Water Diversion Project may be used for leveling.

As shown in Figure 12, the land adjacent to the Khurkot bus terminal is improved, and the major facilities are placed.

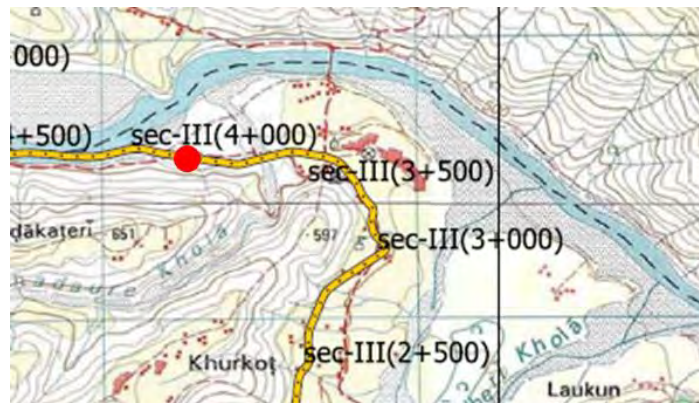


Figure12 Layout image of “Michi-no-Eki”

Source: JICA Expert Team

It is expected that DOR and local government collaborate in the construction of the “Michi-no-Eki”, which plays a role in social and economic development of the district.

**The Project for
Operation and Maintenance of
The Sindhuli Road Phase 2**

**Preliminary Survey Report
For
The Road Improvement Plan**

March 2020

JICA Expert Team

- Table of Contents -

- 1	General	1
1.1	Background.....	1
1.2	Objective of the Survey	1
1.3	Survey Approach for Each Section	1
- 2	Improvement Plan for Section I, Ch. 0 – 44 km (Bardibas - Chiyabari)	3
2.1	Site Situation.....	3
2.2	Design Conditions	7
2.3	Preliminary Design of the Road Improvement	9
- 3	Improvement Plan for Section II and III, Ch. 44 – 110 km (Chiyabari - Khurkot - Nepalthok)	31
3.1	Road Situations.....	31
3.2	Road Improvement Plan	32
- 4	Improvement Plan for Section IV, Ch. 110 – 160 km (Nepalthok – Dhulikhel)	36
4.1	Site Situations	36
4.2	Previous Improvement Activities	37
4.3	Current Problems	38
4.4	Design Condition	42
4.5	Preliminary Design of Road Improvement	44
4.6	Road Safety Measure.....	63
- 5	Suggestions	69

1 General

1.1 Background

After full opening of the Sindhuli Road (National Highway NO.6) from Dhulikhel to Bardibas in 2015, traffic volume of the Sindhuli Road is drastically increasing year by year. This change is caused by not only activating of socio-economic activities among the vicinity areas, but also connection with the Mid Hill Highway and the increase in traffic movement between Kathmandu and Terai in eastern area. Along with the increase of the traffic volume, the number of traffic accident in the Sindhuli Road is increasing, thus conducting effective countermeasures is an urgent issue. On the other hand, the government of Nepal is aiming to upgrade the Sindhuli Road to higher class National Highway. Road widening of the Sindhuli Road to 2-lane road, currently 1.5-lane road, is one of the government strategies. However, the most part of the Sindhuli Road is located in steep terrain and difficult to widen.

1.2 Objective of the Survey

This preliminary survey is purposed to indicate a policy for the improvement works of the target section. This result is expected to be utilized as a guideline for the smooth implementation of the various improvement works which will be performed on the Sindhuli Road.

There are 2 demands need to be satisfied, one is road safety improvement and the other is government strategy for upgrading the Sindhuli Road as a National Highway. In order to satisfy these demands, the following items need to be considered.

To achieve road safety improvement,

- ✓ reduction of head-on collision and speed
- ✓ prevention of vehicles' falling from road
- ✓ improvement of driving comfort (to keep concentration), and
- ✓ improvement of pedestrian safety

are considered.

To achieve upgrading the Sindhuli Road as a National Highway,

- ✓ selection of possible section of Road widening (Partial widening) and
- ✓ basic widening methodology

are considered.

1.3 Survey Approach for Each Section

This survey covers entire stretch of the Sindhuli Road from Bardibas to Dhulikhel. However, since roadside conditions / characteristics and the types of improvement required are different for each section, the work items and approaches differ for each section. Survey approach for

each section of the Sindhuli Road is mentioned in the following table. It is noted that the first 7 km from Bardibas is being implemented as a priority section based on agui, therefore, this report basically focuses the remaining part of the Sindhuli Road.

Table 1-1 Survey Approach for Each Section

Section	Approach
[Ch.0+000 – 44+000] Section I + first 7 km of Section II (Bardibas – Chiyabari)	To find out the possible section and methodology for the road widening with minimum technical difficulty and risk. To improve the road closure/collapse portion.
[Ch.44+000 – Ch.77+000] Section II after Chiyabari (Chiyabari – Khurkot)	To find out the suitable space for emergency parking and passing lane
[Ch.77+000 – 110+000] Section III (Khurkot – Nepalthok)	To find out the suitable space for emergency parking and passing lane
[Ch.110+000 – 160+000] Section IV (Nepalthok - Dhulikhel)	To extend the safety measures to as many sections as possible, with reviewing the past implementations and the latest data of accident prone spot.

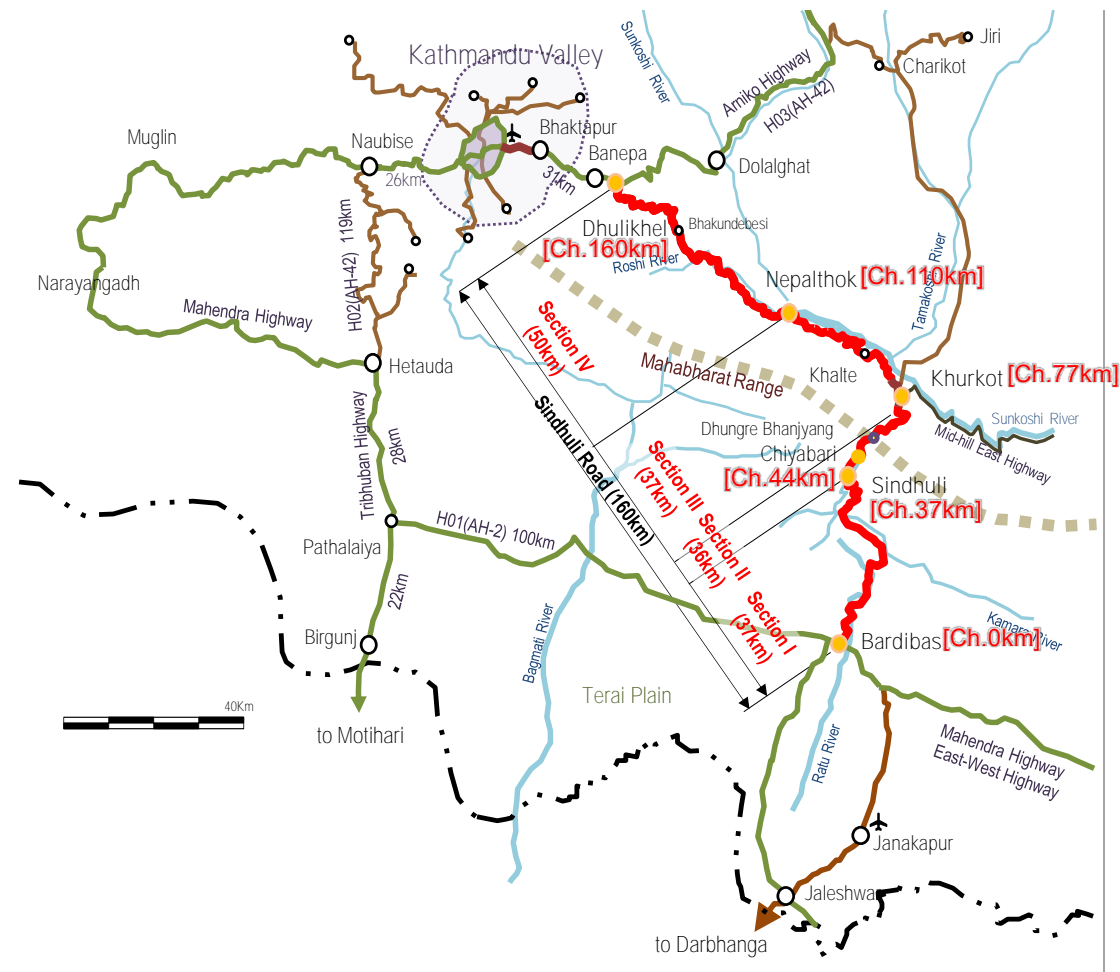


Figure 1-1 Location Map of Each Section

2 Improvement Plan for Section I, Ch. 0 – 44 km (Bardibas - Chiyabari)

2.1 Site Situation

2.1.1 Roadside Features

The target section starts from Ch.0+000 in Bardibas to Ch.44+000 in Chiyabari. The features of target section are shown below.

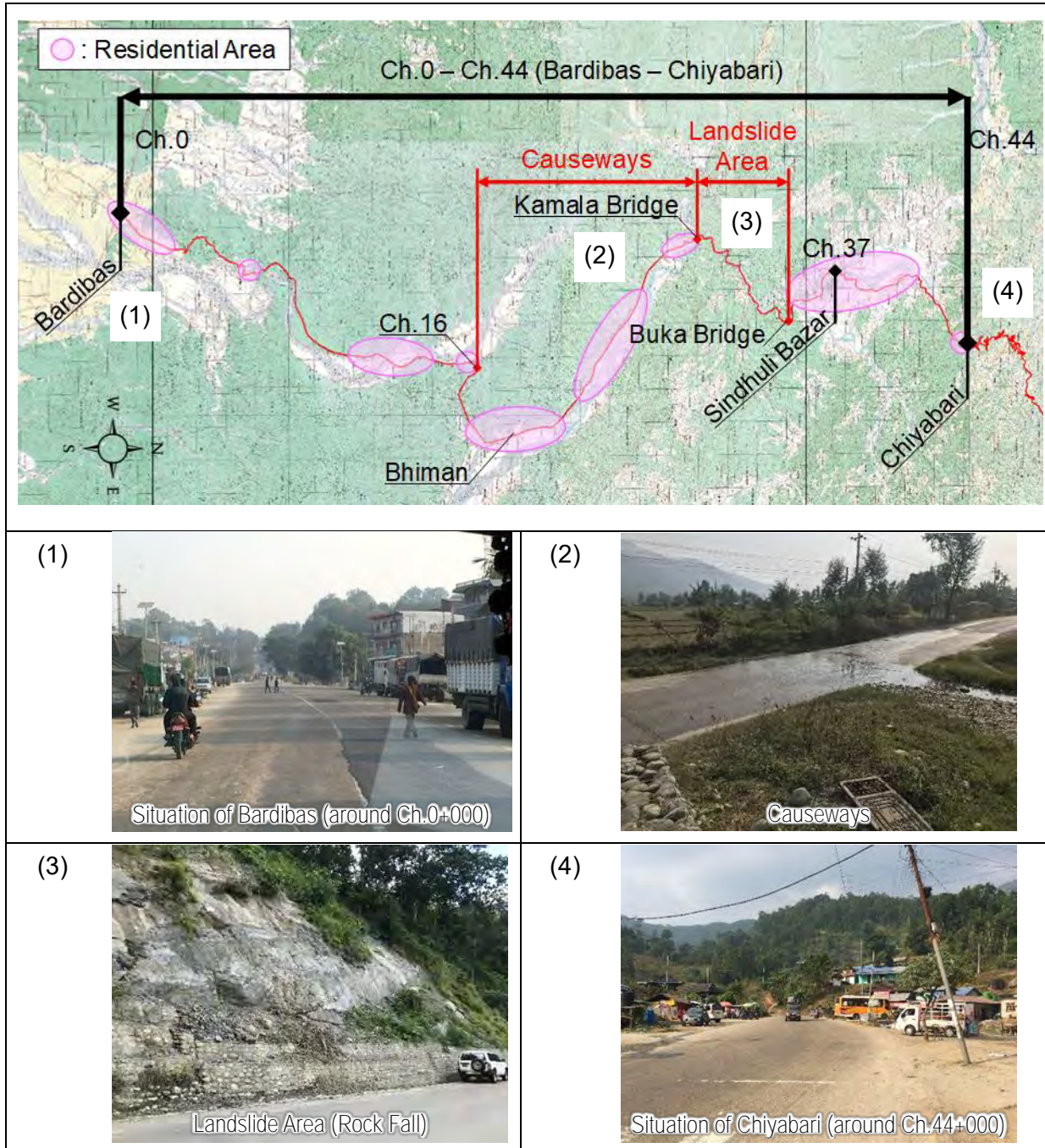


Figure 2-1 Roadside Features of Target Section (Ch. 0+000 – 44+000)

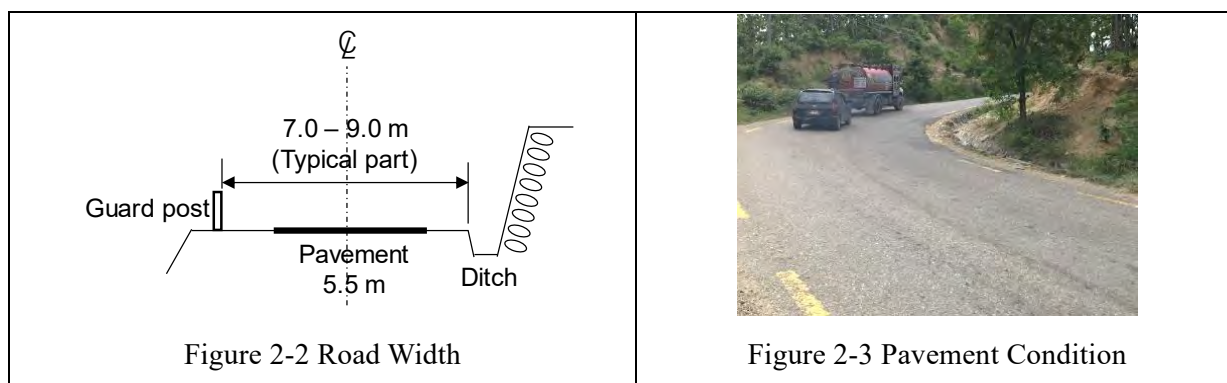
2.1.2 Existing Road Conditions

(1) Road Width

Road width between guard posts or ditches varies by the place. Typically it is from 7.0 m to 9.0 m, but there are some exceptionally narrow part. Pavement width is generally 5.5m through the all section.

(2) Pavement Condition

Current road pavement conditions are relatively good because of proper maintenance activities, but there is partial damaged portion due to several causes such as ground settlement and heavy vehicle load.



2.1.3 Road Crossing Structures

There are 10 bridges and 23 causeways in the section from 0 to 44 km. Most of structures were constructed in 1990's with fund of Japanese grant and few structures are constructed by DOR. According to the site observation, some causeways are frequently suffered from temporary road closure due to principally flooding and debris. Carriage way width of bridges are generally 6.0m which can secures 2 lane traffic other than Gwang Bridge which is only 4.5 m of one way traffic.

Table 2-1 Major Crossing Structures in 0 km - 44 km Section

No.	Ch.	Type	Name	Length (m)	Issue
B1	7+830	Bridge	Bhogate Bridge	60	
B2	8+225	Bridge	Karkare Bridge	50	
B3	8+305	Bridge	Gangate Bridge	30	
B4	12+625	Bridge	Ratu Bridge	270	
Co1	16+300	Floodway	Existing old causeway - 1	20	
Co2	16+400	Floodway	Existing old causeway - 2	20	
C1	17+150	Floodway	Chor Khola Causeway	60	Sometime closed by flood
C2	17+600	Floodway	Karki Khola Causeway	30	Frequently closed by water & debris / Steep Gradient
C3	18+300	Floodway	Dhabsar Khola Causeway	40	
C4	19+400	Floodway	Sukhe Khola Causeway	40	Sometime closed by flood
Co3	19+600	Floodway	Existing old causeway - 3	40	Frequently closed by water
C5	20+100	Floodway	Panesi Khola Causeway	30	The most frequently closed by water & debris
C6	21+250	Floodway	Hardiya Khola Causeway	30	Frequently closed by water
C7	21+800	Box Type	Bhurunga Khola Causeway	30	
C8	22+010	Floodway	Guhe Khola Causeway	40	Sometime closed by flood
C9	22+300	Floodway	Thado Khola Causeway	60	Sometime closed by flood
Cn1	23+000	Floodway	New causeway - 1	40	
C10	23+400	Floodway	Maintar Khola Causeway	60	Sometime closed by flood
C11	23+800	Floodway	Damai Khola Causeway	40	Sometime closed by flood
Cn2	24+150	Floodway	New causeway - 2	40	
C12	24+600	Floodway	Panighat Khola Causeway	80	Sometime closed by flood
C13	25+100	Floodway	Thapa Khola Causeway	80	Sometime closed by flood
C14	25+800	Floodway	Beljholi Khola Causeway	30	
C15	26+100	Box Type	Kalyani Khola Causeway	30	
C16	26+600	Floodway	Balabathan Khola Causeway	80	Sometime closed by flood
Cn3	26+980	Floodway	New causeway - 3	40	
C17	27+300	Box Type	Dhabsar Khola Causeway	50	
B5	28+220	Bridge	Sindure Bridge	60	
B6	28+950	Bridge	Kamala Bridge	120	
B7	32+405	Bridge	Phitting Bridge	50	
B8	34+345	Bridge	Buka Bridge	50	
B9	35+175	Bridge	Gadouli Bridge	50	
B10	43+350	Bridge	Gwang Bridge	48	

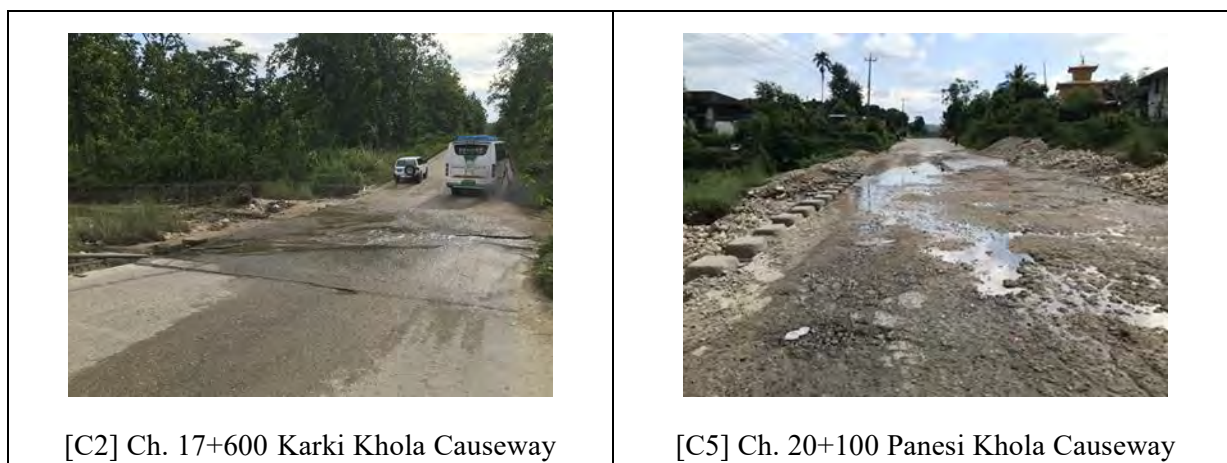


Figure 2-4 Causeways Frequently Closed by Flooding

2.1.4 Accident Record

The accident recording for the Sindhuli Road has been done from 2008 and still given continuation in all the four sections. The total number of accidents in Section I from 2012 to 2018 is 102 out of which 48 accidents occurred in past two years. The accident records show massive increase in the number of accidents in this section in past two years. Similarly the total number of accident casualty in Section I is 440 which is the highest compared to other sections including 51 fatal and 165 serious casualties. The records shows that more than 45% of vehicles involved in the accidents are motorcycles. In the portion between Ch. 37+000 to 44+000 (Section II), accident clusters have been seen on Ch. 39+200, 42+500 and 43+200.

2.2 Design Conditions

2.2.1 Design Policy

For the improvement of the target section, the design is to conform to the Class II road described in Nepal Road Standard 2070 B.S. (July, 2013 A.D.) as much as possible. The recommended basic policies for the road improvement is shown in Table 2-2.

Table 2-2 Recommended Basic Policies for Road Improvement

Item		Basic Policy
Widening section		<ul style="list-style-type: none"> ➤ Areas difficult to widen are defined as “no widening” section, such as areas with landslides, both side structures, or any other difficulties which make construction cost or risk much higher. ➤ The minimum stretch of widening section is 1 km. In case the stretch is less than 1 km, the section is defined as “no widening” section.
Cross section	General	➤ Road cross section widening is planned within the width of the right of way (25m on the both sides).
	Carriageway	➤ 7.0 m (3.5 m x 2 lanes) carriageway is secured in all section.
	Shoulder	➤ Shoulder width can be varied depending on existence of structures, risk slope, deep valley, etc. are constraining the width.
	Footpath	<ul style="list-style-type: none"> ➤ In the section where many pedestrians walking, footpath is to be provided on the effective side as much as space allows. ➤ Shoulder width can be reduced by regarding the width of footpath as a part of shoulder width, but not less than 1.0 m.
Road centerline		➤ Shift of road centerline is acceptable in case that there is roadside structure to be kept and continuity of the alignment is not so much affected.
Utilization of existing structure		<ul style="list-style-type: none"> ➤ If the existing pavement has the enough strength that can conform to the structural requirement, utilization of existing pavement is considered. ➤ The existing drainage and retaining walls are maintained if possible.

2.2.2 Design Criteria

The proposed design criteria for improvement of Section I is shown in Table 2-3. Basically, Nepal Road Standard 2070 B.S. (July, 2013 A.D.) is to be conformed. In difficult area, such as landslide prone area, reduction of shoulder width is considered.

Table 2-3 Technical/Functional Classification in Nepal Road Standard

Class I	Class I roads are the highest standard roads with divided carriageway and access control (Expressways) with ADT of 20,000 PCU or more in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 120 km/h.
Class II	Class II roads are those with ADT of 5000-20000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 100 km/h.
Class III	Class III roads are those with ADT of 2000-5000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 80 km/h
Class IV	Class IV roads are those with ADT of less than 2000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 60 km/h

Table 2-4 Proposed Design Criteria

Items of Design Criteria	Nepal Road Standard 2070 (July, 2013)		Proposed Parameters	
			Ch.0+000 - 44+000 (Bardibas - Chiyabari: 44 km)	
1 Terrain Classification	Rolling Terrain	Mountainous Terrain	Rolling Terrain	Mountainous Terrain
2 Highway Classification	Class II	Class II	Class II	Class II
3 Traffic Capacity	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000
4 Design Speed	60 km/hr - 80 km/hr	40 km/hr - 60 km/hr	60 km/hr	40 km/hr
5 Formation width	12.0 m (desirable) 9.0 m (minimum)	12.0 m (desirable) 9.0 m (minimum)	9.0 - 12.0 m	9.0 - 12.0 m
6 Carriageway width	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m
7 Shoulder width	2.5 m x 2 = 5.0 m (desirable) 1.0 m x 2 = 2.0 m (minimum)	2.5 m x 2 = 5.0 m (desirable) 1.0 m x 2 = 2.0 m (minimum)	(1.0 - 2.5 m) x 2 = 2.0 - 5.0 m	(1.0 - 2.5 m) x 2 = 2.0 - 5.0 m
8 Maximum gradient	6.0% (at 80 km/hr) 7.0% (at 60 km/hr)	7.0% (at 60 km/hr) 9.0% (at 40 km/hr)	6%	7%
9 Minimum Radius	210 m (at 80 km/hr) 110 m (at 60 km/hr)	110 m (at 60 km/hr) 40 m (at 40 km/hr)	110 m	40 m
10 Sight distance	130 m (at 80 km/hr) 80 m (at 60 km/hr)	80 m (at 60 km/hr) 50 m (at 40 km/hr)	80 m	50 m
11 Overtaking distance	470 m (at 80 km/hr) 300 m (at 60 km/hr)	300 m (at 60 km/hr) 165 m (at 40 km/hr)	300 m	165 m

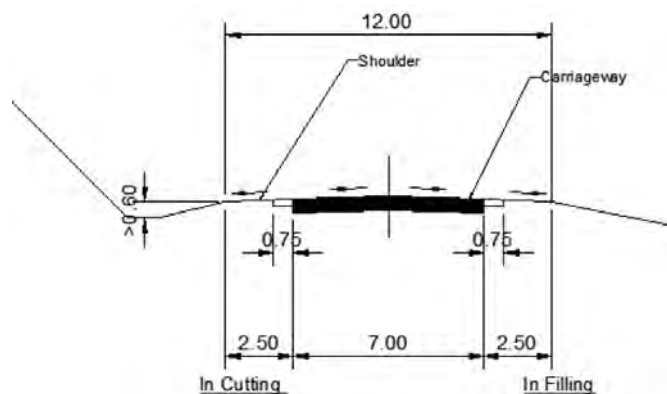


Figure 2-5 Typical Cross Section of Class II Road in Nepal Road Standard 2070 B.S (July, 2013 A.D.)

2.3 Preliminary Design of the Road Improvement

2.3.1 Road Widening

(1) Typical Cross Section

Standard road width is proposed as shown in Table 2-5.

Table 2-5 Proposed Width of Cross Section to be Applied

Roadside Condition	Cross Section Type	Width (m)			Note
		Carriage way	Shoulder	Formation	
Town Area	Type A	7.0 (3.5 x 2)	1.5 – 2.5	10.0 – 12.0	Footpath is provided in school & market area.
Rural Area	Type B	7.0 (3.5 x 2)	1.0 – 1.5	9.0 – 10.0	The minimum value of shoulder in the standard is 1.0 m.
			0 – 1.0	7.0 – 9.0	In case that shoulder width is less than 1.0 m, the pavement of shoulder is recommended to be constructed by the same composition as carriage way and separated by painted line.

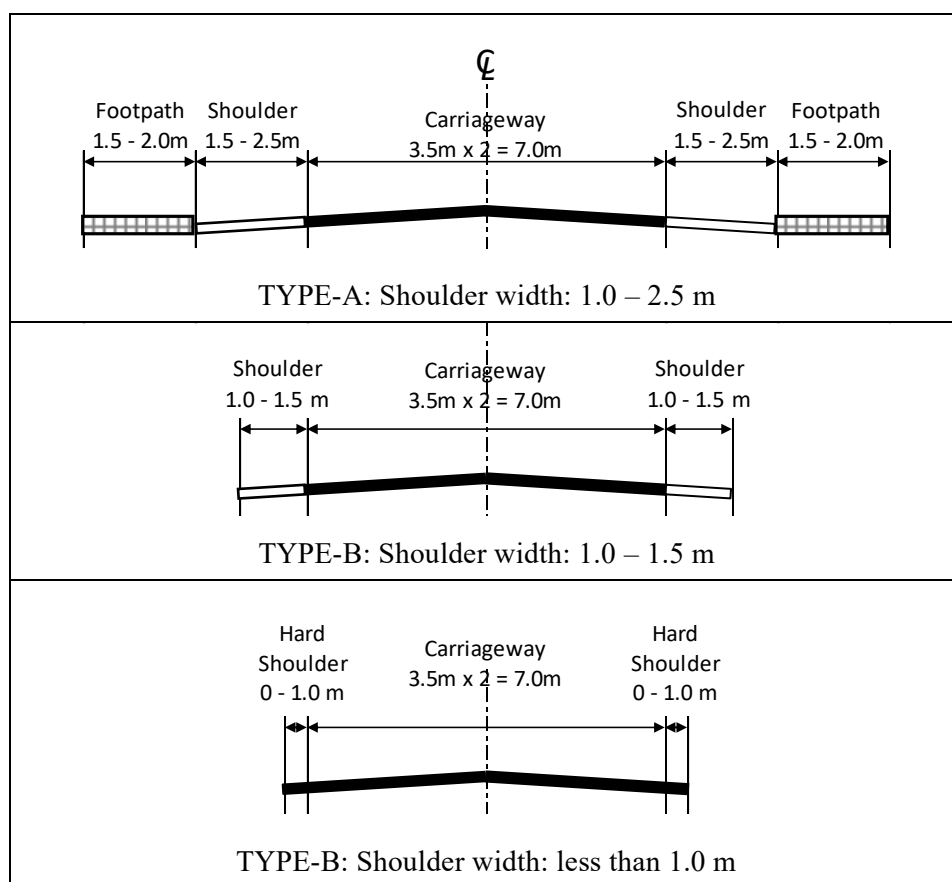


Figure 2-6 Images of Typical Cross Sections

(2) Application of Cross Section Type

1) Application of Type A and B

Type A is applied to Town Area. Residential area exists along the roadside in this area. There are many pedestrians. Sufficient width of shoulder for Class II road is recommended to be secured as much as possible and installation of footpath is considered. In case footpath is provided, shoulder width can be reduced by regarding the width of the footpath as a part of shoulder width, but not less than 1.0 m. Isolated area which has less pedestrian is not necessarily need to introduce footpath.

Type B is applied to Rural Area. Almost no residential area exists along the roadside in this area. There are almost no pedestrians. Shoulder width can be reduced when widening is constrained by existing structures, risk slopes, deep valleys, etc.

2) Difficult Section

For sections where even a reduced width like Type B is not applicable due to steep terrain or high risk of slope-failure, there is room to consider how to secure the road width wider as much as possible for drive safety and comfort. One conceivable solution is to utilize space of the existing road side drainage. Current road side drainage type of the Sindhuli Road is U-shaped

masonry drains. Instead of this, safer type drainage as shown in the following figure can provide extra width for safe driving. In addition, pre-cast U-shaped drain may contribute to minimize the space.

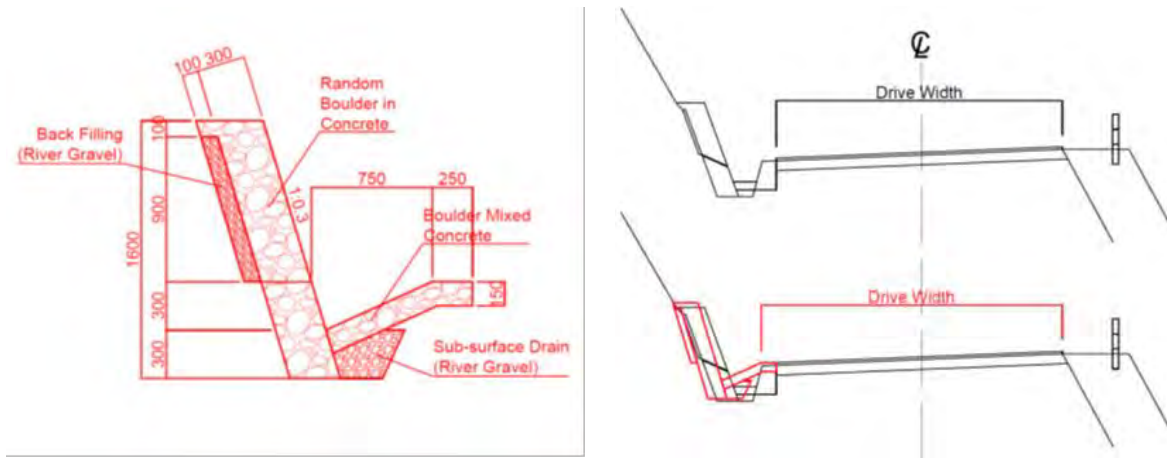


Figure 4-7 Details of Safer Type Drainage



Masonry Type



Safer Type

Figure 4-8 Photo of Side Drainage

3) Examples of Application

An example application of each cross section type for the section from Ch.0 to Ch.44 is summarized in the tables below, and its detailed breakdown is shown in the following figures. It is noted that area division and cross section composition should be determined based on the detailed survey.

Table 2-6 Summary of the Example Application

From	To	Dist.	Widening	Footpath	Remarks
000+000	000+400	400	Widened	Both	Already widened
000+400	002+500	2,100	Type A	Both	
002+500	005+500	3,000	Type B	-	BR:Bhagate, BR:Gangate
005+500	006+500	1,000	Type A	Both/Left	BR:Ratu
006+500	010+700	4,200	Type B	-	
010+700	014+000	3,300	Type A	Both/Right	
014+000	015+000	1,000	Type B	-	
015+000	015+900	900	Type A	Both/Left	
015+900	017+600	1,700	Type B	-	
017+600	021+300	3,700	Type A	Both/Right	Bhiman
021+300	022+300	1,000	Type B	-	
022+300	025+400	3,100	Type A	Both/Right	
025+400	027+300	1,900	Type B	-	
027+300	028+900	1,600	Type A	Left/Right	BR: Sindure,
028+900	034+400	5,500	Difficult	-	Landslide
034+400	035+300	900	Type B	-	BR: Gadouli
035+300	037+000	1,700	Type A	Both	
037+000	040+200	3,200	Widened	Both/Left	Already widened
040+200	042+000	1,800	Type B	-	
042+000	044+000	2,000	Difficult	-	BR: Gwang

Table 2-7 Proportion of Type Application

Application	Dist.	Ratio	Remarks
Type A	17,400	40%	Footpath is applied as necessary
Type B	15,500	35%	
Already widened	3,600	8%	Footpath is applied as necessary
Difficult	7,500	17%	Restoration of drainage is conceivable
Total	44,000	100%	

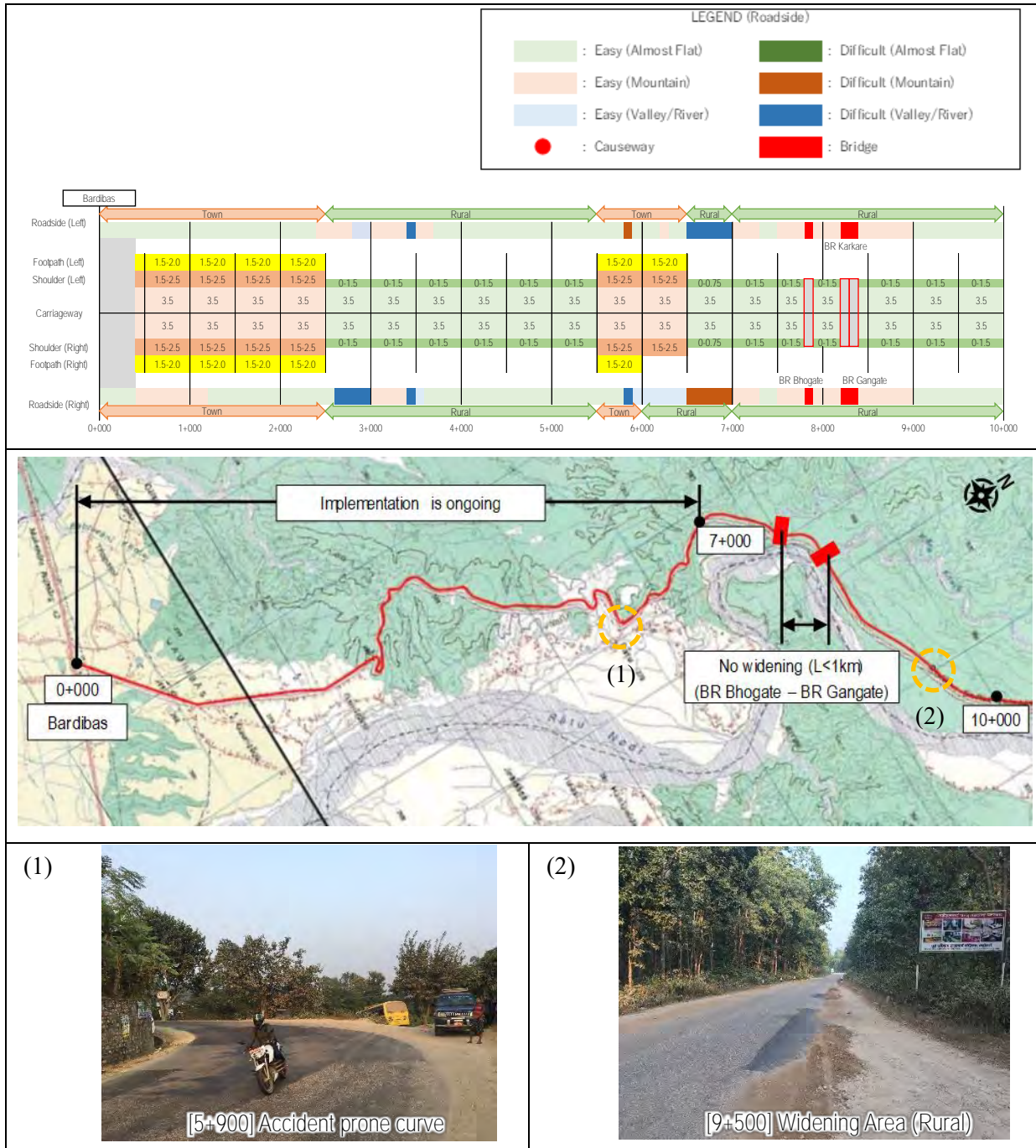


Figure 2-9 Example of Application of Cross Section Type (Ch.0-10km)

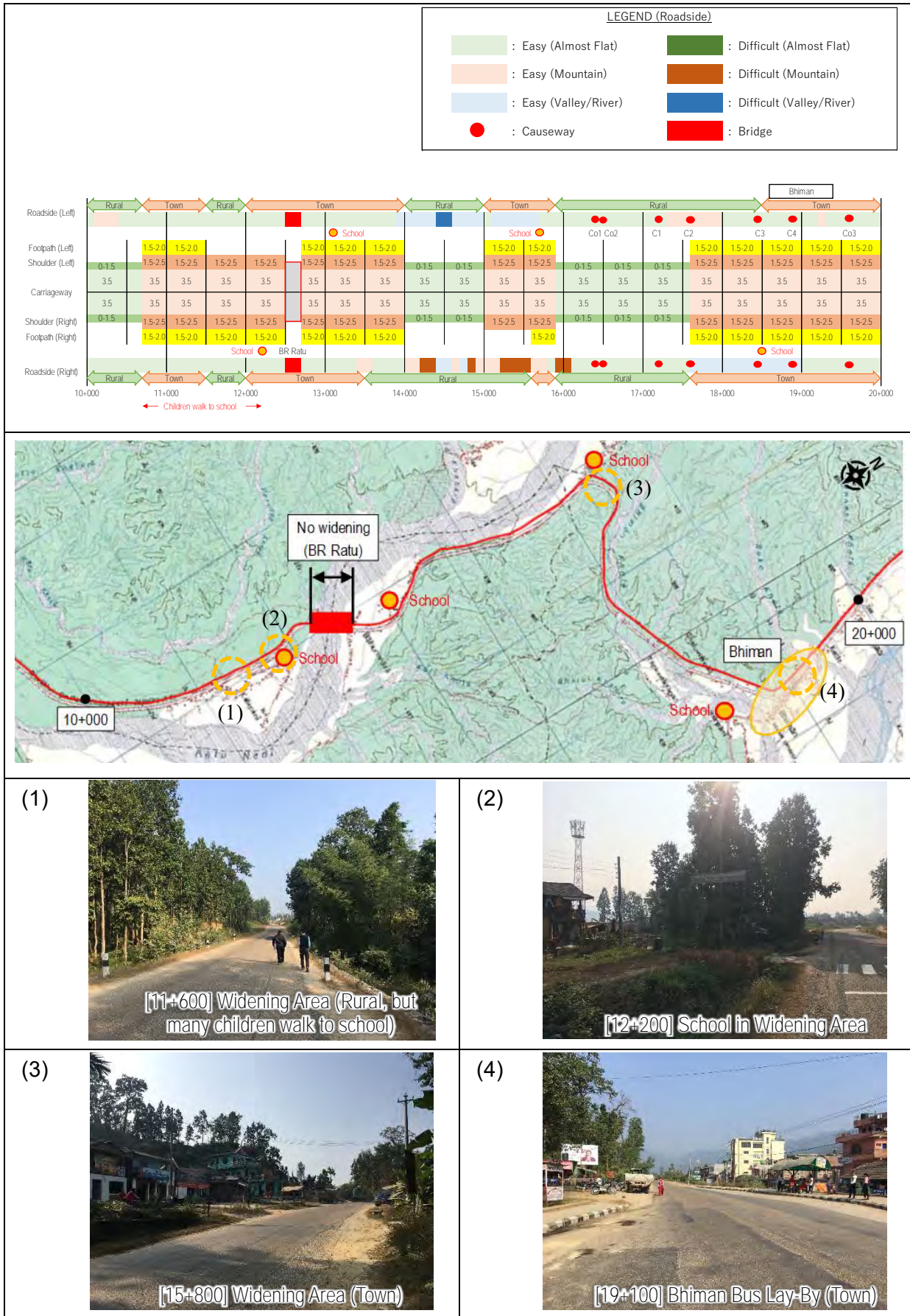


Figure 2-10 Example of Application of Cross Section Type (Ch.10-20km)

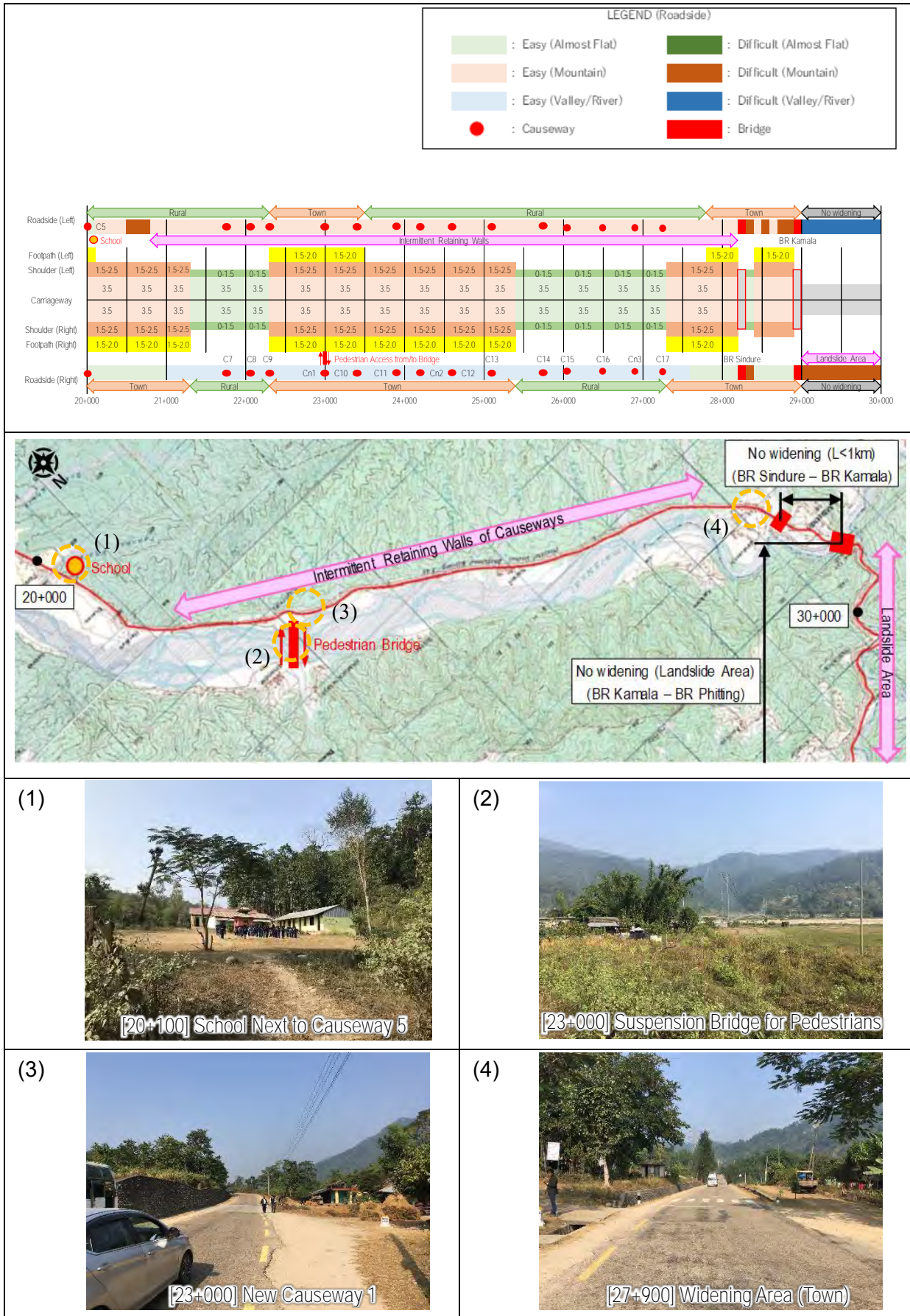


Figure 2-11 Example of Application of Cross Section Type (Ch.20-30km)

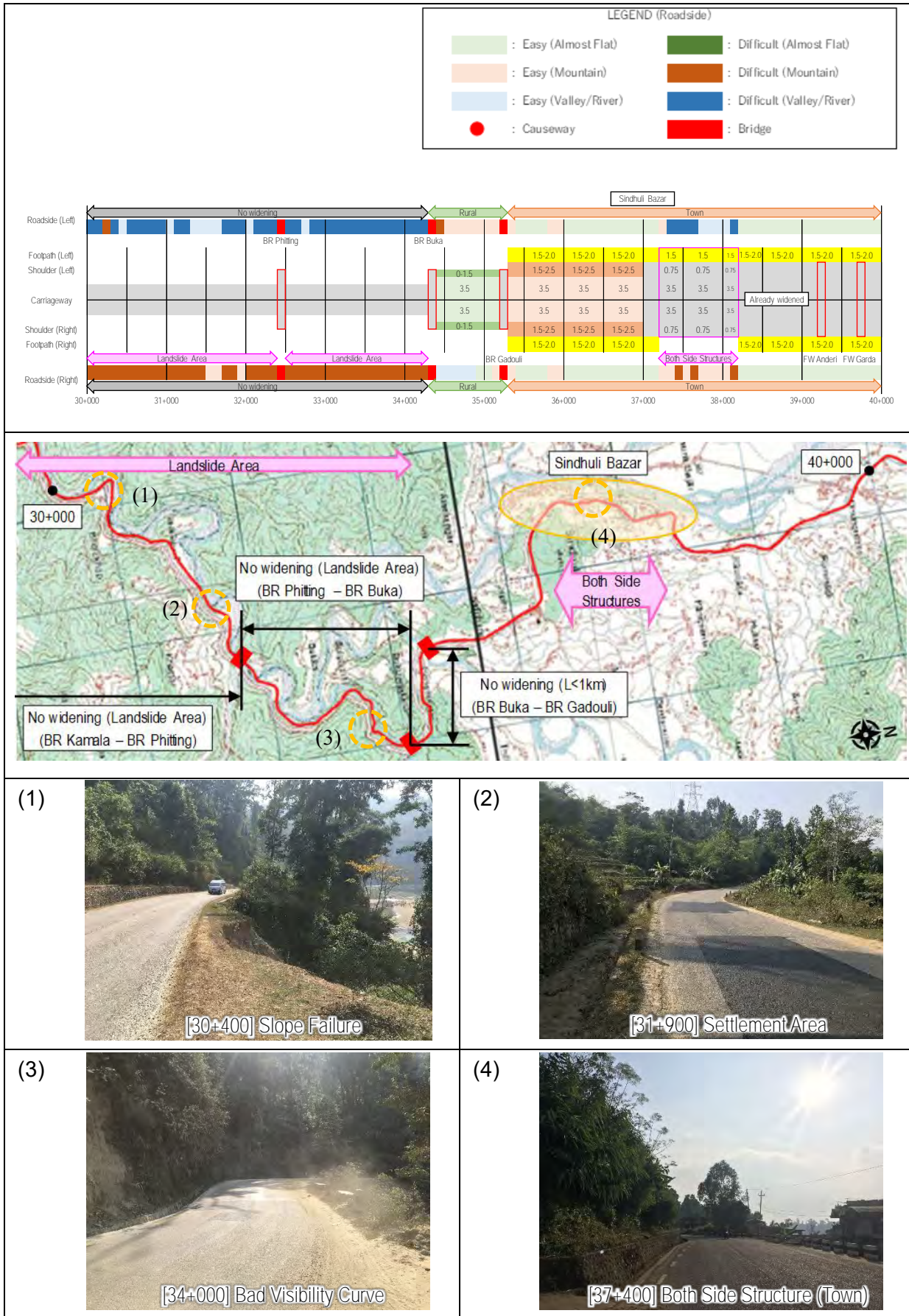


Figure 2-12 Example of Application of Cross Section Type (Ch.30-40km)

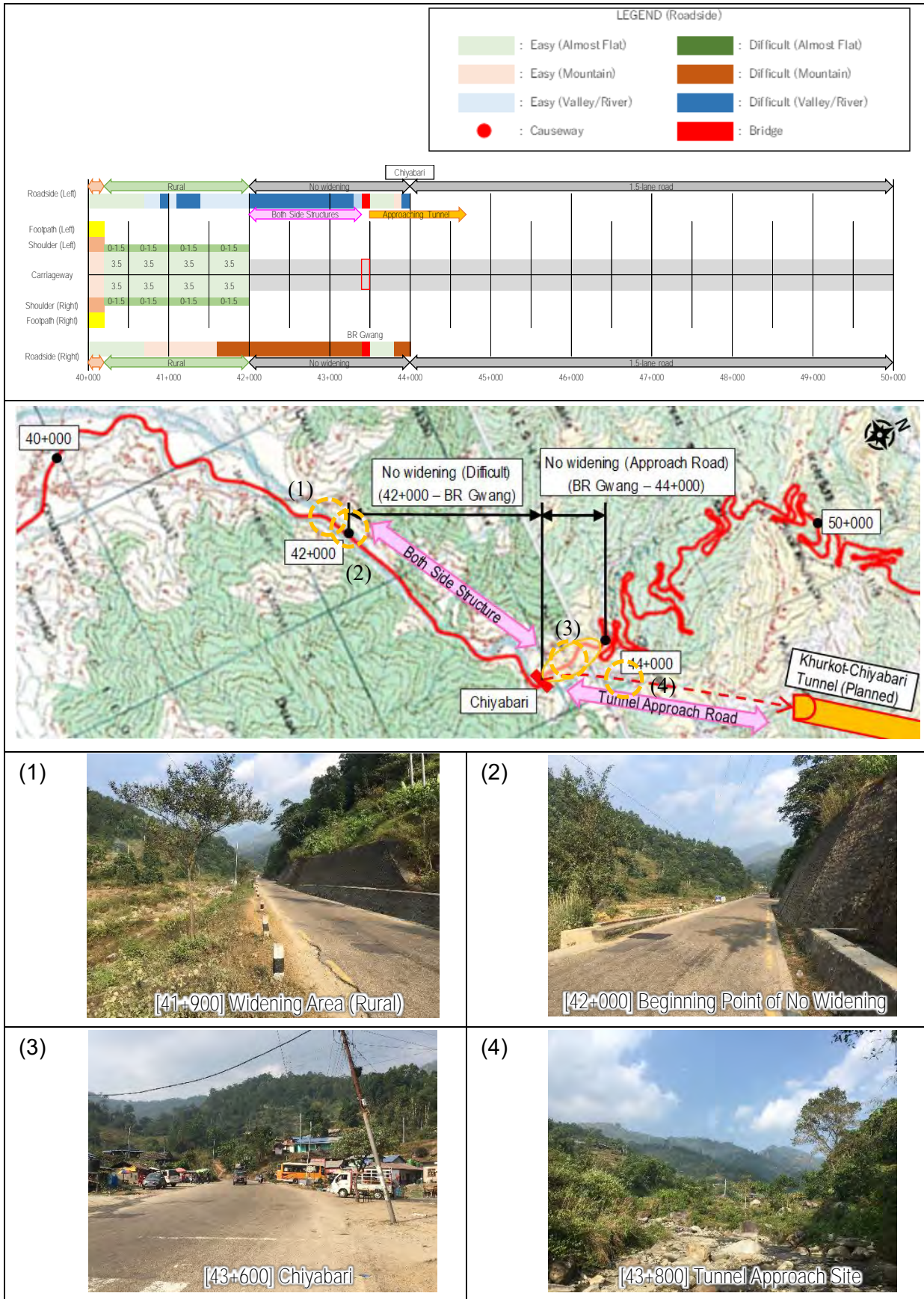


Figure 2-13 Example of Application of Cross Section Type (Ch.40-44km)

(3) Widening Method

Recommended widening method is shown in Table 2-8.

Table 2-8 Recommended Widening Method

Case No.	Constraint (Retaining wall, risk slope, valley)	Existing Width Between Constraints	Recommendation
1	No constraint	Enough	No centerline shift is recommended.
2	One side	Enough	Centerline shift is recommended, but consideration on the continuity of the alignment is necessary.
3	Both sides	Not enough	Option-1: Widening within the existing road width with reducing the width of shoulders. Option-2: Widening to the economical or safer side with centerline shift. Consideration on the continuity of the alignment is necessary.

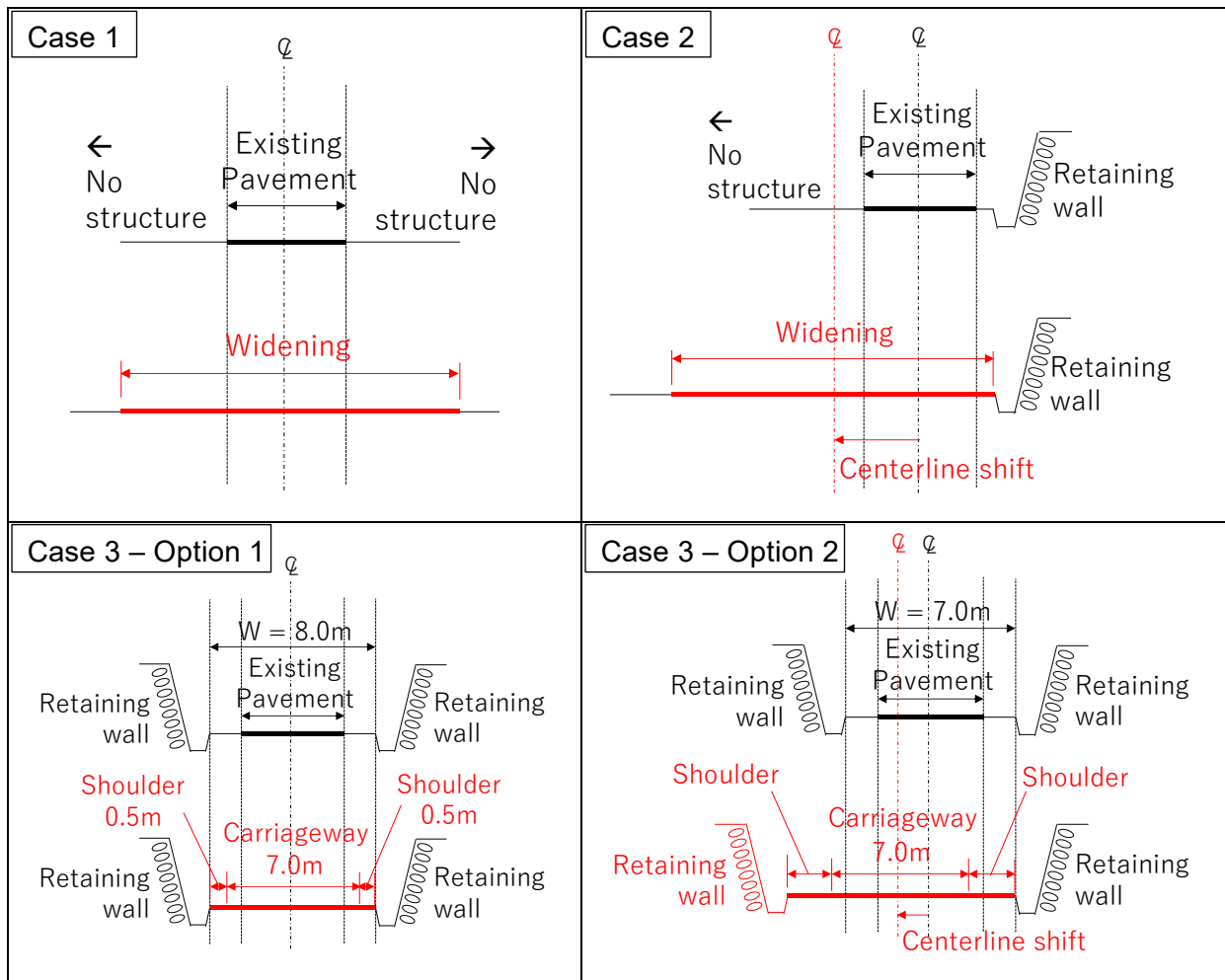


Figure 2-14 Image of Recommended Widening Method

(4) Consideration on Centerline Shift

Although basic widening method is to follow the original centerline, because of constraint on the roadside, the road centerline shifting may be required depending on the situation. Centerline shifting itself is no problem for the comfort drive, but if such shift occurs frequently in short section, the road alignment will be worse. From this reason, enough shift length is recommended to be provided in accordance with its shift width and design speed. For example, the standard shift length is defined as the following table in Road Structure Ordinance of Japan. Comparing the value from formula and minimum, larger value is taken as the standard shift length. For reference, when $V = 60$ (km/hr) and $\Delta W = 1.5$ (m), calculated shift length $L = 45$ m (< 60 m). Then, $L = 60$ m.

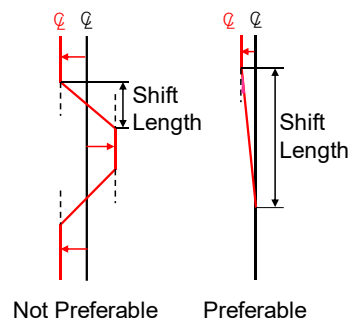


Figure 2-15 Centerline Shift

Table 2-9 Standard Shift Length in Road Structure Ordinance of Japan

Design Speed V (km/h)	Rural Area		Urban Area	
	Formula (m)	Minimum (m)	Formula (m)	Minimum (m)
80	$\frac{V \cdot \Delta W}{2}$	85	$\frac{V \cdot \Delta W}{3}$	-
60		60		40
50	$\frac{V \cdot \Delta W}{3}$	40		35
40		35		30
30		30		25
20		25		20

* ΔW : Shift width

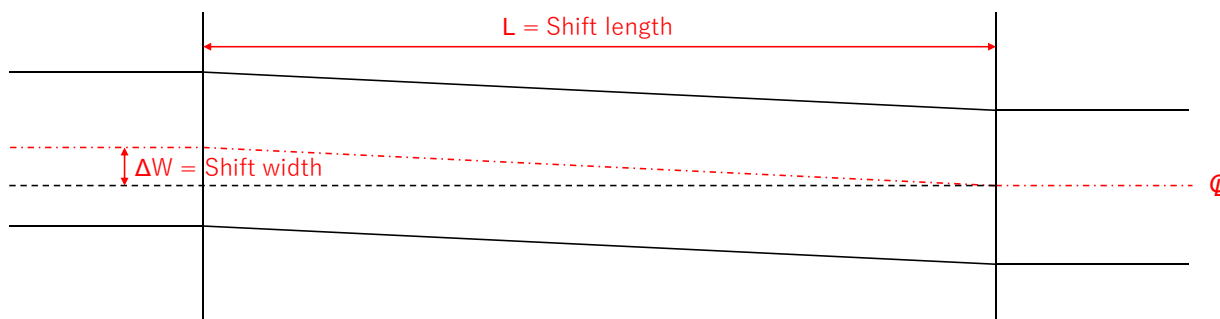


Figure 2-16 Consideration of the Necessary Shift Length

(5) Consideration on Transition of Lane

In widening sections, driving speed is expected to be higher than that of no-widening sections. These sections cannot be connected directly. It needs adequate transition section from 1.5 lanes to 2 lanes and from 2 lanes to 1.5 lanes. Warning sign which shows “lane decrease ahead” is recommended to install before transition begin. This draws drivers’ attention and makes speed lower.

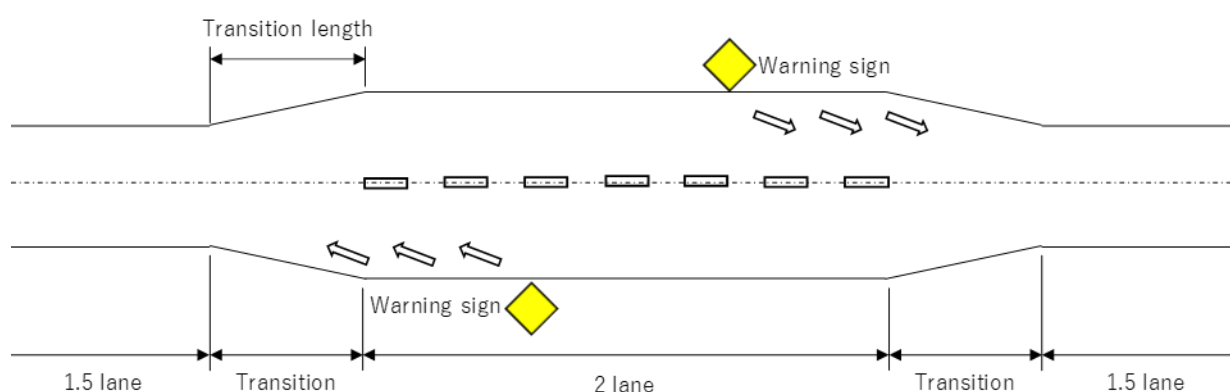


Figure 2-17 Transition of Lane

(6) Widening in Specific Area

In some part of widening section, it is important to consider the method of widening or provision of footpath, for example topographically difficult or pedestrian area. It should be carefully determined based on detailed survey.

a. Pedestrian needs in Rural Area (Ch.11+500 – Ch.12+000)

This part is surrounded by forest and there are almost no houses on roadsides. However, in morning and evening time, there are many students walking to school. Considering the safety of the students, footpath should be installed even if almost no houses around the area. If there are any areas with such kind of situation, installation of footpath should be considered as well.

b. Bridges in the Section from Ch.0+000 to Ch.44+000

There are 10 bridges in this section, 9 bridges are in Section I (Ch.0+000 – 37+000) and 1 bridge is in Section II (Ch.37+000 – 44+000). The bridges in Section I are already 2-lane road, but that in Section II, Gwang Bridge, is not 2-lane. Therefore, in case a section is divided by a bridge in Section I, it can be treated as continuous widening section.

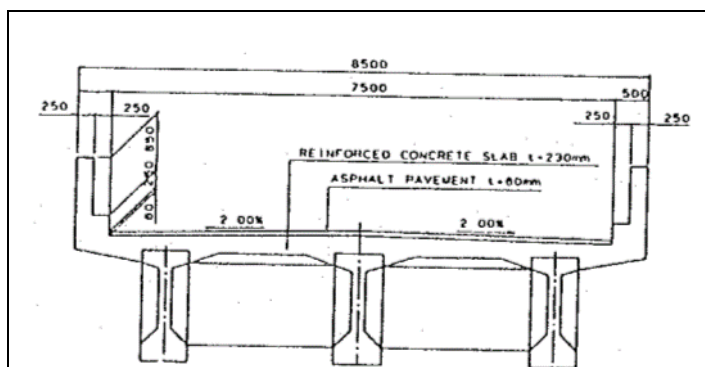


Figure 2-18 General Cross Section Drawing of Bridges in Section I (Ch.0+000 – 37+000)

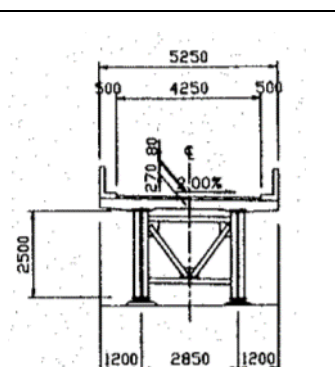


Figure 2-19 Cross Section Drawing of Gwang Bridge

c. Bus Lay-Bys

In Town Area like Sindhuli Bazar or Bhiman, there are structures of bus lay-bys. These bus lay-bys are equipped with a certain width of carriageway and footpath, so widening cross section needs to be considered to connect smoothly to the cross section of existing bus lay-bys.

d. Safety measures around schools

In school areas, there are many students walking along the road. In such areas, footpath should be provided at least one side. In case footpath is installed on the other side of school, installation of pedestrian crossing near the school is recommended. For reducing speed and drawing drivers' attention, installation of signs which show "SCHOOL ZONE" can be considered.



Figure 2-20 Example of Pedestrian Crossing (Ch.5+900)

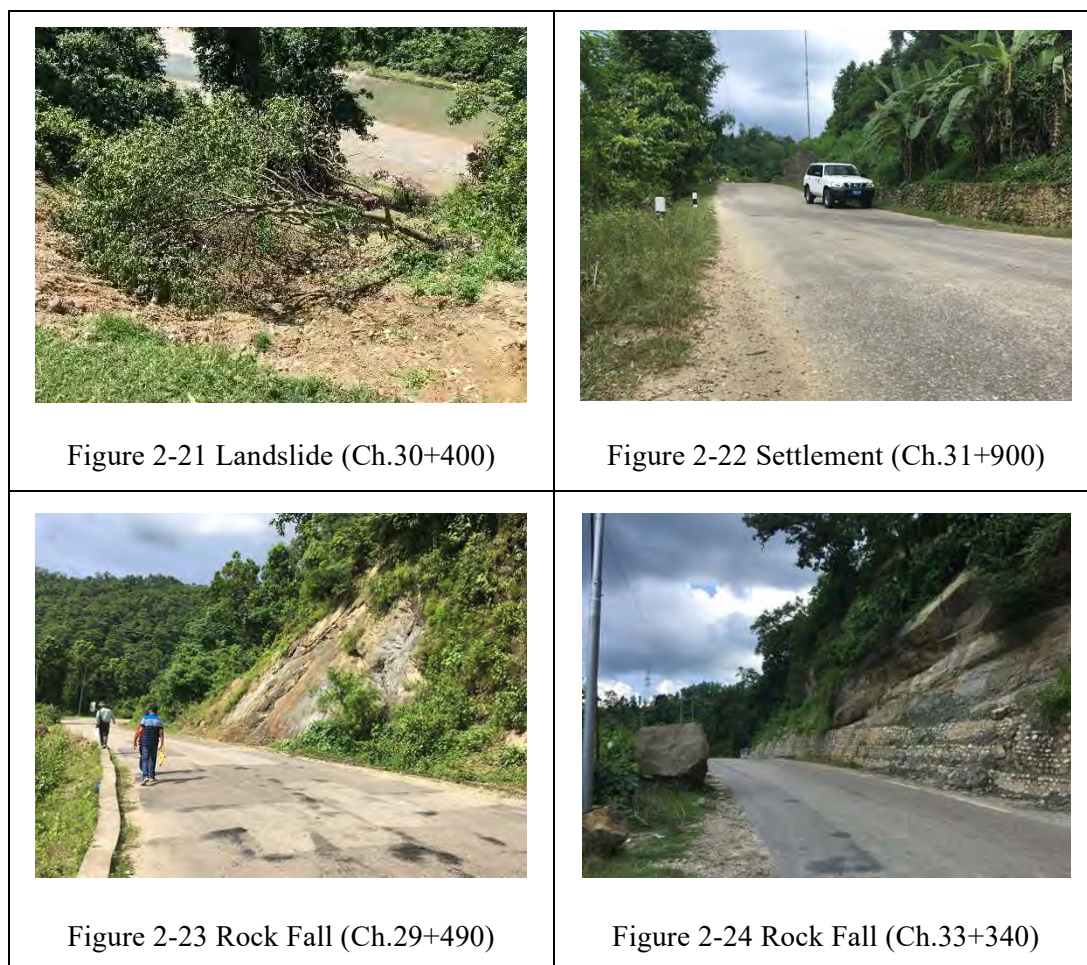
e. Intermittent causeways (Ch.20+800 – Ch.28+200)

Many causeways are existing in this part. Centerline shift of road in this section will affect

on the widening of the causeways. When considering the centerline shift in this section, shifting side of road is recommended to be considered with the widening method of causeways.

f. Landslide area (Br. Kamala – Br. Buka)

In this area, landslide area or rock fall area frequently exist, and slope condition is not stable and still changing. Widening in such area will increase the risk of landslide or collapse and it is difficult to secure 1km length of widening section. It is necessary to survey this area in detail and construction of gabion wall, retaining wall, or revetment for the prevention of erosion by river.



g. Both side structures area in Sindhuli Bazar (Ch.37+200 – Ch.38+200)

Many pedestrians walk in this area, but the existing width is not sufficient for securing 7.0m carriageway and both side footpaths. The best way to secure pedestrian safety is to reconstruct the structure for securing enough width for both side footpath. However, in case reconstruction of structure is difficult, another idea is to install one-side footpath and pedestrian crossings on the both ends of one-side footpath. Even if there are difficulties, at least

installation of one-side footpath is recommended in such town areas.



Figure 2-25 Both Side Structure Part in Sindhuli Bazar Area

- h. Both side structures area after Sindhuli Bazar (Ch.42+000 – Ch.43+400)

Well-constructed structures are on the both side of the road and there are almost no houses along the road. After the point shown in the photo below, drainage is also on valley side and very difficult to widen to either mountain side and valley side. It is recommended to end the widening here.



Figure 2-26 Both Side Structure Part After Sindhuli Bazar

- i. Section after Gwang Bridge (Ch.43+500-Ch.44+000)

The length of the section from Gwang bridge to the point just before the hairpin bend is only 500m, less than 1km. This section will be the approach road to Khurkot – Chiyabari Tunnel. As of now, the location of tunnel portal and its approach road is not a concrete plan yet, so it is recommended to design at the same time as the design of the tunnel.

2.3.2 Road Improvement

(1) Improvement of Road Alignment for Ch.2+500 - Ch.3+700 Section

Road alignment plan for the section from Ch.2+500 to Ch.3+700 has been already discussed in the previous report which was prepared and submitted in September 2019.

(2) Road Collapse Rehabilitation on Ch.3+500

In the road collapse area at Ch.3+500 of the existing alignment, basically new alignment is recommended to be shifted to the other side as much as possible. For the reconstruction of valley side, concrete foundation is recommended to be placed under the gabion walls.

(3) Road Improvement on Ch. 5+900

Intersection point around Ch. 5+900 was used to be an accident prone area due to 90 degrees curve and declined road alignment from both direction. Even though traffic accident number seems reduced because of road crash barriers / guard-rails installation in the beginning of this year (2019), there are still some dangerous situations due to less sight distance and the access point from the villages at middle of curve. There is high traffic of school bus from / to villages on the eastern side of the intersection in the morning and evening time. Therefore, further improvement should be taken to secure traffic safety around this intersection.



Figure 2-27 Current Situations of the intersection at Ch. 5+900

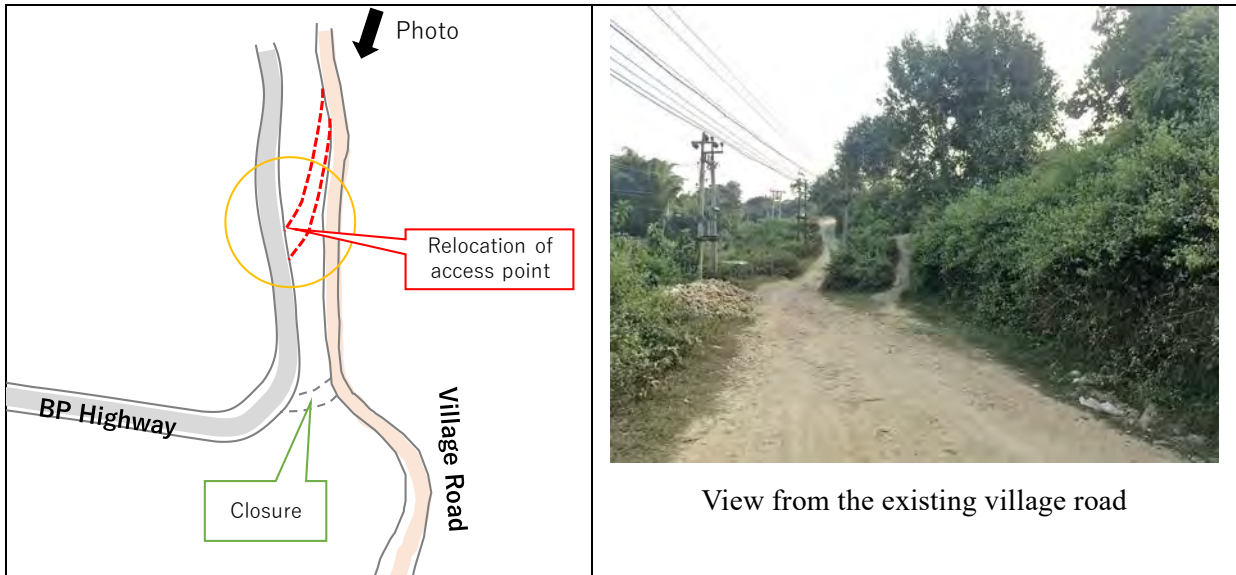


Figure 2-28 Recommended Improvement of Village Road Access

(4) Improvement of Road Alignment for Ch.33+800 - Ch.34+200 Section

The section from Ch. 33+800 to Ch. 34+200, road alignment has winding and high gradient upto around 7 % which exceeds limitation of the criteria for Class II Road. Together with the widening construction, road alignment improvement works to meet the criterion value is recommended.

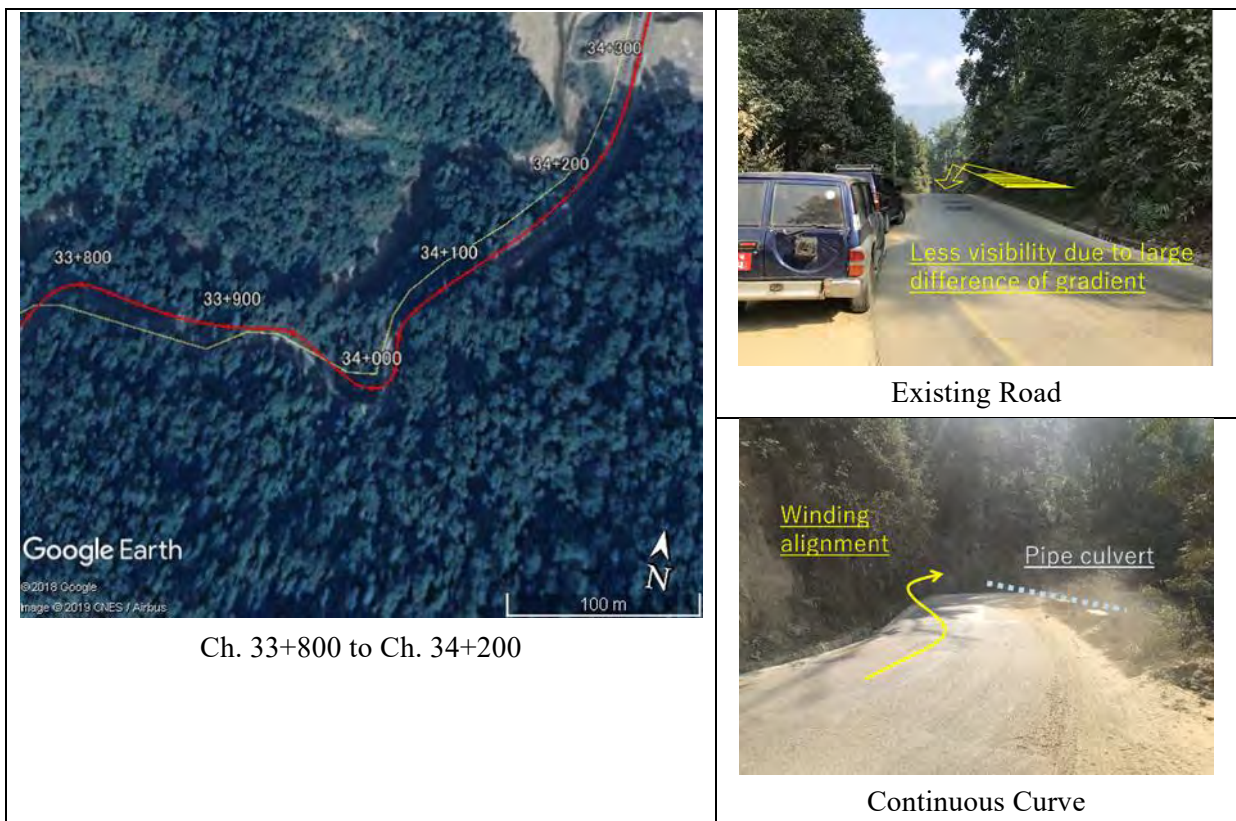


Figure 2-29 Current Situations of the Road Section from Ch. 33+800 to Ch. 34+200

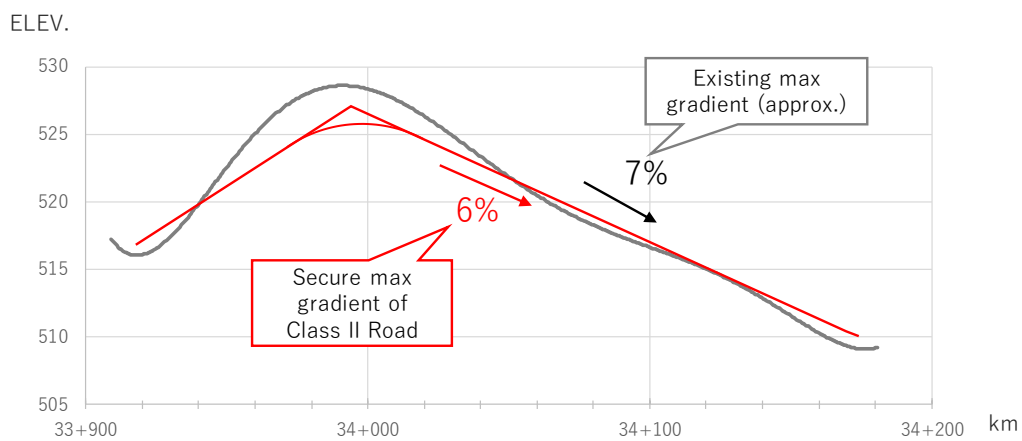


Figure 2-30 Recommended Improvement of Vertical Alignment (To be confirmed site situation)

2.3.3 Pavement Design

(1) Design Conditions

Pavement design is proposed to be determined based on the following design conditions.

Table 2-10 Design Conditions for Pavement Structure

Design Standard	“Pavement Design Guidelines (Flexible Pavement)” published by the Department of Roads, planning and design branch in 2014 AD
Design Life	15 years
Traffic Volume	Two-way traffic 24 hours count at Bardibas Station along the Sindhuli Road
Remarks	Condition surveys of bituminous pavements are used to determine not only the maintenance requirements but also the nature and rate of change of condition to if and when the pavement is likely to need strengthening.

(2) Proposed Pavement Structure

The components of pavement and their respective thickness is based on the design traffic and CBR. The charts of Annex III of the Pavement Design Guidelines (Flexible Pavement) is referred to determine the required thickness of sub-base, base, DBM and Asphalt. As the information on CBR values are not available, it is recommended to conduct site investigations before determine the pavement structure. In this preliminary study, the CBR value is assumed as 8 or 6 tentatively. Based on it, total pavement thickness for traffic 15.89 msa is interpolated as 565 mm for CBR value 8 and 630 mm for CBR value 6. The individual thickness of pavement are shown below.

Table 2-11 Design Thickness of Pavement (Reference)

CBR		8%	6%
Total Pavement Thickness		565 mm	630 mm
Pavement Composition	Asphalt Concrete	50 mm	50 mm
	DBM	50 mm	80 mm
	Granular base	180 mm	200 mm
	Granular subbase	285 mm	300 mm

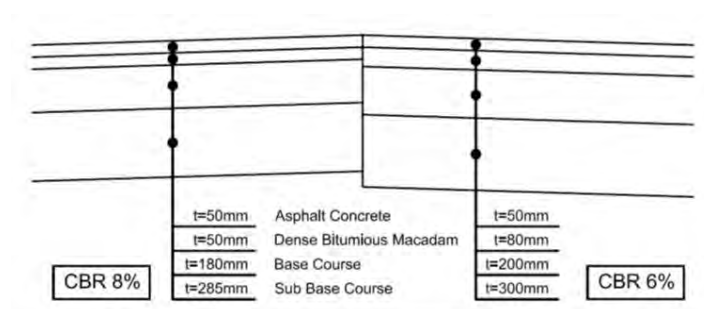


Figure 2-31 Design Thickness of Pavement (Reference)

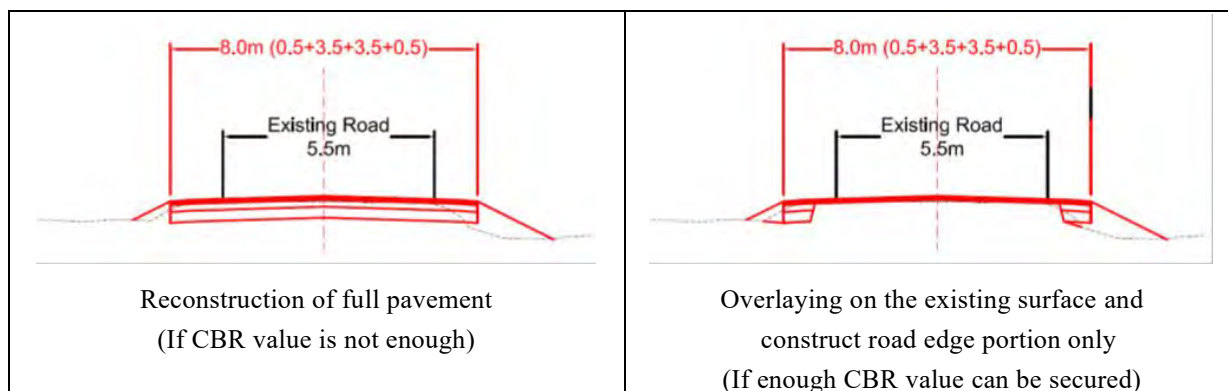


Figure 2-32 Image of Full Scale Pavement and Partial Pavement

2.3.4 Drainage Design

For drainage design, the existing drainage is recommended to be maintained as much as possible. In case the existing drainage is removed, an equivalent drainage is recommended to be constructed. Some cross drainages are needed to be extended when the road is widened. Sometimes cross drainage is located at so deep position from the road surface that cannot be extended easily, thus it is recommended to check the actual location and condition of cross drainage.

2.3.5 Road Rehabilitation and Repair

If any damaged portion on road surface such as pothole, large crack and surface settlement is observed in the target site, it is assumed that the pavement structure is no longer stable for the further increasing heavy vehicle. Therefore, pavement reconstruction works above sub base course layer is required prior to the road improvement.

2.3.6 Road Safety Measure

(1) Road safety measures in Sindhuli Bazar

Sindhuli Bazar area is the most prosperous town in Section I. There are many people walking along the road and some vehicles drive at very high speed. Necessity of safety measure in this area is very high. It is recommended to provide safety facilities if cost increases. The following safety measures are recommended to consider.

a. Provision of footpath

To provide footpath, widening width becomes wider and widening cost becomes higher. However, in prosperous town area like Sindhuli Bazar, it is recommended to secure the sufficient width for installing footpath if reconstruction of retaining wall is inevitable. In case securing enough width is impossible due to the site situation, at least installation of one-side footpath is necessary to be considered.

b. Gateway sign

Gateway sign shows a town area starts from this point and sometimes shown with speed limitation and road paint also. This draws drivers' attention and can make speed lower. This kind of sign can be installed with relatively low cost, but only psychological effect and sometimes can be ignored easily. This will be more effective with traffic safety education.

c. Rumble Strips

Rumble strips used to be installed to alert inattentive drivers of potential danger. Rumble strips make drivers notice they are driving outside the lane or drive slower by making noise. This can be an effective measure for speed reduction.

d. Road hump

Road hump can physically decrease driving speed. This is effective for reducing speed in areas many people walking along the road. In case of considering installation of road hump, at least it must be clearly foreseeable from the distance. It will be another cause of traffic accident if visibility is not considered. This type of measures should be carefully considered with effects and risks.

3 Improvement Plan for Section II and III, Ch. 44 – 110 km (Chiyabari - Khurkot - Nepalthok)

3.1 Road Situations

3.1.1 Section of Chiyabari - Khukot

After Chiyabari, the existing road ascends for about 800m till it reaches Sindhuli Gadhi located in Mahabharat Range and descends towards Khurkot on right bank of Sunkoshi River. There are only two causeways in this section. The existing road was full opened after construction completed at 2009.

Due to its steep cross slope, large quantity of masonry walls and gabion walls were constructed along strictly designed road alignment. In other words, left available space for road widening is quite limited.

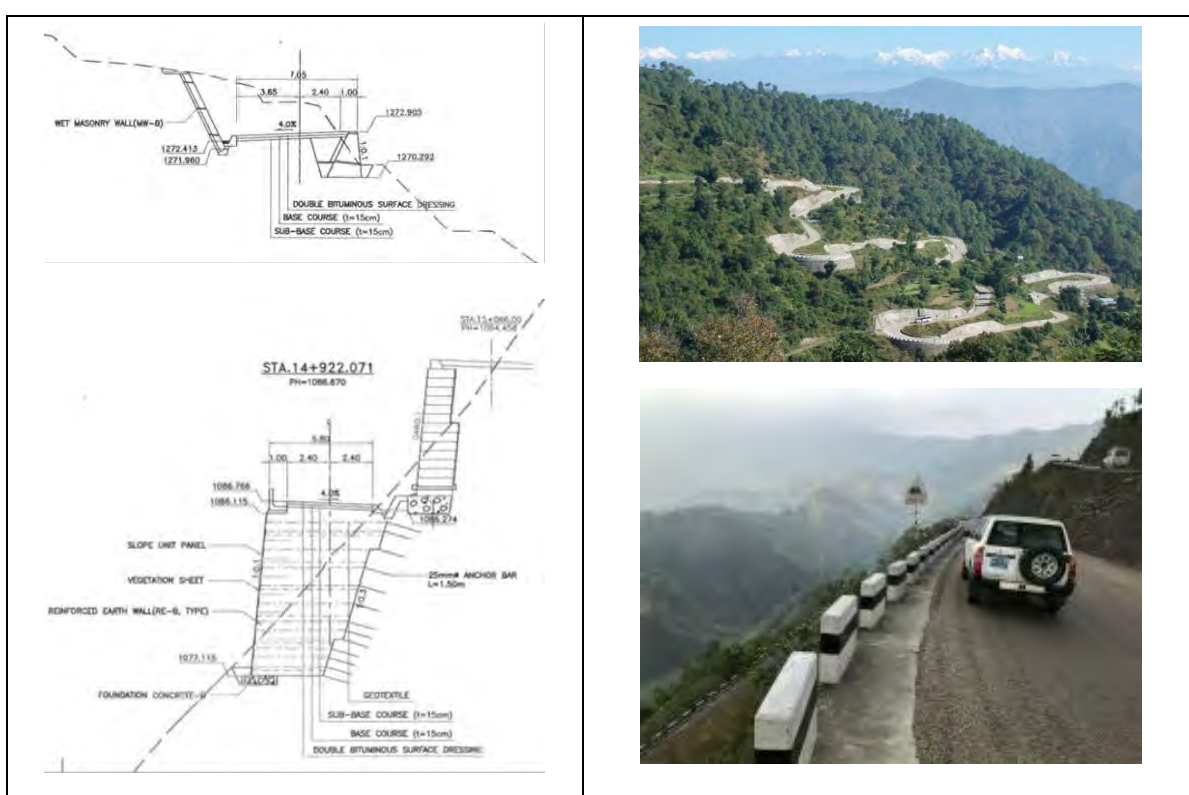


Figure 3-1 Typical Cross Sections and Images

3.1.2 Section of Khukot - Nepalthok

This section follows right bank of Sunkoshi River, a principal tributary of Saptakoshi River. The road is located in Sindhuli district in the Central Development Region of Nepal. The road construction was completed in 2015. Since this section was relatively new, road pavement conditions are generally well. Similar to the previous section, less space is left for the further widening along the existing road.

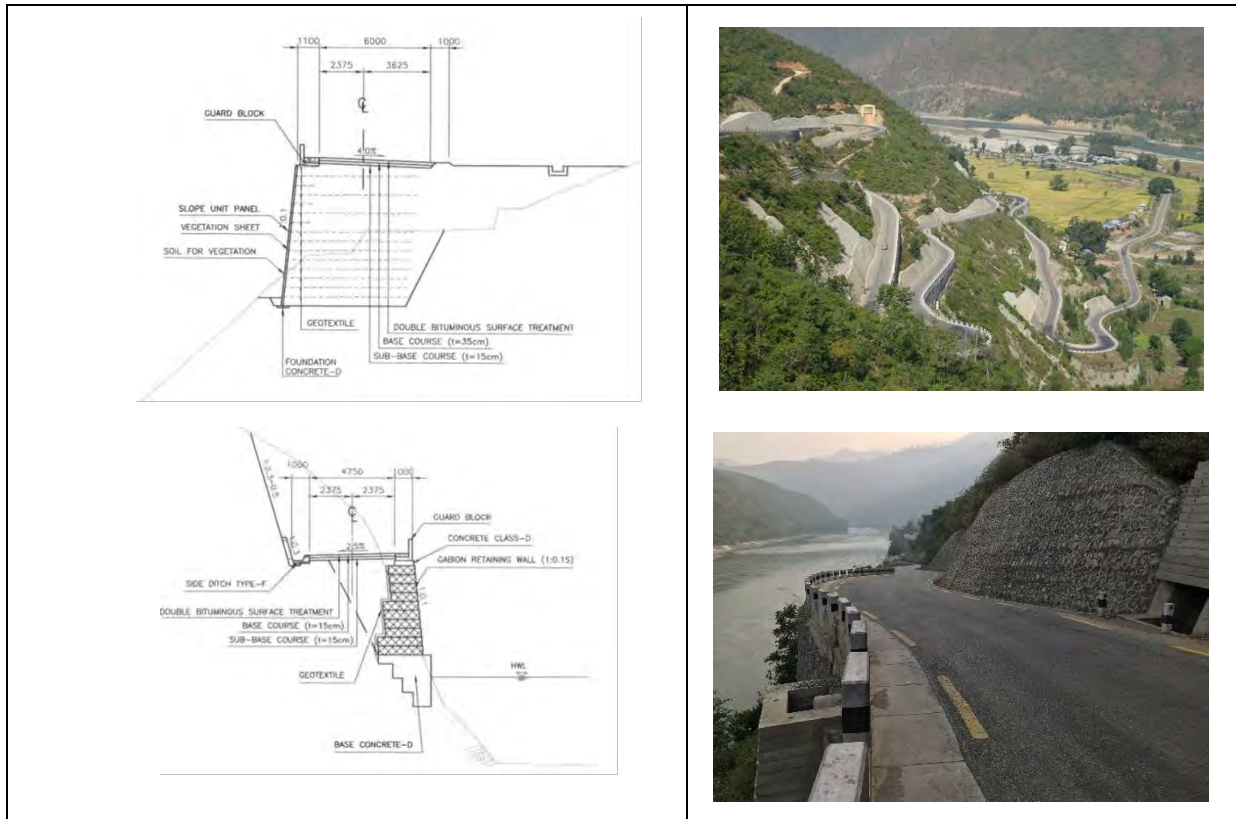


Figure 3-2 Typical Cross Sections and Image

3.2 Road Improvement Plan

3.2.1 Design Policy

As described in the earlier part, this section of Ch. 44 – 110 km (Chiyabari - Khurkot - Nepalthok) has topographic difficulties. This condition leads restriction to secure enough length of widened road, therefore, it is not recommended to consider continuous widening works. Accordingly, design policy for this section is to find out available space for providing emergency parking and passing lane, instead of road widening.

3.2.2 General Layout of Emergency Parking and Passing Lane

The following figure is the proposed layout of emergency parking and passing lane. This is drawn referred to the existing passing lane in Section II of the Sindhuli Road.

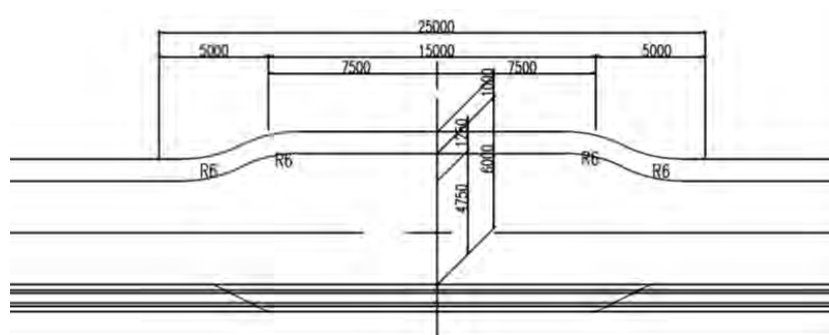


Figure 3-3 General Layout of Emergency Parking and Passing Lane

3.2.3 Selection of Target Location

(1) Proposed Location

The following locations are proposed to develop an emergency parking or passing lane.

Table 3-1 Proposed Location of Emergency Parking or Passing Lane

S.N	Section	Region/Village	Chainage	Left or Right
1	II	Khaniyakharka	Ch. 62+650	Right
2	II	Bara	Ch. 66+950	Right
3	II	Bimeshwor	Ch. 73+050	Right
4	III	Khurkot	Ch. 77+200	Left
5	III	Chainpur	Ch. 85+250	Right



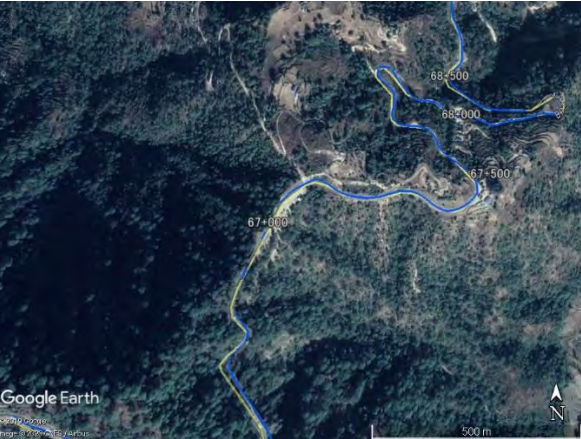

Satellite Photo	Site Photo
 <p>Google Earth 62+500 62+600 62+700 62+800 62+900 200 m</p>	 <p>Khaniyakharka, Ch. 62+650, Right Side</p>
 <p>Google Earth 67+500 68+000 68+500 500 m</p>	 <p>Bara, Ch. 66+950, Right Side</p>



Figure 3-4 Location and Site Situations

(2) Available Space in Khaniyakharka, Ch. 62+650

There is a toll tax collection checkpoint in Khaniyakharka at the instant of December 2019. This is one of four toll gates which were being operated by RBN from September 2019. According to the engineer of RBN, they have a strategy for upgrading toll collection system with introducing semi-automatic collection method and providing toll plaza which is larger than the current one. However, the current land will be not sufficient for constructing new toll plaza, therefore, relocation of toll gate may be proposed as one option. After relocation of toll tax collection checkpoint, the current space will be available to provide emergency parking and passing lane for ensuring driving safety.

3.2.4 Footpath Provision

Apart from the above policy of partial widening, it is recommended to provide footpath in residential area where has many pedestrians. The candidate site is as follows.

Table 3-2 Candidate Site of Footpath Provision

S.N	Section	Region/Village	Chainage	Length	Left or Right
1	II	Dhungrebhanjyang	Ch. 54+000	200m	Right
	II	Khaniyakharka	Ch. 59+800	150m	Both
	II-III	Khurkot	Ch. 75+600	200m	Both
	III	Mulkot	Ch. 94+500	700m	Both
	III	Ramtar-1	Ch. 97+200	200m	Left
	III	Ramtar-2	Ch. 98+400	500m	Both
	III	Jhangajholi Bazar	Ch. 101+700	500m	Right

4 Improvement Plan for Section IV, Ch. 110 – 160 km (Nepalthok – Dhulikhel)

4.1 Site Situations

4.1.1 Roadside Features

The target section starts from Ch.110+000 in Nepalthok to Ch.160+000 in Dhulikhel. The features of target section are shown below.

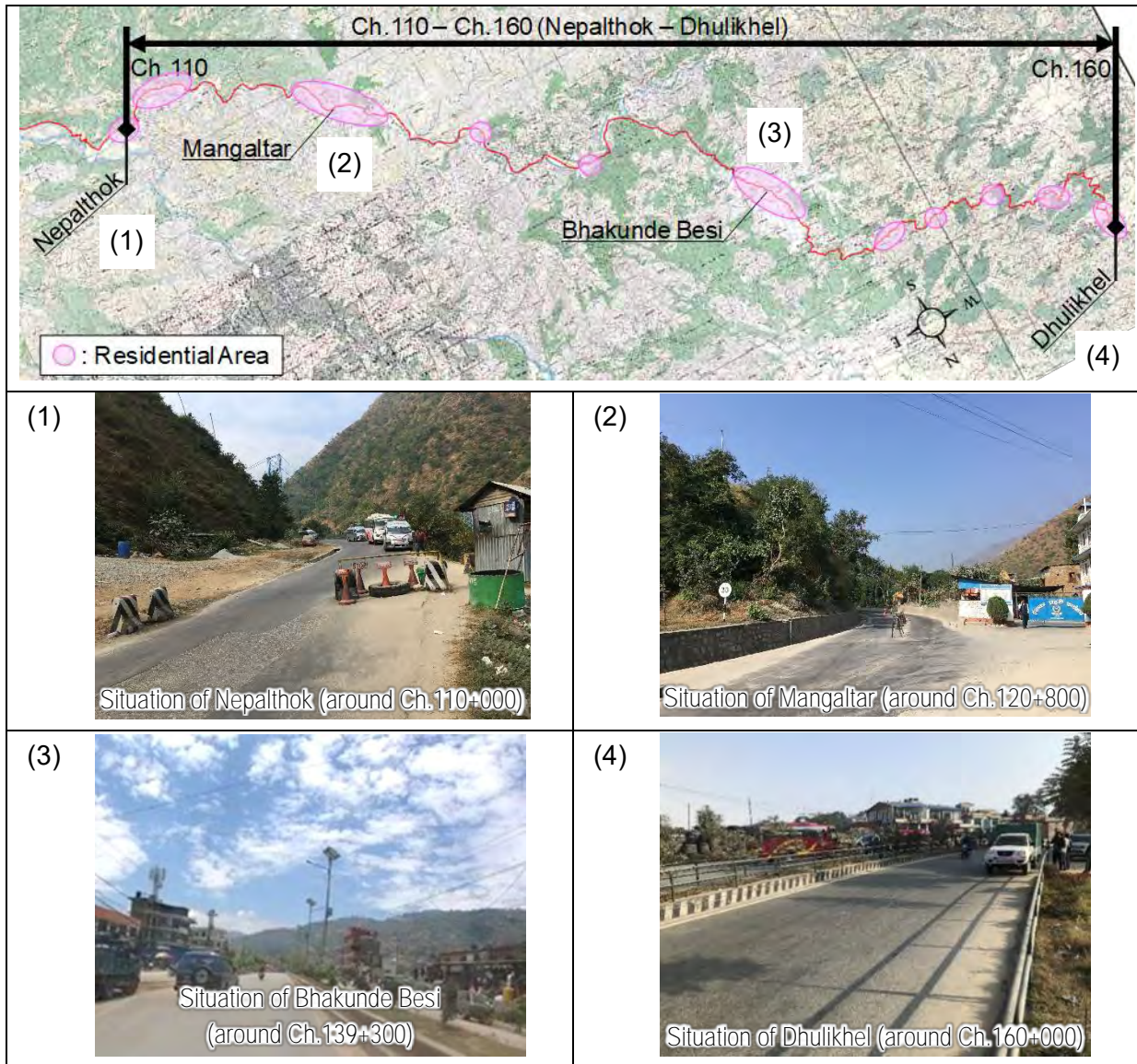
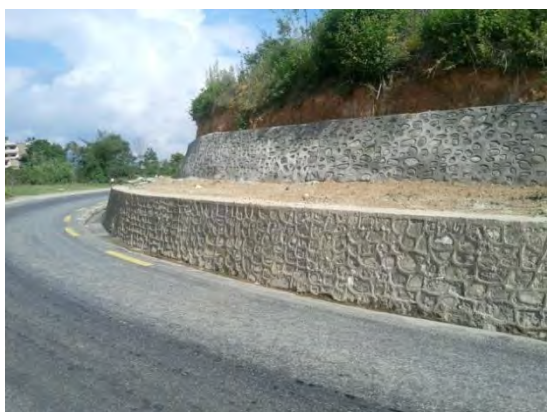


Figure 4-1 Roadside Features of Target Section (Ch. 110+000 – 160+000)

4.2 Previous Improvement Activities

During the time of SRMU Project Phase-1 (2012 - 2015), the following road safety countermeasure works were planned and some of them have been implemented in the Sindhuli Road.

- | | |
|---------------------------------|---|
| 1) Intersection Improvement | 8) Guard Block |
| 2) Road Information Board (RIB) | 9) Road Traffic Signs |
| 3) Roadside Delineator | 10) Road Markings (Road Edge, Zebra) |
| 4) Bus Lay Bys | 11) Speed Reduction (Road hump or Rumble Strip) |
| 5) Footpath Construction | 12) Parking Area |
| 6) Sight Distance Improvement | 13) Road Safety Campaign |
| 7) Curve Mirror | |



Sight distance improvement by cutting slope of mountain side



Curve mirror installation on sharp bend



Construction of footpath at high traffic section



Lane marking

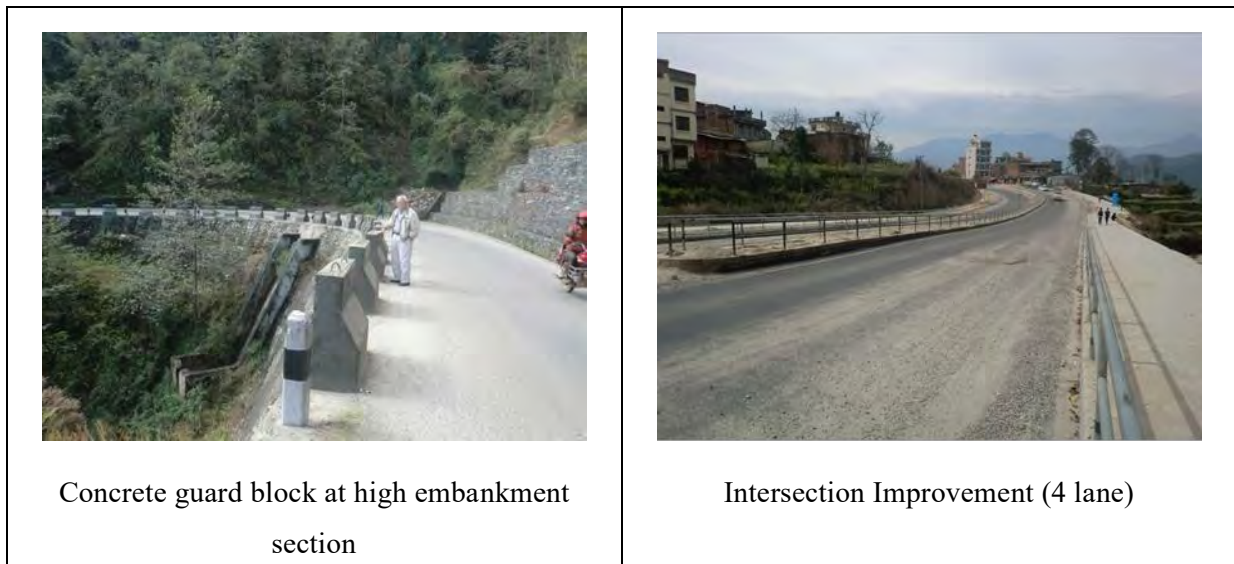


Figure 4-2 Example of Measures Conducted in SRMU Project Phase-1

4.3 Current Problems

4.3.1 Accident Record

There are many locations to be improved in Section IV. Priority of road improvement activity is recommended to be determined by the frequency of road accidents at the location. The total number of accidents in Section IV from 2012 to 2018 is 111 out of which 68 accidents occurred in past two years i.e. 2017 and 2018. The accident records show massive increase in the number of accidents in this section in past two years. Similarly the total number of accident casualty in Section IV from 2012 to 2018 is 207 out of which 39 were fatal and 91 were serious. The highest contributors in accident occurrence in this section are the motorcycles followed by trucks and cars/jeeps. Based on the accident records, accident spot maps have been prepared and accident cluster points are identified. The clusters are found in straight as well as curved sections. The following figures show the accident spot maps.

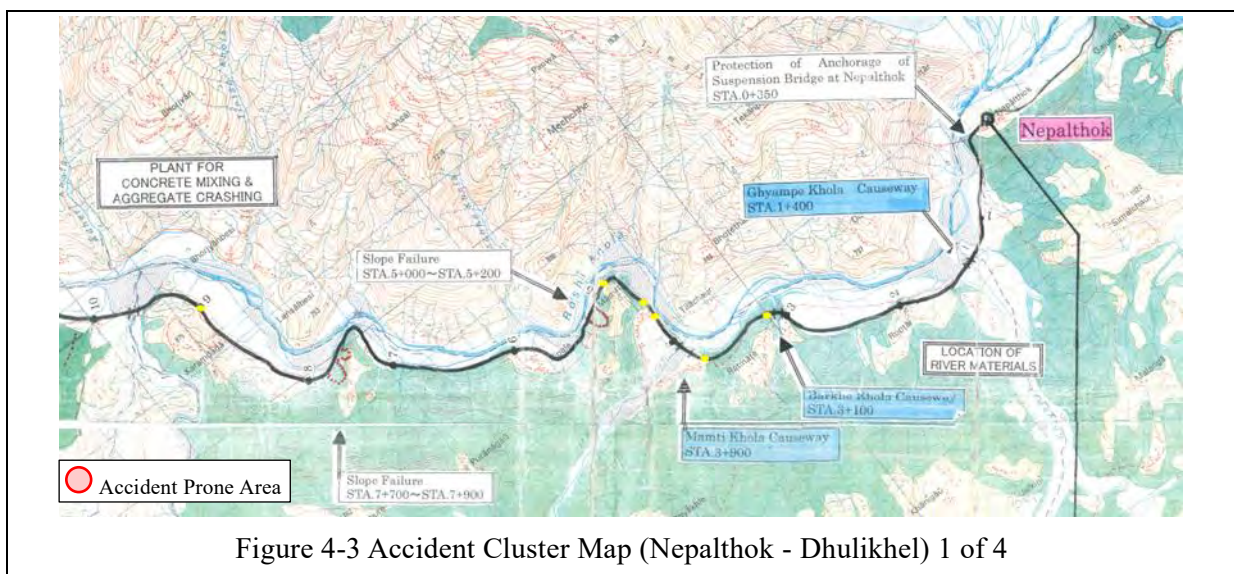


Figure 4-3 Accident Cluster Map (Nepalthok - Dhulikhel) 1 of 4

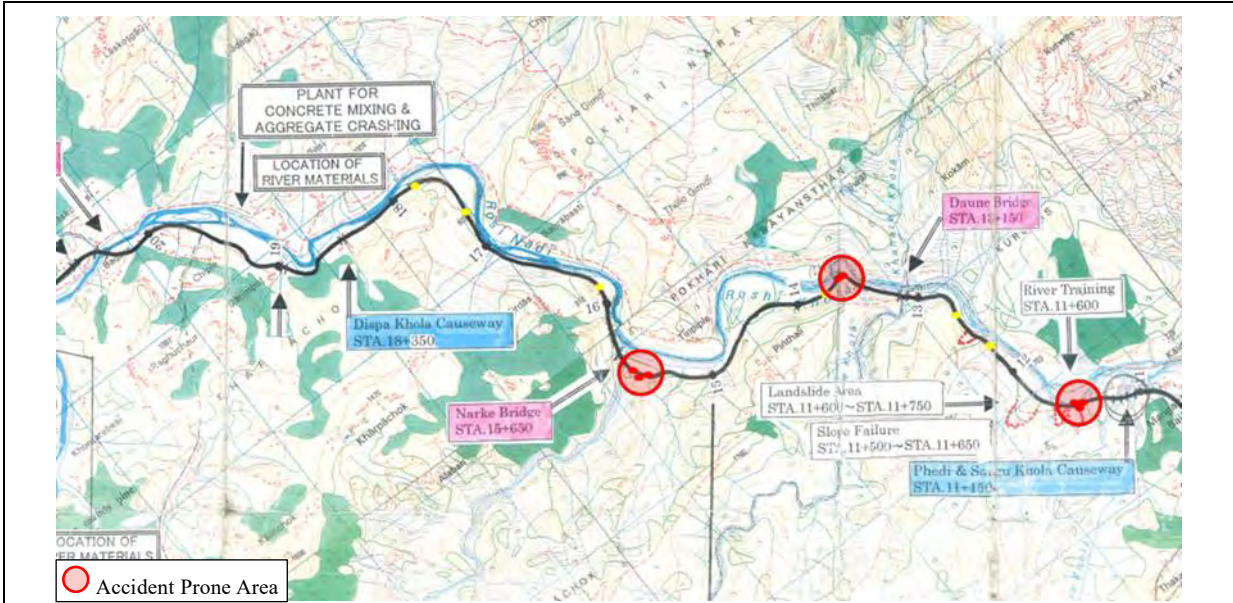


Figure 4-4 Accident Cluster Map (Nepalthok - Dhulikhel) 2 of 4

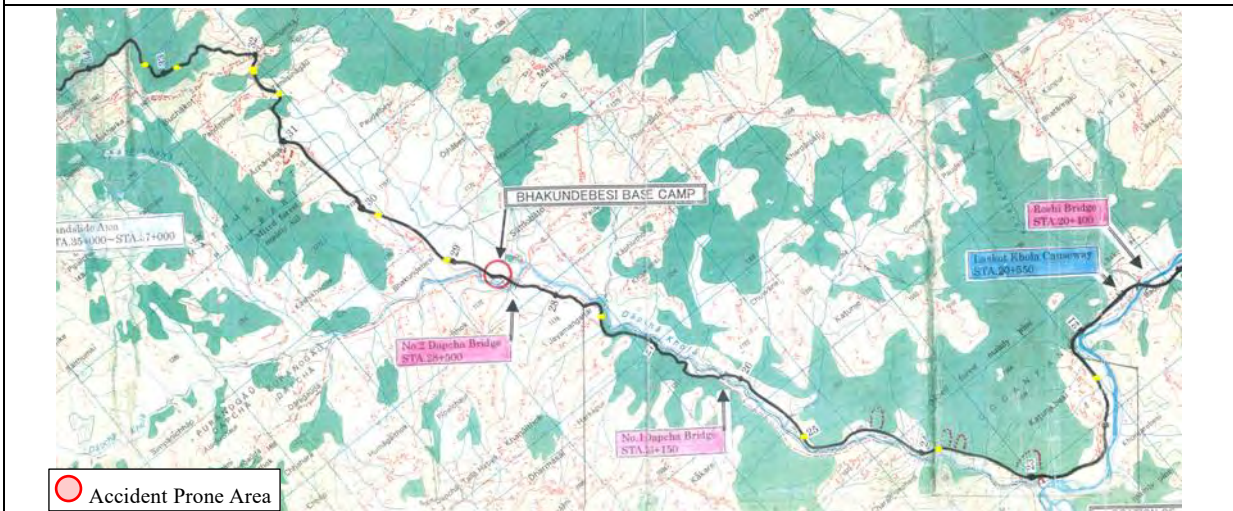


Figure 4-5 Accident Cluster Map (Nepalthok - Dhulikhel) 3 of 4

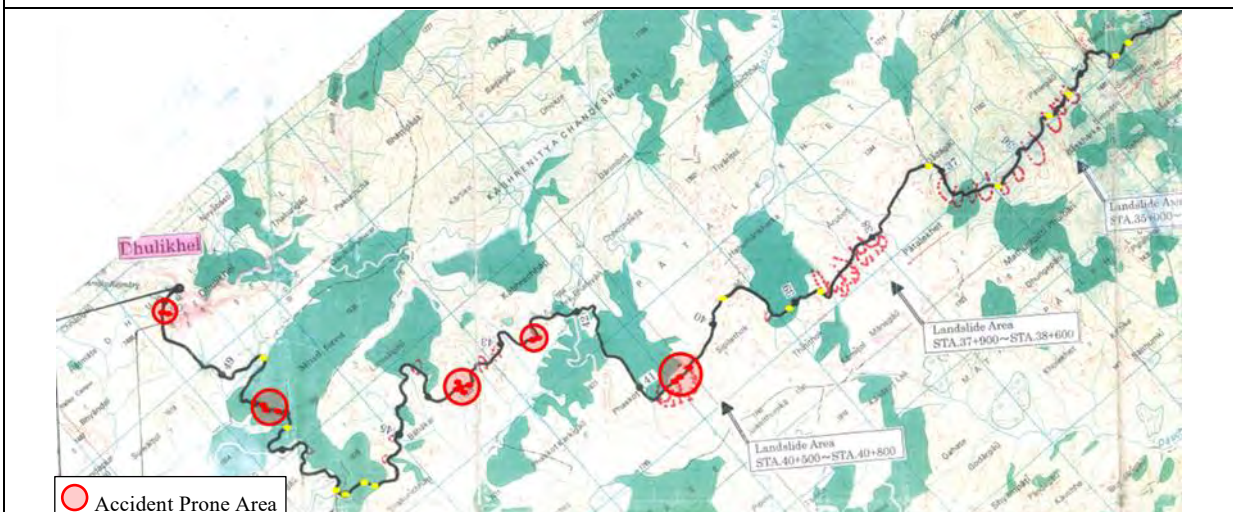


Figure 4-6 Accident Cluster Map (Nepalthok - Dhulikhel) 4 of 4

4.3.2 Cause of Accident

Gerarally, traffic accident is induced by various causes. It is considered that most major causes of accidents on the Sindhuli Road can be said overspeed, but it is difficulet to determine the direct cause of accident. Here, the possible causes of accidents are mentioned.

(1) Overspeed

One of the casues of accident could be overspeed. Although the maximum design speed for Section IV is 40 km/h, numerous vehicles were found travelling in much higher speeds especially in straight portions. Some of the motorcycles and light vehicles were observed travelling in speeds of above 60 km/h when measured by speed radar gun in some random portions of section IV.

(2) Lack of Sight Distance

The following problems are observed in site.

- There are still many curves with bad visibility.
- Growing plants are making sight distance worse including the measured part in Phase-1.
- Excessively widened curve induces improper overtaking.
- Broken or stolen mirrors, which were installed in Phase-1, are not repaired.

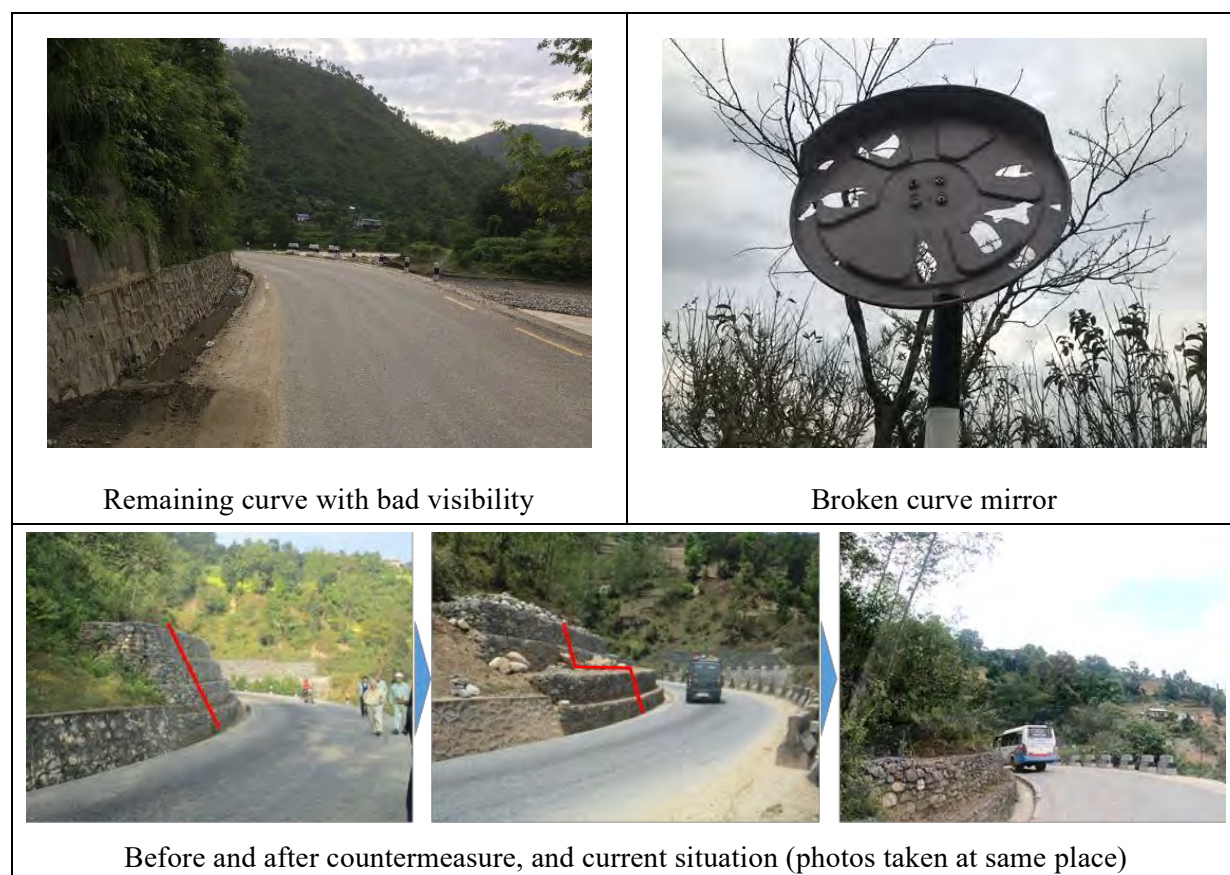


Figure 4-7 Problems Related to Sight Distance

(3) Insufficient Fall Prevention Structure

The following problems are observed in site.

- There are still many fearful places without fall prevention measures.
- Some broken guard posts are not repaired.

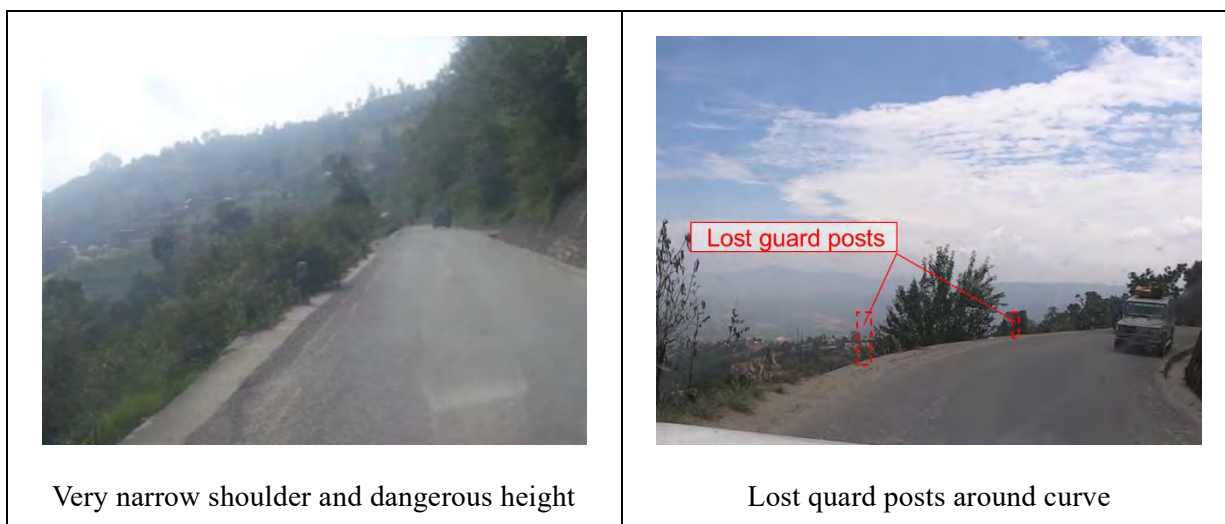


Figure 4-8 Problems Related to Fall Prevention

(4) Inappropriate parking space

Some part of the Sindhuli Road is hilly and winding. Consecutive small radius curves make drivers fatigued and steep gradient induces engine failure of large vehicles. However, the shoulder width of the Sindhuli Road is not sufficient for parking. The following problems are observed in site.

- There are some vehicles parking on inner curve inappropriately.
- Most of stopping lay-bys, they are provided at interval of around 200 m, on valley side are not paved and not comfortable for use as stopping lay-by.

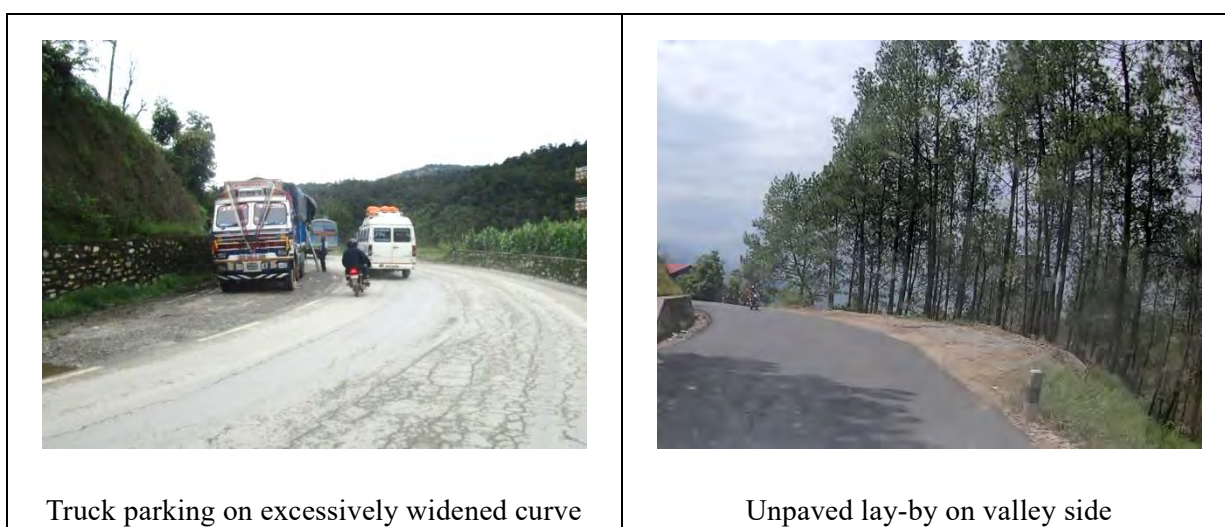


Figure 4-9 Problems Related to Parking Space

4.4 Design Condition

4.4.1 Design Policy

For the improvement of the target section, the design is to conform to the Class II road described in Nepal Road Standard 2070 B.S. (July, 2013 A.D.) as much as possible. The recommended basic policies for the road improvement is shown in Table 4-1.

Table 4-1 Recommended Basic Policies for Road Improvement

Item		Basic Policy
Widening section		<ul style="list-style-type: none"> ➤ Areas difficult to widen are defined as “no widening” section, such as areas with landslides, both side structures, or any other difficulties which make construction cost or risk much higher. ➤ The minimum stretch of widening section is 1 km. In case the stretch is less than 1 km, the section is defined as “no widening” section.
Cross section	General	➤ Road cross section widening is planned within the width of the right of way (25m on the both sides).
	Carriageway	➤ 7.0 m (3.5 m x 2 lanes) carriageway is secured in all section.
	Shoulder	➤ Shoulder width can be varied depending on existence of structures, risk slope, deep valley, etc. are constraining the width.
	Footpath	<ul style="list-style-type: none"> ➤ In the section where many pedestrians walking, footpath is to be provided on the effective side as much as space allows. ➤ Shoulder width can be reduced by regarding the width of footpath as a part of shoulder width, but not less than 1.0 m.
Road centerline		➤ Shift of road centerline is acceptable in case that there is roadside structure to be kept and continuity of the alignment is not so much affected.
Utilization of existing structure		<ul style="list-style-type: none"> ➤ If the existing pavement has the enough strength that can conform to the structural requirement, utilization of existing pavement is considered. ➤ The existing drainage and retaining walls are maintained if possible.

4.4.2 Design Criteria

The proposed design criteria for improvement of Section IV is shown in Table 4-3. Basically, Nepal Road Standard 2070 B.S. (July, 2013 A.D.) is to be conformed. In difficult area, such as landslide prone area, reduction of shoulder width is considered.

Table 4-2 Technical/Functional Classification in Nepal Road Standard

Class I	Class I roads are the highest standard roads with divided carriageway and access control (Expressways) with ADT of 20,000 PCU or more in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 120 km/h.
Class II	Class II roads are those with ADT of 5000-20000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 100 km/h.
Class III	Class III roads are those with ADT of 2000-5000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 80 km/h
Class IV	Class IV roads are those with ADT of less than 2000 PCU in 20 yrs perspective period. Design speed adopted for design of this class of roads in plain terrain is 60 km/h

Table 4-3 Proposed Design Criteria

Items of Design Criteria	Nepal Road Standard 2070 (July, 2013)		Proposed Parameters	
			Ch.110+000 - 160+000 (Nepalthok - Dhulikhel: 50 km)	
1 Terrain Classification	Rolling Terrain	Mountainous Terrain	Rolling Terrain	Mountainous Terrain
2 Highway Classification	Class II	Class II	Class II	Class II
3 Traffic Capacity	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000	PCU ADT of 5,000 - 20,000
4 Design Speed	60 km/hr - 80 km/hr	40 km/hr - 60 km/hr	60 km/hr	40 km/hr
5 Formation width	12.0 m (desirable) 9.0 m (minimum)	12.0 m (desirable) 9.0 m (minimum)	9.0 - 12.0 m	9.0 - 12.0 m
6 Carriageway width	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m	3.5 m x 2 = 7.0 m
7 Shoulder width	2.5 m x 2 = 5.0 m (desirable) 1.0 m x 2 = 2.0 m (minimum)	2.5 m x 2 = 5.0 m (desirable) 1.0 m x 2 = 2.0 m (minimum)	(1.0 - 2.5 m) x 2 = 2.0 - 5.0 m	(1.0 - 2.5 m) x 2 = 2.0 - 5.0 m
8 Maximum gradient	6.0% (at 80 km/hr) 7.0% (at 60 km/hr)	7.0% (at 60 km/hr) 9.0% (at 40 km/hr)	6%	7%
9 Minimum Radius	210 m (at 80 km/hr) 110 m (at 60 km/hr)	110 m (at 60 km/hr) 40 m (at 40 km/hr)	110 m	40 m
10 Sight distance	130 m (at 80 km/hr) 80 m (at 60 km/hr)	80 m (at 60 km/hr) 50 m (at 40 km/hr)	80 m	50 m
11 Overtaking distance	470 m (at 80 km/hr) 300 m (at 60 km/hr)	300 m (at 60 km/hr) 165 m (at 40 km/hr)	300 m	165 m

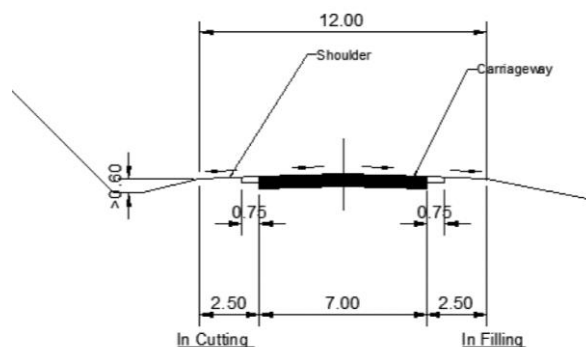


Figure 4-10 Typical Cross Section of Class II Road in Nepal Road Standard 2070 B.S (July, 2013 A.D.)

4.5 Preliminary Design of Road Improvement

4.5.1 Road Widening

(1) Typical Cross Section

Standard road width is proposed as shown in Table 4-4.

Table 4-4 Proposed Width of Cross Section to be Applied

Roadside Condition	Cross Section Type	Width (m)			Note
		Carriageway	Shoulder	Formation	
Town Area	Type A	7.0 (3.5 x 2)	1.5 – 2.5	10.0 – 12.0	Footpath is provided in school & market area.
Rural Area	Type B	7.0 (3.5 x 2)	1.0 – 1.5	9.0 – 10.0	The minimum value of shoulder in the standard is 1.0 m.
			0 – 1.0	7.0 – 9.0	In case that shoulder width is less than 1.0 m, the pavement of shoulder is recommended to be constructed by the same composition as carriageway and separated by painted line.

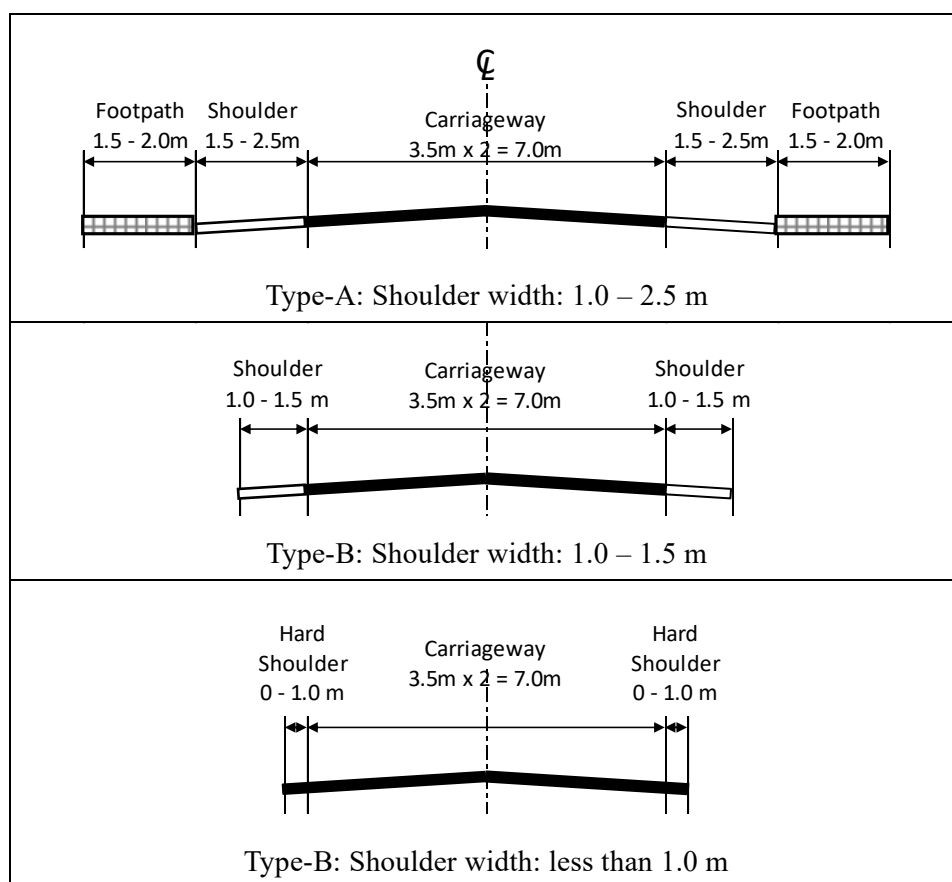


Figure 4-11 Images of Typical Cross Sections

(2) Application of Cross Section Type

1) Application of Type A and B

Type A is applied to Town Area. Residential area exists along the roadside in this area. There are many pedestrians. Sufficient width of shoulder for Class II road is recommended to be secured as much as possible and installation of footpath is considered. In case footpath is provided, shoulder width can be reduced by regarding the width of the footpath as a part of shoulder width, but not less than 1.0 m. Isolated area which has less pedestrian is not necessarily need to introduce footpath.

Type B is applied to Rural Area. Almost no residential area exists along the roadside in this area. There are almost no pedestrians. Shoulder width can be reduced when widening is constrained by existing structures, risk slopes, deep valleys, etc.

2) Difficult Section

For sections where even a reduced width like Type B is not applicable due to steep terrain or high risk of slope-failure, there is room to consider how to secure the road width wider as much as possible for drive safety and comfort. One conceivable solution is to utilize space of the existing road side drainage. Current road side drainage type of the Sindhuli Road is U-shaped

masonry drains. Instead of this, safer type drainage as shown in the following figure can provide extra width for safe driving. In addition, pre-cast U-shaped drain may contribute to minimize the space.

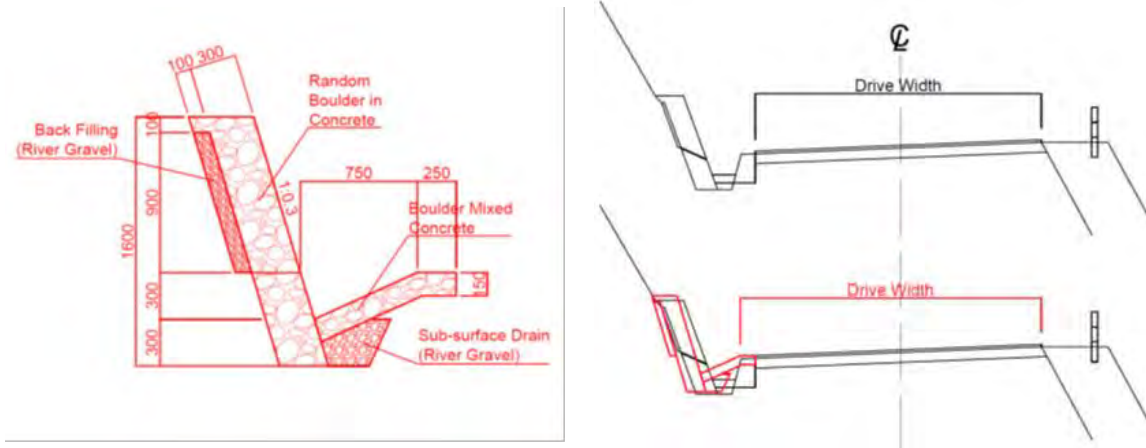


Figure 4-12 Details of Safer Type Drainage



Masonry Type



Safer Type

Figure 4-13 Photo of Side Drainage

3) Examples of Application

An example application of each cross section type for the section from Ch.110 to Ch.160 is summarized in the tables below, and its detailed breakdown is shown in the following figures. It is noted that area division and cross section composition should be determined based on the detailed survey.

Table 4-5 Summary of the Example Application

From	To	Dist.	Widening	Footpath	Remarks
110+000	110+700	700	Difficult	-	
110+700	113+000	2,300	Type A	Left	CW: Gyampe
113+000	117+700	4,700	Difficult	-	Landslide
117+700	121+300	3,600	Type A	Left	CW: Bhyakure
121+300	137+800	16,500	Difficult	-	
137+800	140+700	2,900	Type A	Left/Right	BR: Dapcha2, Bhakunde Besi
140+700	152+000	11,300	Difficult	-	Landslide
152+000	158+400	6,400	Type B	-	
158+400	159+500	1,100	Type A	Right	
159+500	160+000	500	Difficult	-	

Table 4-6 Proportion of Type Application

Application	Dist.	Ratio	Remarks
Type A	9,900	20%	Footpath is applied as necessary
Type B	6,400	13%	
Difficult	33,700	67%	Restoration of drainage is conceivable
Total	50,000	100%	

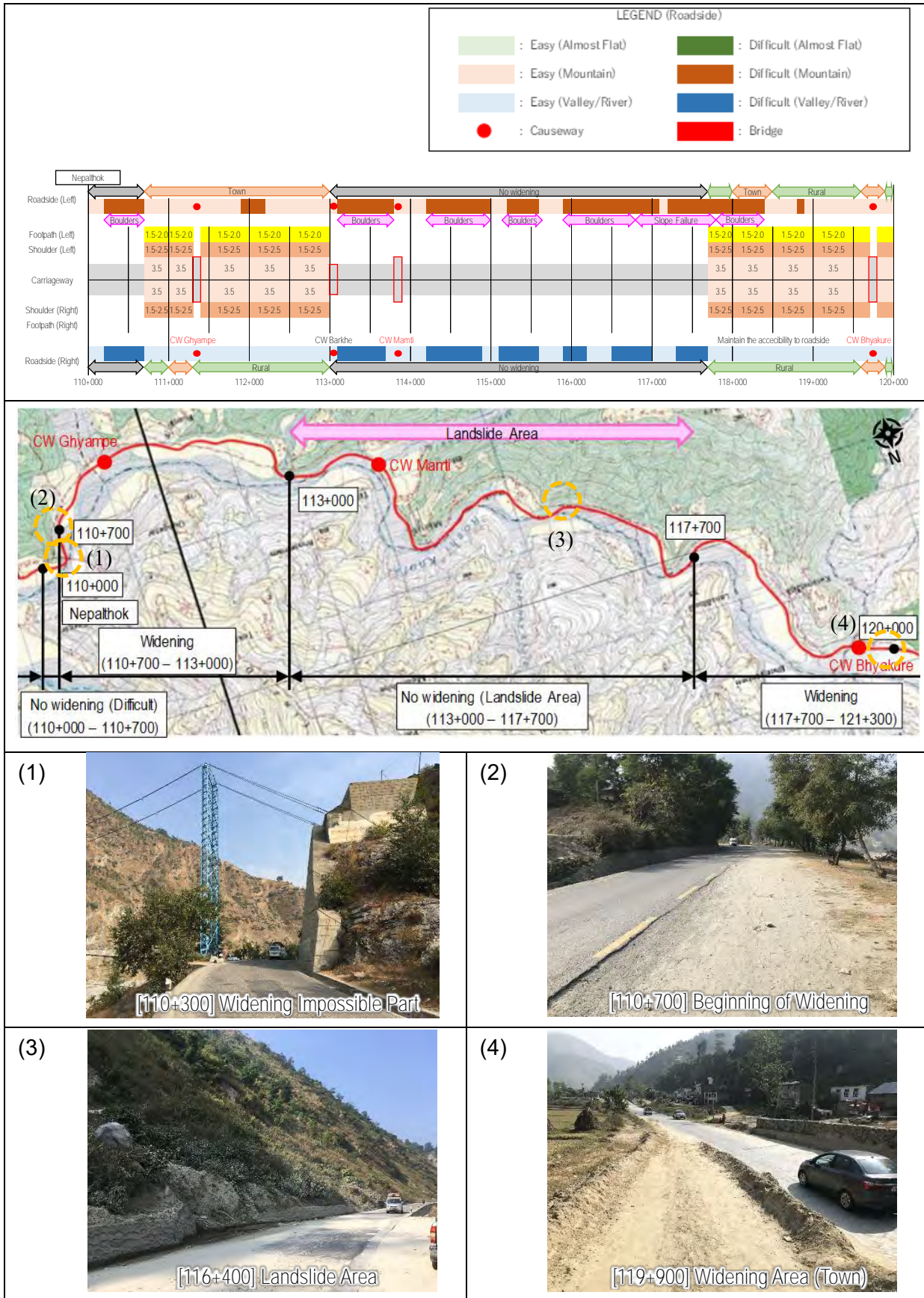


Figure 4-14 Example of Application of Cross Section Type (Ch.110-120km)

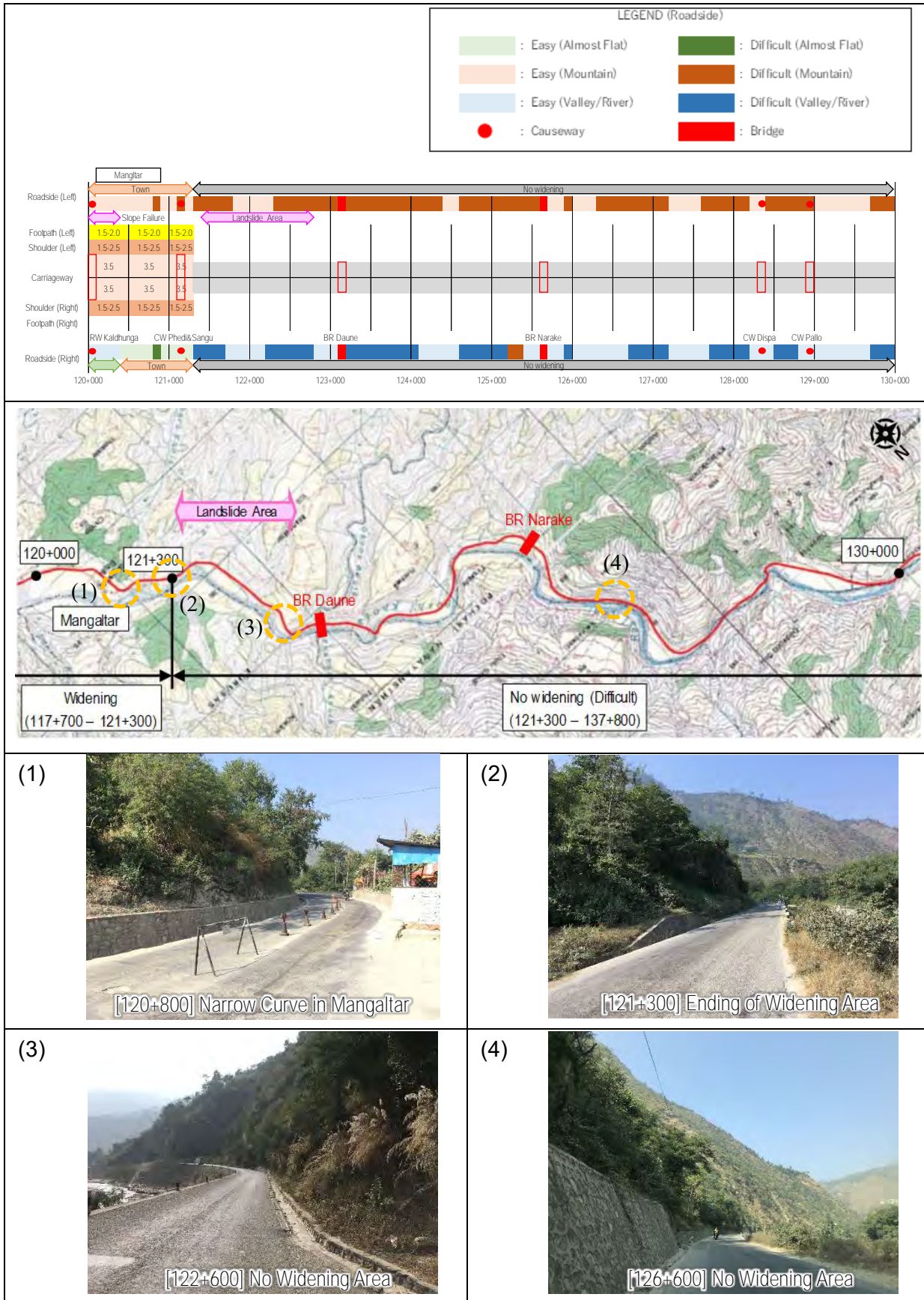


Figure 4-15 Example of Application of Cross Section Type (Ch.120-130km)

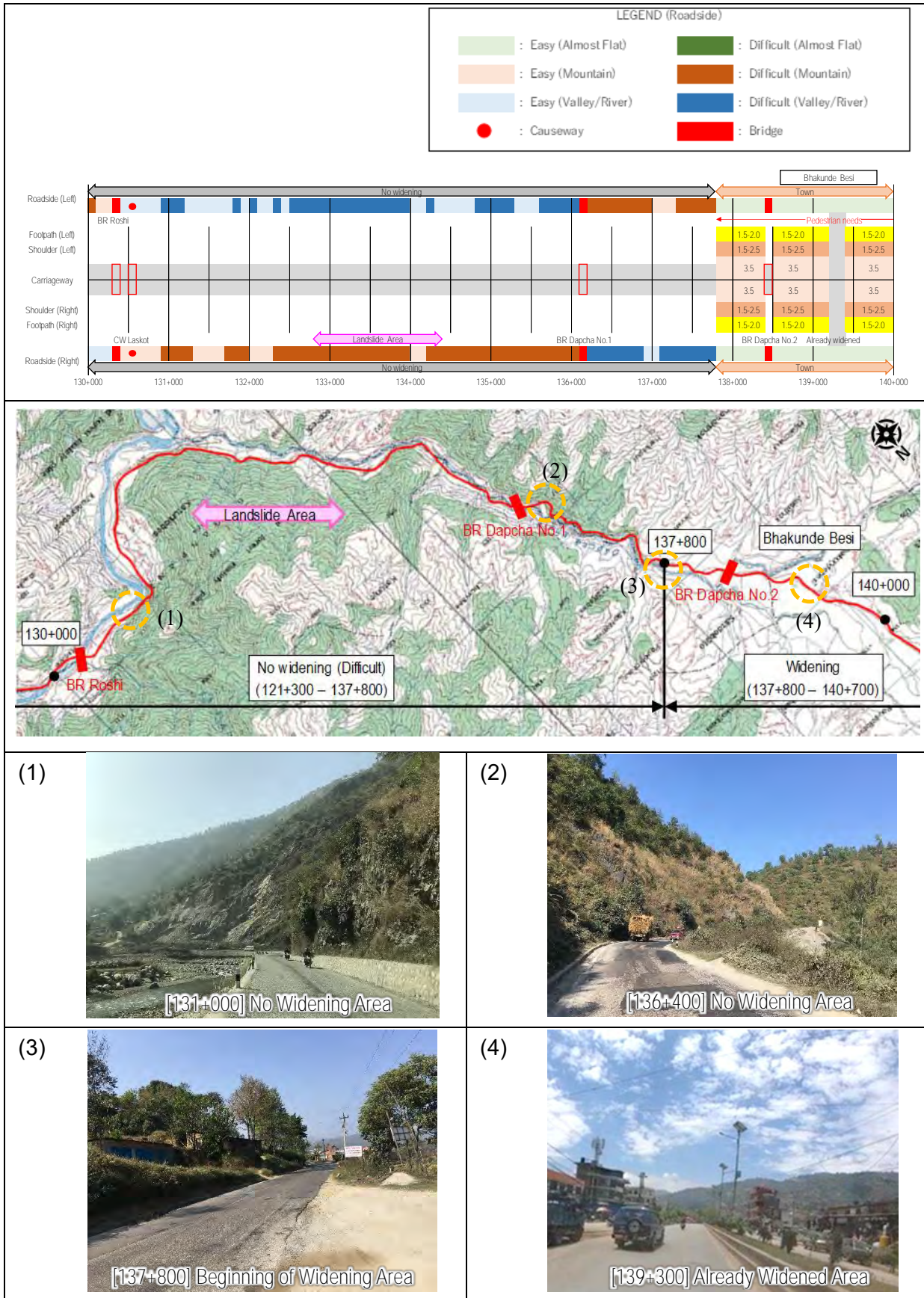


Figure 4-16 Example of Application of Cross Section Type (Ch.130-140km)

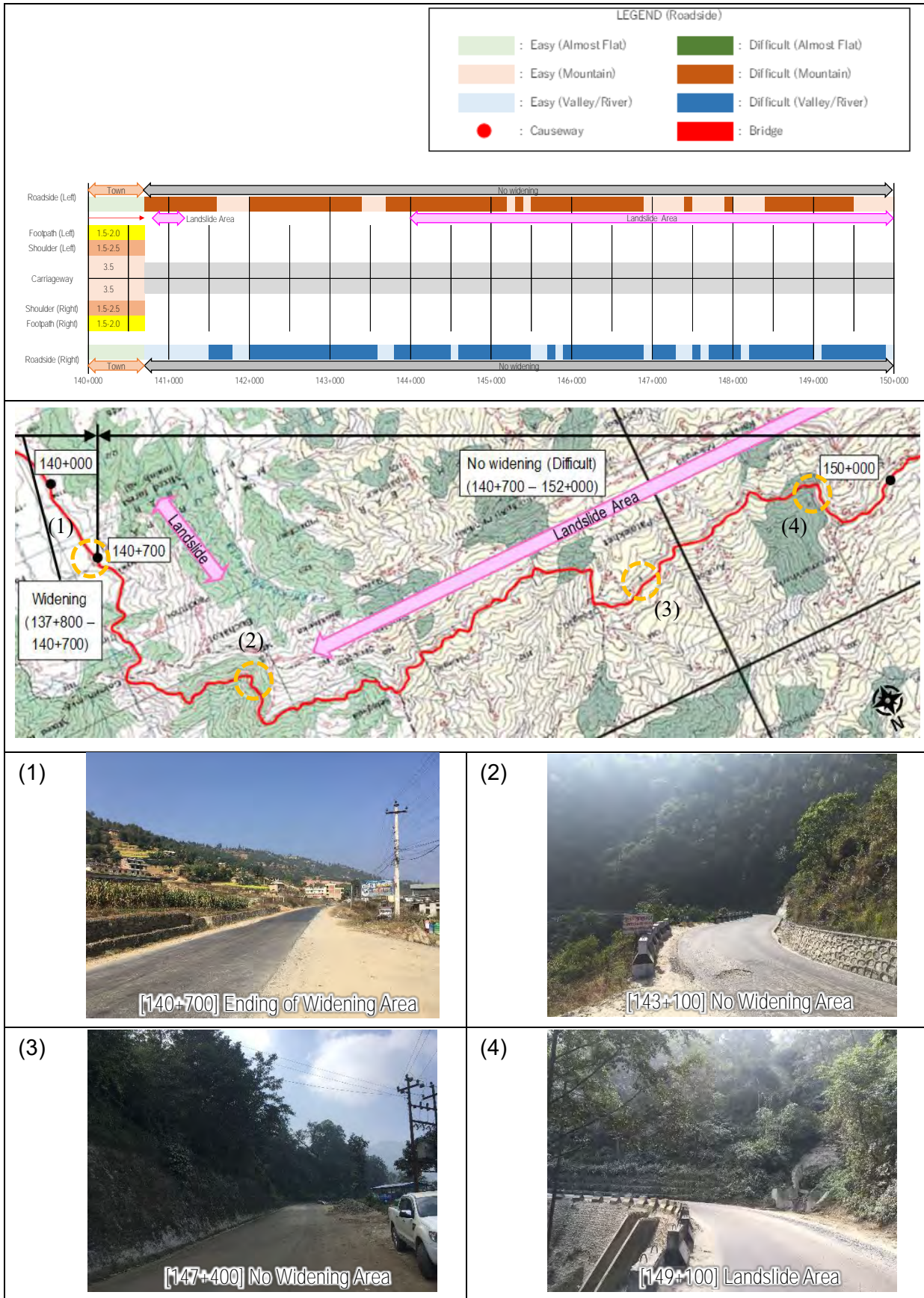


Figure 4-17 Example of Application of Cross Section Type (Ch.140-150km)

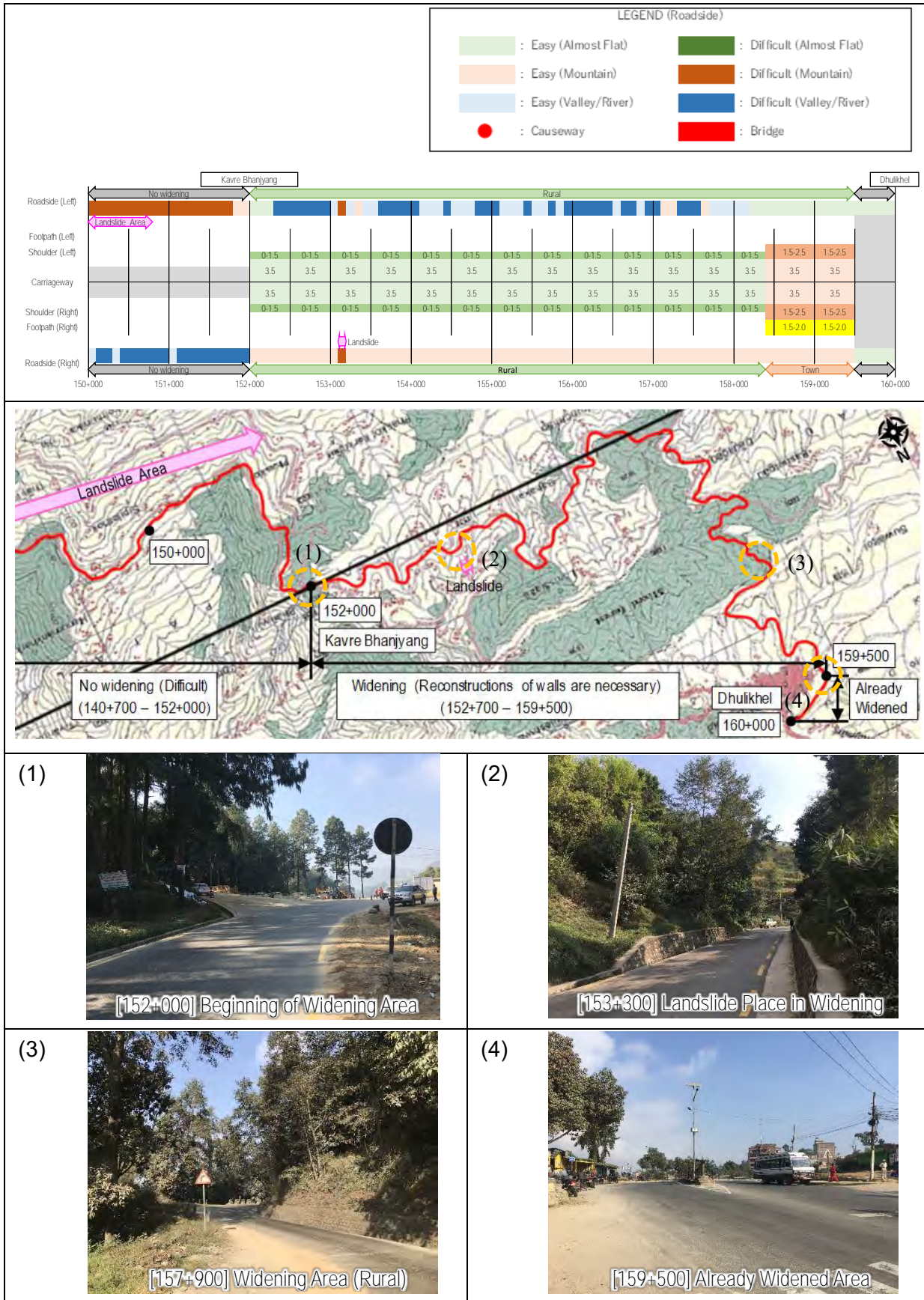


Figure 4-18 Example of Application of Cross Section Type (Ch.150-160km)

(3) Widening Method

Recommended widening method is shown in Table 4-7.

Table 4-7 Recommended Widening Method

Case No.	Constraint (Retaining wall, risk slope, valley)	Existing Width Between Constraints	Recommendation
1	No constraint	Enough	No centerline shift is recommended.
2	One side	Enough	Centerline shift is recommended, but consideration on the continuity of the alignment is necessary.
3	Both sides	Not enough	Option-1: Widening within the existing road width with reducing the width of shoulders. Option-2: Widening to the economical or safer side with centerline shift. Consideration on the continuity of the alignment is necessary.

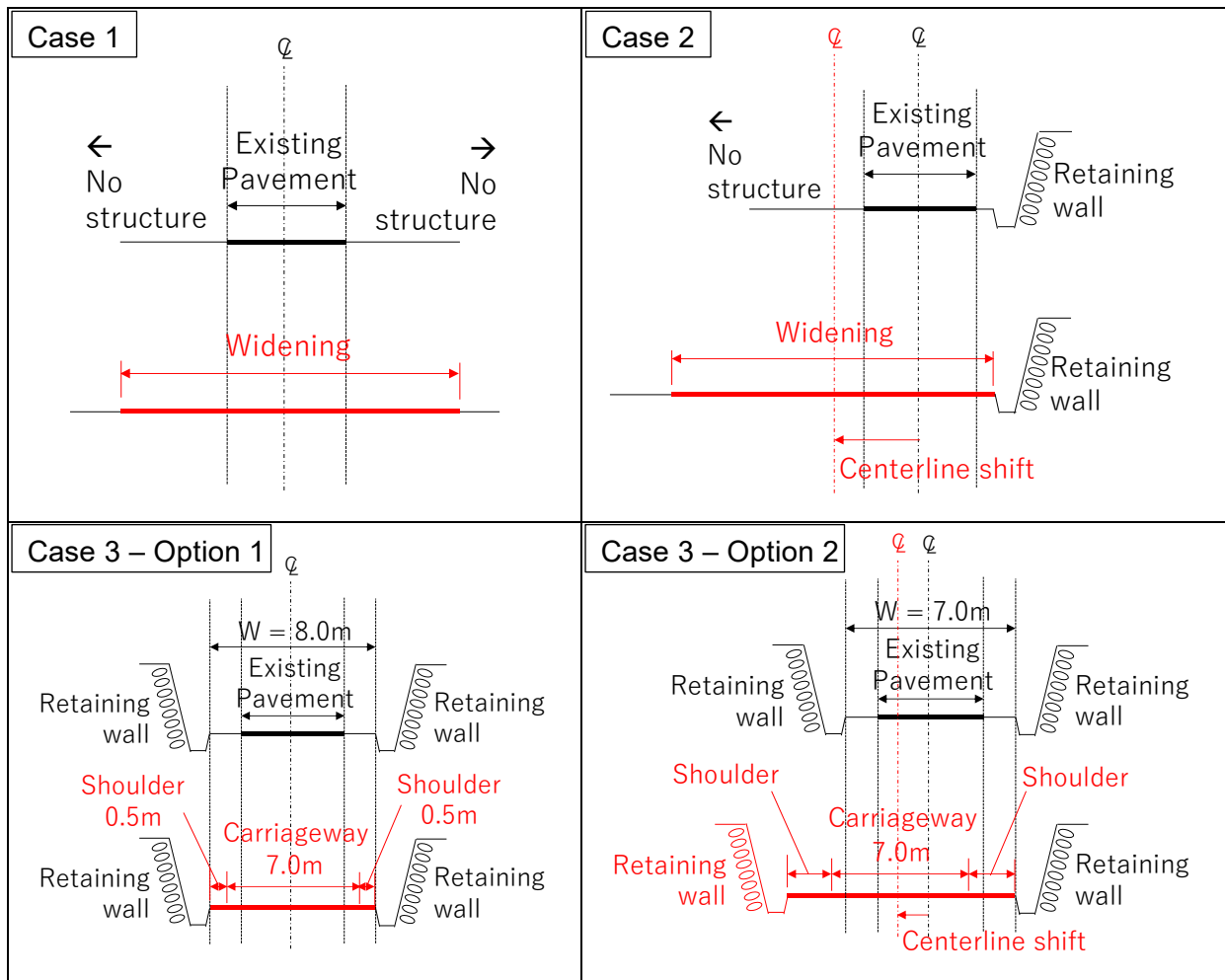


Figure 4-19 Image of Recommended Widening Method

(4) Consideration on Centerline Shift

Although basic widening method is to follow the original centerline, because of constraint on the roadside, the road centerline shifting may be required depending on the situation. Centerline shifting itself is no problem for the comfort drive, but if such shift occurs frequently in short section, the road alignment will be worse. From this reason, enough shift length is recommended to be provided in accordance with its shift width and design speed. For example, the standard shift length is defined as the following table in Road Structure Ordinance of Japan. Comparing the value from formula and minimum, larger value is taken as the standard shift length. For reference, when $V = 60$ (km/hr) and $\Delta W = 1.5$ (m), calculated shift length $L = 45$ m (< 60 m). Then, $L = 60$ m.

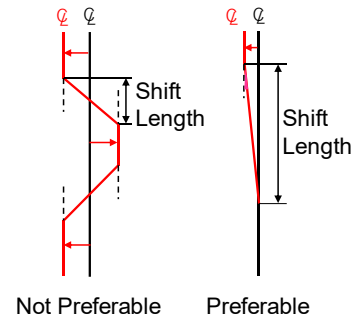


Figure 4-20 Centerline Shift

Table 4-8 Standard Shift Length in Road Structure Ordinance of Japan

Design Speed V (km/h)	Rural Area		Urban Area	
	Formula (m)	Minimum (m)	Formula (m)	Minimum (m)
80	$\frac{V \cdot \Delta W}{2}$	85	$\frac{V \cdot \Delta W}{3}$	-
60		60		40
50	$\frac{V \cdot \Delta W}{3}$	40		35
40		35		30
30		30		25
20		25		20

* ΔW : Shift width

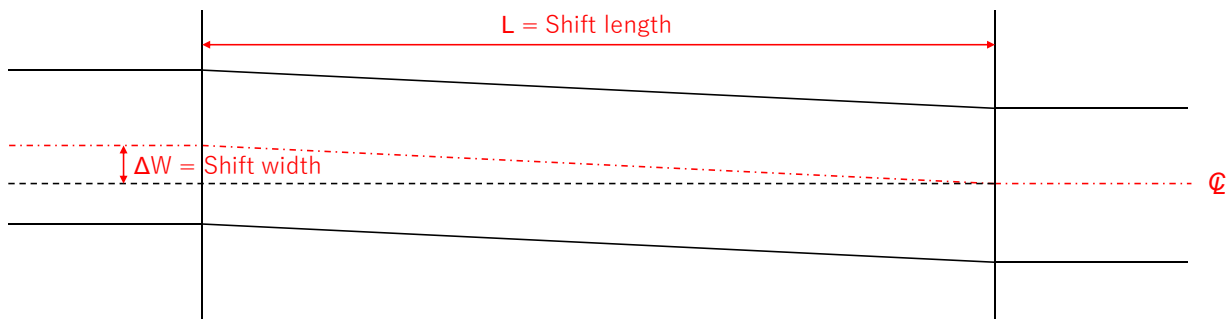


Figure 4-21 Consideration of the Necessary Shift Length

(5) Consideration on Transition of Lane

In widening sections, driving speed is expected to be higher than that of no-widening sections. These sections cannot be connected directly. It needs adequate transition section from 1.5 lanes to 2 lanes and from 2 lanes to 1.5 lanes. Warning sign which shows “lane decrease ahead” is recommended to install before transition begin. This draws drivers’ attention and makes speed lower.

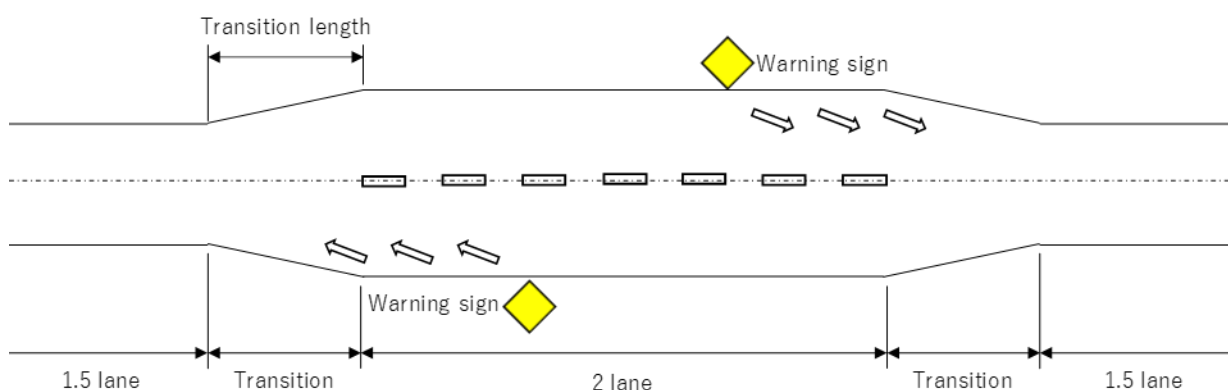


Figure 4-22 Transition of Lane

(6) Widening in Specific Area

In some part of widening section, it is important to consider the method of widening or provision of footpath, for example topographically difficult or pedestrian area. It should be carefully determined based on detailed survey.

- a. Approach road to the causeways to be upgraded, Ghyampe, Mamti, and Bhyakure

Pilot Project of upgrading causeways, Ghyampe, Mamti, and Bhyakure, is proceeding and design of causeways are already completed. Not only structural design of causeways, but also design of approach road and detour plan for the causeways are included in the design. Therefore, it must be considered that the connection to the approach road design of the 3 causeways in terms of horizontal/vertical alignment and cross-sectional composition.

- b. Narrow Curve in Mangaltar (Ch.120+800)

In populated areas or sections with pedestrians, safety measure, such as installation of foot-path or separation of pedestrians from vehicles, should be implemented. For example, in Mangaltar Bazaar, there is a very narrow part which is sandwiched by retaining walls. There is a school and many students pass this narrow road without separation from vehicles. A police station is on one side, and the other side is constrained by a mountain. Sight distance here is not good.

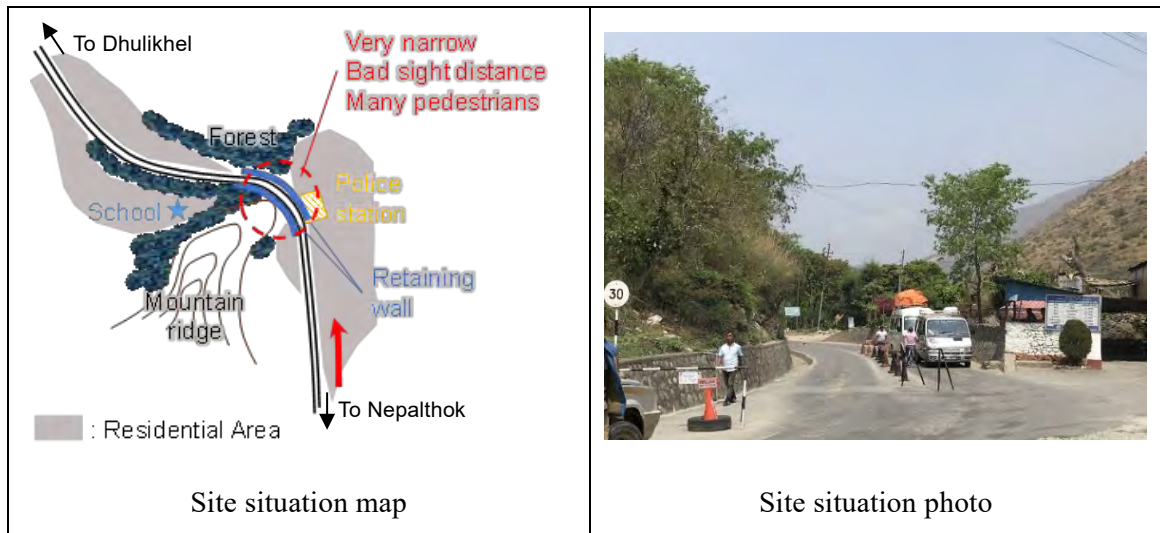


Figure 4-23 Site Situation of Narrow Part in Mangaltar Bazaar

In case widening of this part is difficult, a recommended idea for improving pedestrian safety is construction of pedestrian walk by cutting the slope. It can provide a separated pedestrian walk and improved sight distance as a side effect. Installation of pedestrian crossing is necessary considering flow of pedestrian.

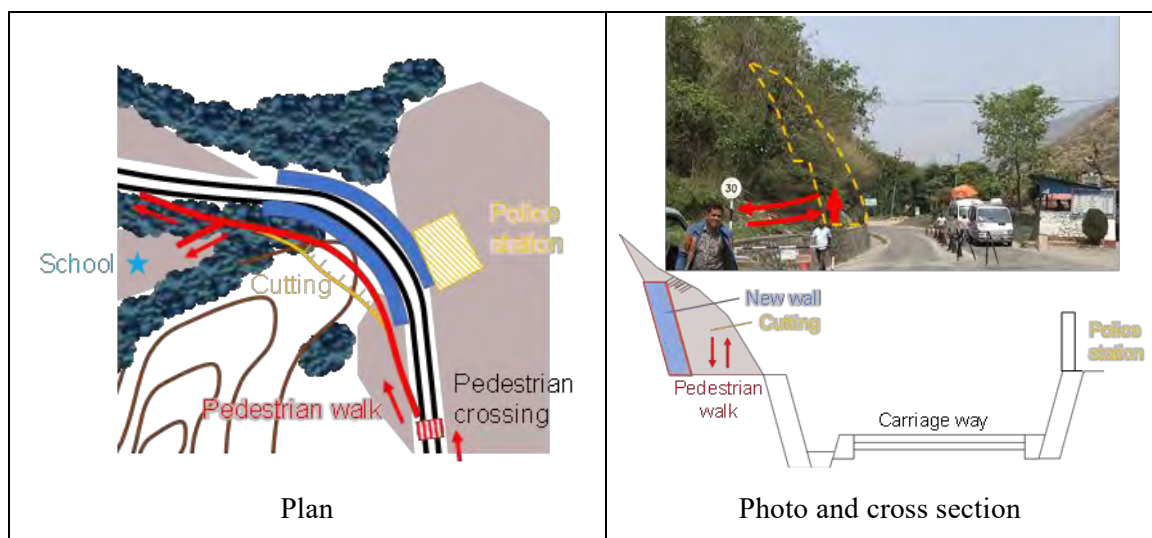


Figure 4-24 Recommended Idea for Improving Pedestrian Safety

c. Connection to the already widened sections (Bhakunde Besi and Dhulikhel)

In Bhakunde Besi and Dhulikhel, there are already widened sections, which are close to prosperous area. It is necessary to consider smooth connection to these sections and secure appropriate transition.



Figure 4-25 Section with Median in Bhakunde Besi



Figure 4-26 Section with Median in Dhulikhel

- d. Widening of the section less than 1 km in Bhakunde Besi (Ch.137+800 – Br. Dapcha No.2)

The length of this section is about only 700m, less than 1km, but many pedestrians are walking along the road and topographically widening is easy. Therefore, this section is recommended to be widened.

- e. Widening side in the section along the river

River side walls and revetments were carefully designed and well-constructed for disaster prevention. These walls and revetments cannot be reconstructed easily. Therefore, widening to river side in such section is impossible.



Figure 4-27 Example of Well-Constructed Walls



Figure 4-28 Example of Well-Constructed Revetment

- f. Already widened curves (around Ch.155+000 – 160+000)

Some curves in this section are already widened as one of safety measures. These widened spaces can be utilized for the widening this time.

g. Widening of the section from Ch.152+000 to Ch.158+400

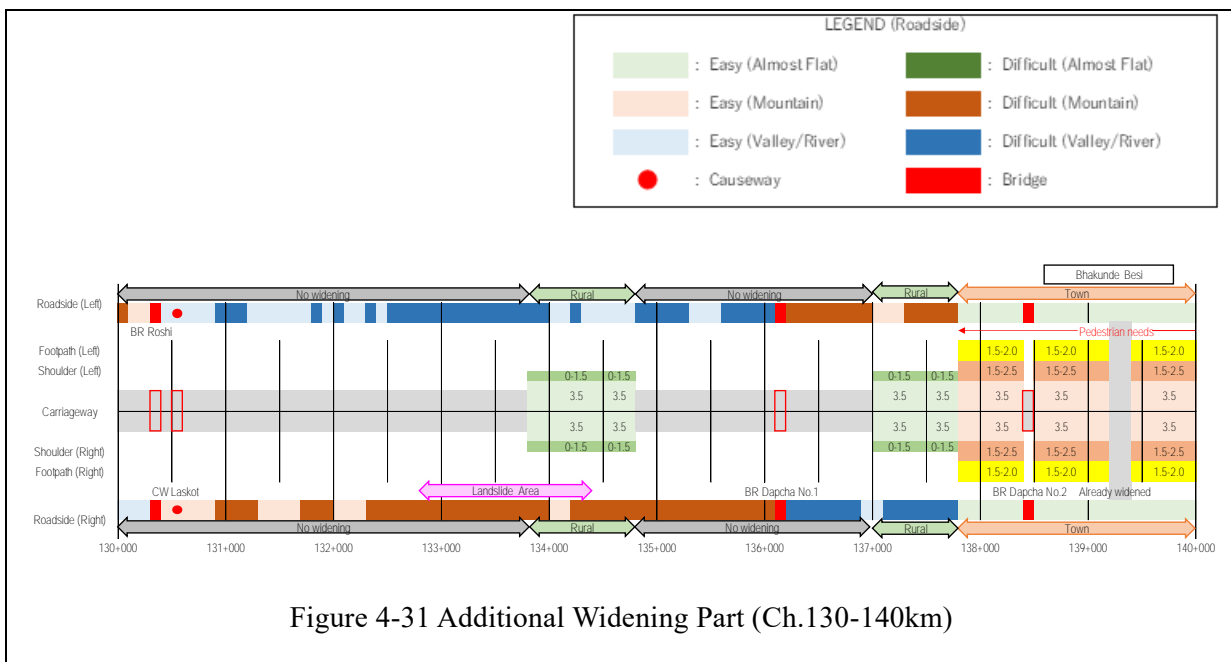
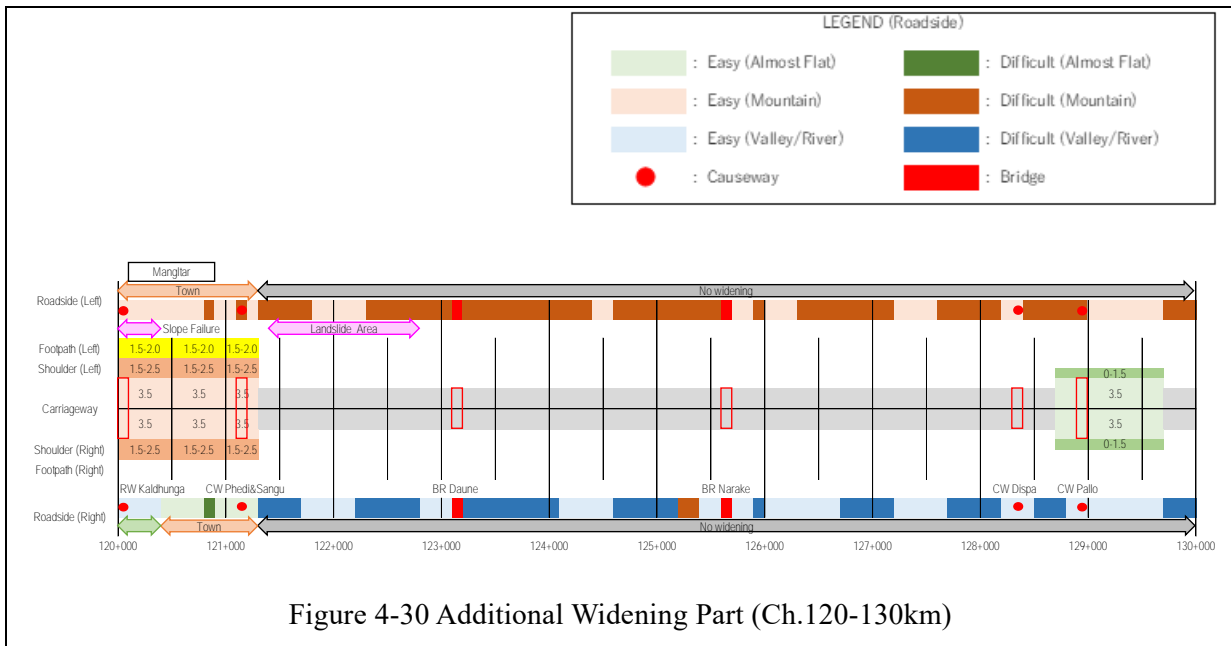
In this section, generally retaining walls on mountain side are not so high and can be set back. However, construction cost will be higher than widening in flat area. If the reconstruction of retaining wall is acceptable, this section will be continuous widening section up to Kavre Bhanjyang.



Figure 4-29 Typical Situation of the section from Ch.152+000 to Ch.158+400

(7) Alternative Study of Widening

In certain sections like Ch. 128+700 to 129+700, Ch. 133+800 to 134+800 and Ch. 137+000 to 138+000, it can be considered to widen for 1 km stretch as an alternative because widening for longer stretch is very difficult due to presence of landslide prone area and/or boulders. Full width widening including shoulder and footpath on both side is not possible and being rural area, carriageway width of 7 m in all three portions and shoulder width of 0 to 1.5 m can be attained subjected to site possibilities.



Detailed construction cost of road widening will not be shown in this preliminary survey. Although, cost difference between with and without additional widening for the Town above three section can be discussed with the rough estimate.

According to the similar works for 7 km in Section I which was designed as a priority section, direct cost of road widening works per 1 km is estimated 36 million NRs. Expected work items for the above section other than the typical road widening works are reconstruction of stone masonry walls and excavation of soil or rock. Per km cost of such additional items are roughly estimated as follows.

Table 4-9 Rough Estimate of Direct Cost (Per km) for the Alternate Widening Part

Unit: Million NRs. Per km

Group	Included Items	7 km in Sec. I (as example)	Ch. 128+700 to 129+700	Ch. 133+800 to 134+800	Ch. 137+000 to 138+000
General road works	Scarifying existing pavement, providing new pavement, Road way excavation	28.6	28.6	28.6	28.6
Difficult terrain related works	Reconstruction of stone masonry structure and excavation of soil or rock	7.4	27.8	24.6	25.6
	Total	36.0	56.4	53.2	54.2

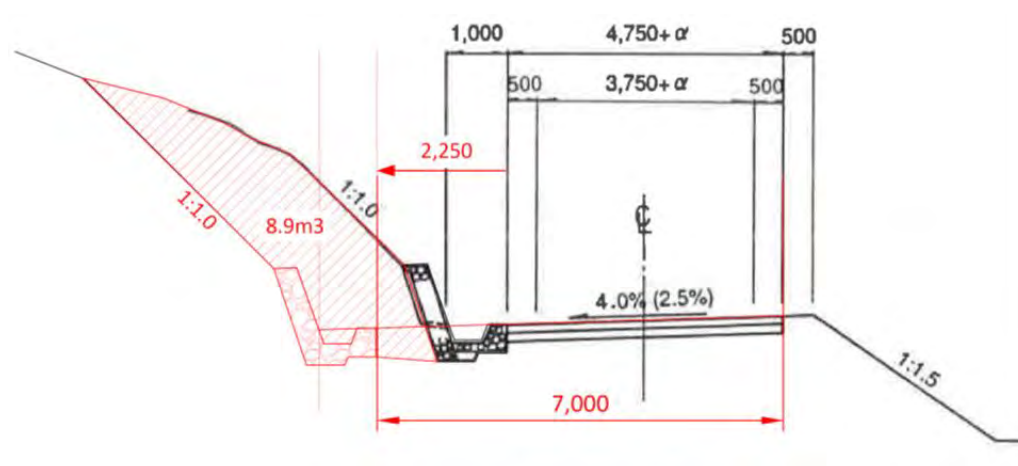


Figure 4 27 Typical Image of Soil Excavation on the Mountain Side

4.5.2 Pavement Design

(1) Design Conditions

Pavement design is proposed to be determined based on the following design conditions.

Table 4-10 Design Conditions for Pavement Structure

Design Standard	“Pavement Design Guidelines (Flexible Pavement)” published by the Department of Roads, planning and design branch in 2014 AD
Design Life	15 years
Traffic Volume	Two-way traffic 24 hours count at Dhulikhel Station along the Sindhuli Road
Remarks	Condition surveys of bituminous pavements are used to determine not only the maintenance requirements but also the nature and rate of change of condition to if and when the pavement is likely to need strengthening.

(2) Proposed Pavement Structure

The components of pavement and their respective thickness is based on the design traffic and CBR. The charts of Annex III of the Pavement Design Guidelines (Flexible Pavement) is referred to determine the required thickness of sub-base, base, DBM and Asphalt. As the information on CBR values are not available, it is recommended to conduct site investigations before determine the pavement structure. In this preliminary study, the CBR value is assumed as 8 or 6 tentatively. Based on it, total pavement thickness for traffic 26.07 msa is interpolated as 585 mm for CBR value 8 and 650 mm for CBR value 6. The individual thickness of pavement are shown below.

Table 4-11 Design Thickness of Pavement (Reference)

CBR		8%	6%
Total Pavement Thickness		585 mm	650 mm
Pavement Composition	Asphalt Concrete	50 mm	50 mm
	DBM	50 mm	100 mm
	Granular base	200 mm	200 mm
	Granular subbase	285 mm	300 mm

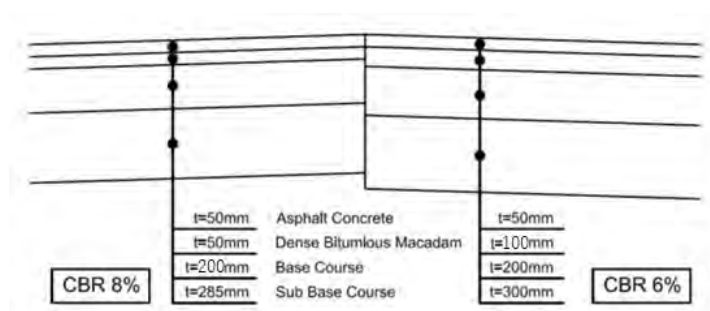


Figure 4-32 Design Thickness of Pavement (Reference)

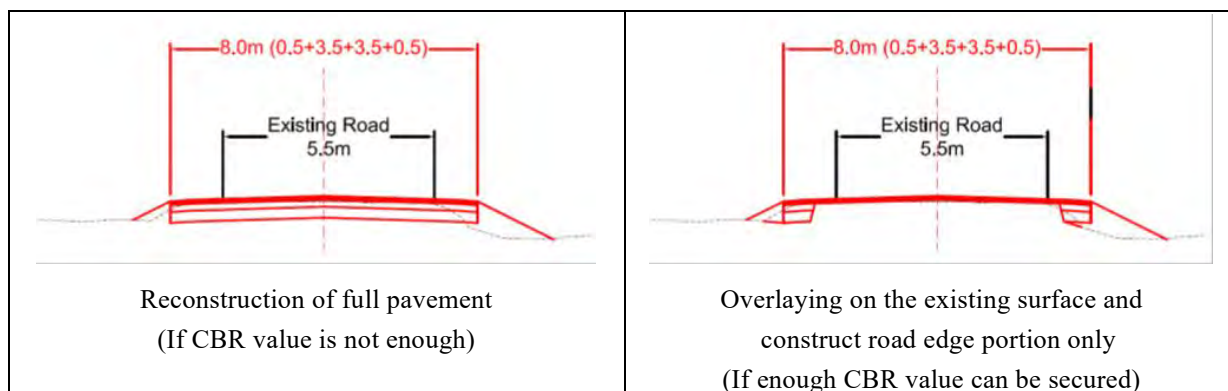


Figure 4-33 Image of Full Scale Pavement and Partial Pavement

4.5.3 Drainage Design

For drainage design, the existing drainage is recommended to be maintained as much as possible. In case the existing drainage is removed, an equivalent drainage is recommended to be constructed. Some cross drainages are needed to be extended when the road is widened. Sometimes cross drainage is located at so deep position from the road surface that cannot be extended easily, thus it is recommended to check the actual location and condition of cross drainage.

4.5.4 Road Rehabilitation and Repair

If any damaged portion on road surface such as pothole, large crack and surface settlement is observed in the target site, it is assumed that the pavement structure is no longer stable for the further increasing heavy vehicle. Therefore, pavement reconstruction works above sub base course layer is required prior to the road improvement.

4.6 Road Safety Measure

4.6.1 Sight Distance Improvement

(1) Additional sight distance improvement

One of recommended locations for additional sight distance improvement is mentioned here. At the curve at around Ch.114+300, accident happened in the past. The road alignment connecting this curve is not so winding and the radius of curve itself is small. In such a situation, drivers can enter the curve without decreasing speed enough and protrude opposite side of road. Especially, this curve has so bad visibility that drivers cannot recognize the vehicle coming from the other side of curve. Thus sight distance improvement at this curve is necessary.

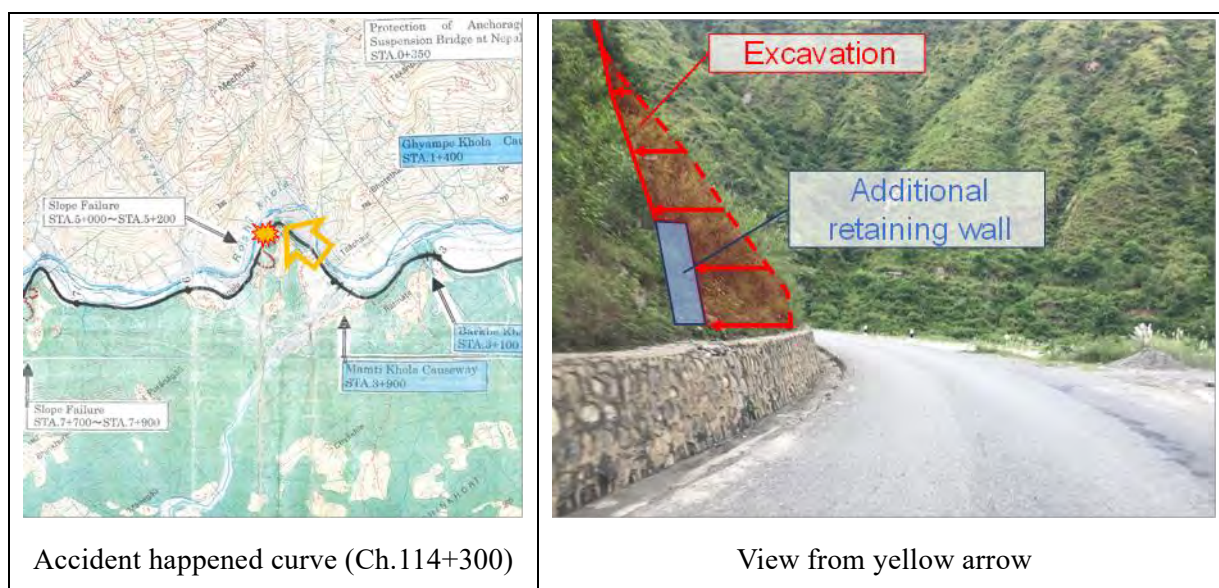


Figure 4-34 Example of Recommended Site for Additional Sight Distance Improvement

(2) Removal of plants

Growth of plant makes sight distance shorter and road safety worse. Especially, grown plants on the inner side of curve disturb visibility of drivers. In the accident prone section around Ch.150+500, plants are growing on the inner slope and top of gabion walls. This situation makes sight distance shorter and is one of the causes of accident. Another example is the curve at around Ch.157+750. Plants are growing on the inner side of curve and this location is one of the accident prone area as well as Ch.150+500. Here, the inside shoulder seems relatively wide and some drivers may think about overtaking, but visibility of this curve is obstructed by the plants growing on the inner side of curve. Therefore, sight distance improvement by cutting the plants is recommended.

Plants are growing everytime and sight distance becoming shorter and shorter, so regular maintenance work is as very important as sight distance improvement work and needs sufficient budget.



Figure 4-35 Example of Recommended Site for Removal of Plants 1

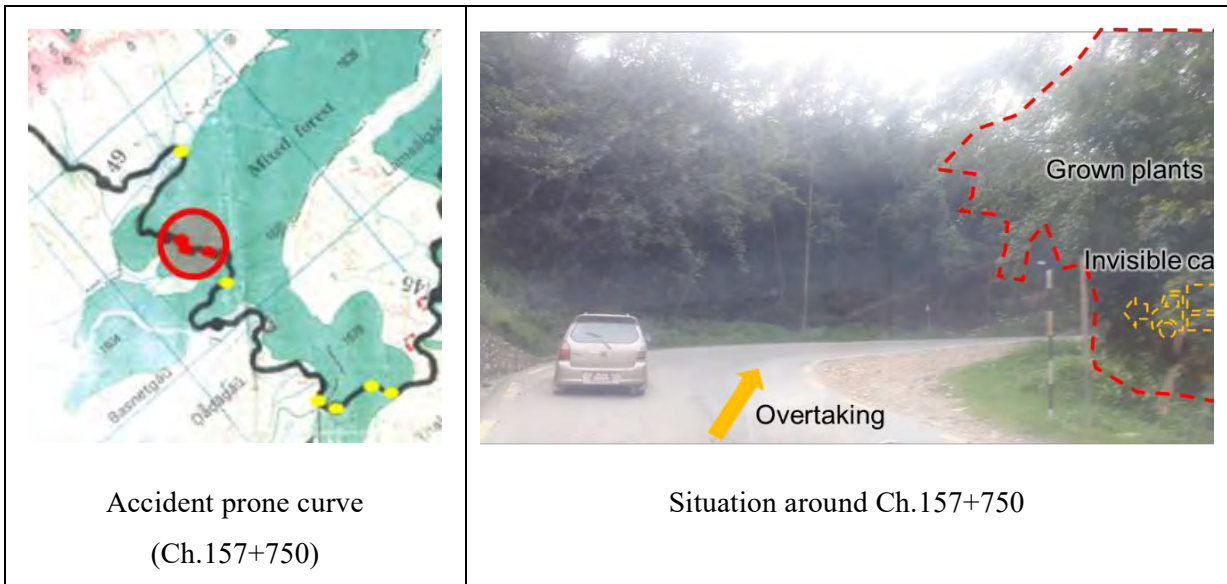


Figure 4-36 Example of Recommended Site for Removal of Plants 2

(3) Prevention of improper parking and overtaking

In order to prevent parking on the inner shoulder and overtaking at curve, reduction of drivable width by installing blocks on the shoulder is one idea. Basically, wide shoulder is preferable to a certain extent, but in the Sindhuli Road, wide shoulder actually induces improper parking and overtaking. Constraining the width of shoulder at curve with blocks can be an effective safety measure.

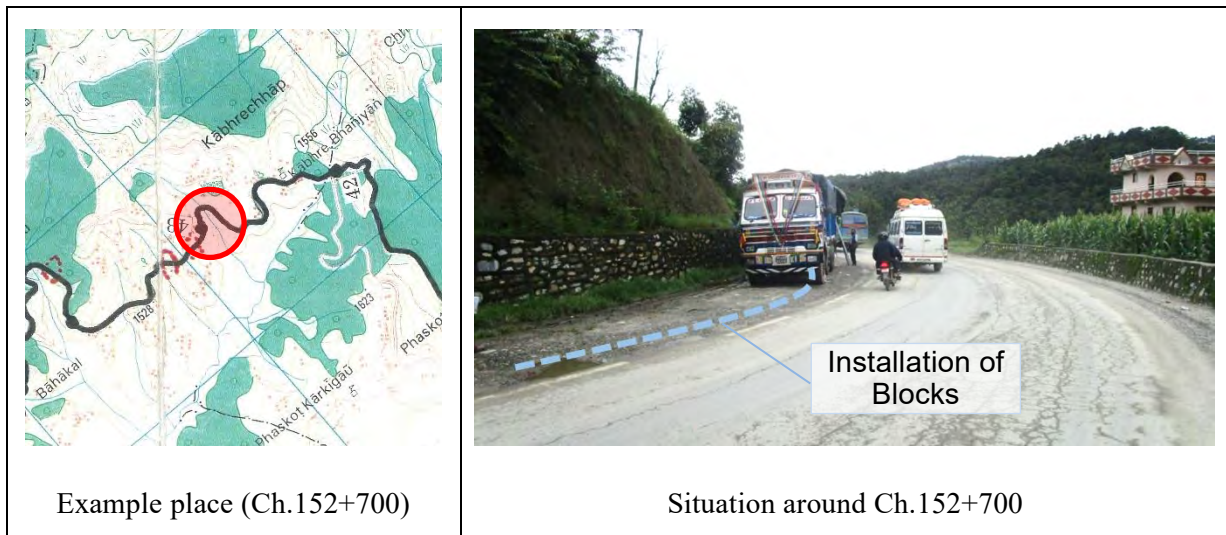


Figure 4-37 Example of Recommended Site for Excessively Widened Shoulder

4.6.2 Curve Mirror Installation

(1) Additional installation

One of recommended locations for additional curve mirror installation is mentioned here. At the curve around Ch.128+600, most vehicles slow down and make a horn due to very limited visibility. This place can be a high priority curve to be improved, but the inner slope is consist of hard rock and difficult to excavate. Thus additional installation of curve mirror is recommended at the curves like this site.

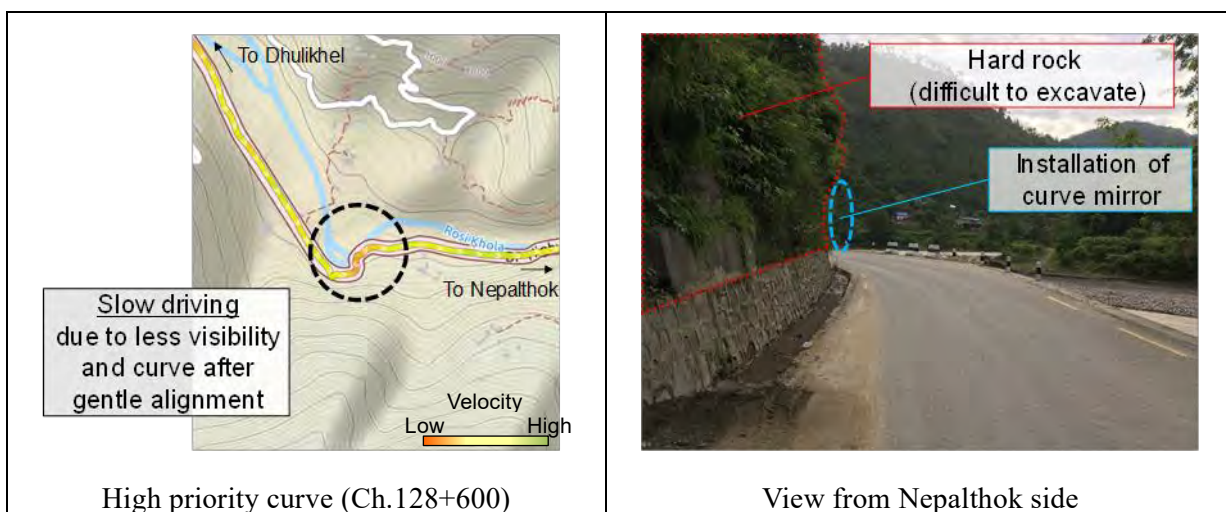


Figure 4-38 Example of Recommended Site for Excessively Widened Shoulder

4.6.3 Fall Prevention Facilities Installation

Regarding fall prevention measure, the places where guard blocks or guard rails are already installed and where recommended to be newly installed are surveyed. The survey result is shown in the following table and figure. The total length of fall prevention necessary section is about 15.2 km, 30.4 % of Section IV, and 9.8 km of fall prevention countermeasure is recommended to be newly installed. Comparing the section near Dhulikhel with near Nepalthok, the Dhulikhel side is well-countermeasured. As for the Nepalthok side, there are many places with high risk of fatal fall accident. Prioritization by the risk of fatal fall accident is recommended, but 9.8 km fall prevention measure is needed to be installed in the future.

Table 4-12 Installation Status of Fall Prevention Countermeasure

Total Length of Section IV		50.0 km
Fall prevention measure necessary section		15.2 km (30.4 %)
	Guard block or guard rail is already installed	5.4 km (10.8 %)
	Section proposed to newly install	9.8 km (19.6 %)

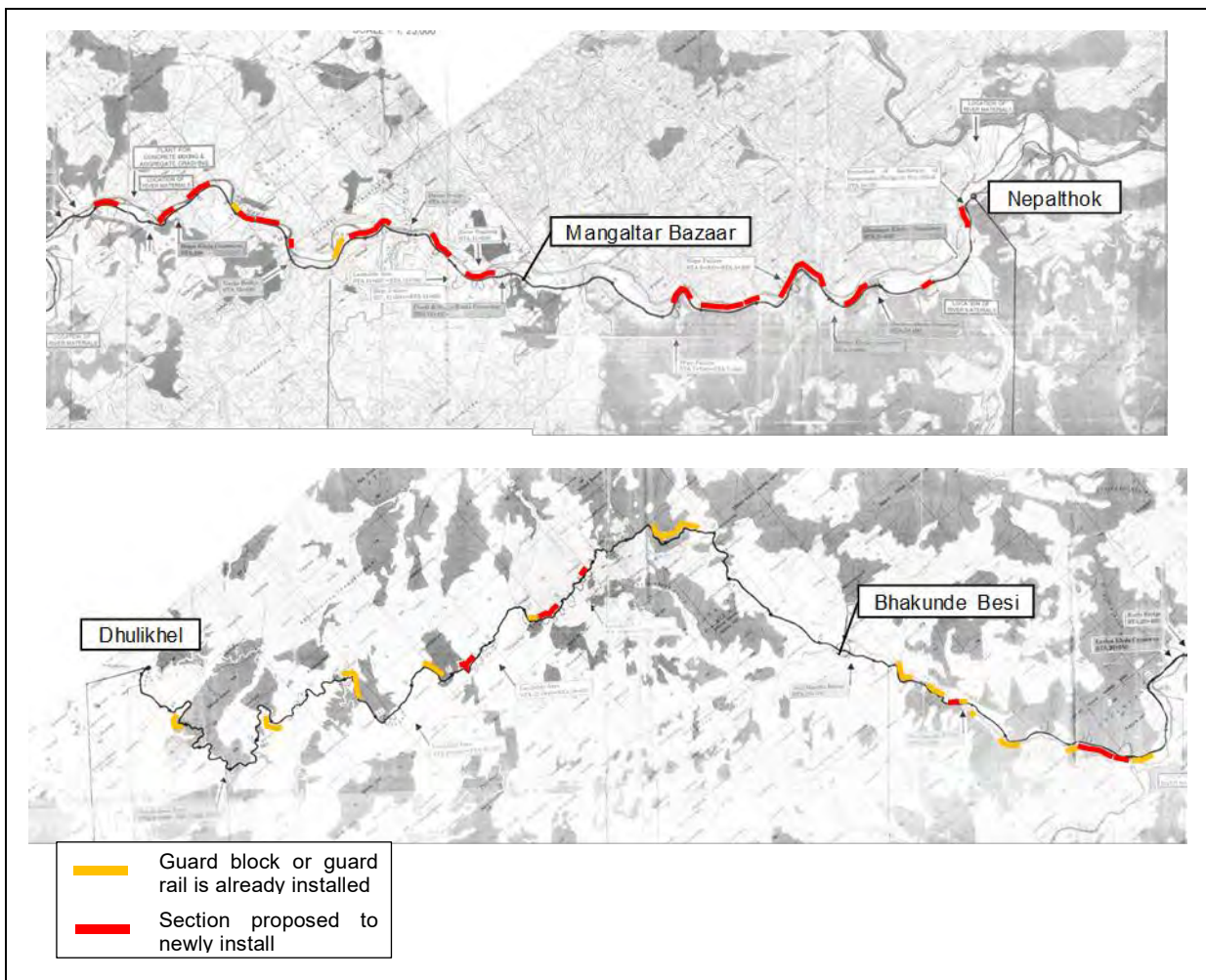


Figure 4-39 Installation Status of Fall Prevention Countermeasure (L > 100m)



Ch.126+650 - 126+950 (L=300m)



Ch.113+250 - 113+700 (L=450m)



Ch.146+150 - 146+700 (L=550m)



Ch.133+250 - 133+800 (L=550m)

Figure 4-40 Candidate Place for Installation of Fall Prevention Countermeasure

4.6.4 Stopping Lay-By Construction

One example of recommended places for installation of paved stopping lay-by is shown in the following figure. This place is located at straight part of road and in mountainous terrain. In case a vehicle stopping this place,

- ✓ the vehicle may not be an obstacle to sight distance, and
- ✓ the visibility from the stopping car is good to re-start from the lay-by.

Also, this lay-by will be

- ✓ good rest place for drivers and vehicles which has driven in mountainous road, and
- ✓ safe passing lay-by for giving way to overtaking vehicles.

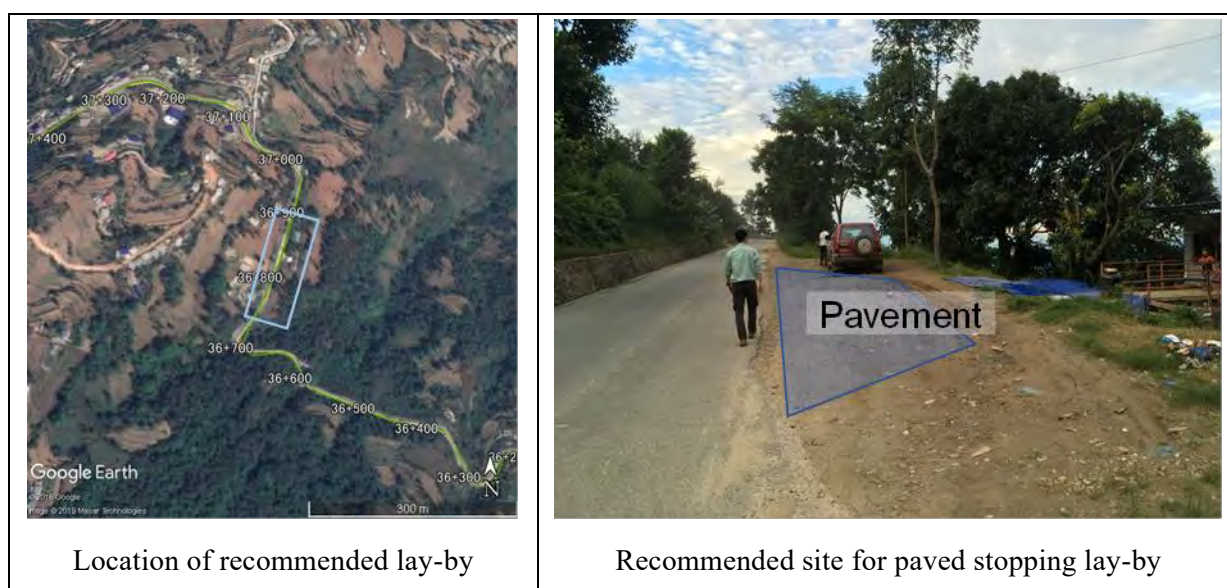


Figure 4-41 Example of Recommended Site for Paved Stopping Lay-By

5 Suggestions

(1) Conduct of Appropriate Site Surveys

➤ Topographic Survey

The precise topography is not shown in the existing map. It is recommended to conduct topographic survey to clarify the detail site condition for the consideration of re-alignment route study. For saving time, using drone for topographic survey is highly efficient. The proposed minimum width of the survey is 25 m from the centerline of selected new alignment to both sides. Also, because forest and deep valley exist in this area, it would be better to include wide area that can cover candidate routes.

➤ Pavement Condition Survey

To know the stability of the existing pavement, conducting soil investigation such as CBR test or DCP test is desirable. Test method and location is recommended to be considered in accordance with DOR standard. The test results are reflected to the pavement design and selection of the construction method in the widening works.

(2) Balance of Cut/Fill Volume

It is expected that a volume of soil is necessary for the widening works in the target section. Thus it is recommended to conduct the detailed design with considering the necessary soil amount for widening.

(3) Detour Plan

Since the alternative alignment in most section will be just following the existing one, the construction works may be obstacle to the traffic of the Sindhuli Road. Therefore, detour plan should be well considered for the smooth traffic during the construction period.

(4) Environmental Considerations

When considering road shifting and re-alignment, environmental study might be necessary to reduce the impact by the construction. Also, it is necessary to confirm if IEE or EIA process is required to conform the regulation in Nepal.

(5) Reporting, Design Drawings and Cost Estimation

The following items are recommended to be considered and included in each deliverable.

a. Report

- Specifications, results, and discussion of conducted surveys
- Consideration process of design (e.g. pavement design, structure design, etc.)
- Road safety consideration (e.g. footpath, guardrail, delineator, etc.)

- Construction plan (e.g. spoil bank, detour plan for existing traffic, etc.)
- b. Design Drawing
 - Existing road in plan drawing (especially for widening project)
 - Structure drawings (e.g. bridges, causeways, box culvert and their approach road)
- c. Cost Estimation
 - At least typical drawing of retaining walls, pavement, drainage, and other facilities are necessary for showing their unit quantity clearly.
 - Cost items based on detailed construction plan.

See also the other comments discussed based on the result of detailed design review of the first 7km in Section I, submitted to DOR on 11th Dec., 2019.

(6) Definition of Chainage

The Sindhuli Road was divided into four sections. Road chainage system of the Sindhuli Road is based on the as-built-drawings prepared during the time of construction. Each section has individual chainage which starts from zero at the section boundary such as Sindhuli bazar, Khurkot and Nepalthok. However, once the road is fully completed, maintaining separate chainage for each section is no longer convenient for road management. Therefore, it is recommended to make a consistent use of chainage from now on. The chainage to be used should be calculated as the distance from Bardibas with slight modification to maintain the compatibility with the current chainage (section-wise chainage) as well as the location of kiloposts installed along the road. Following figure shows the section chainage as well as proposed chainage to be used now onwards.

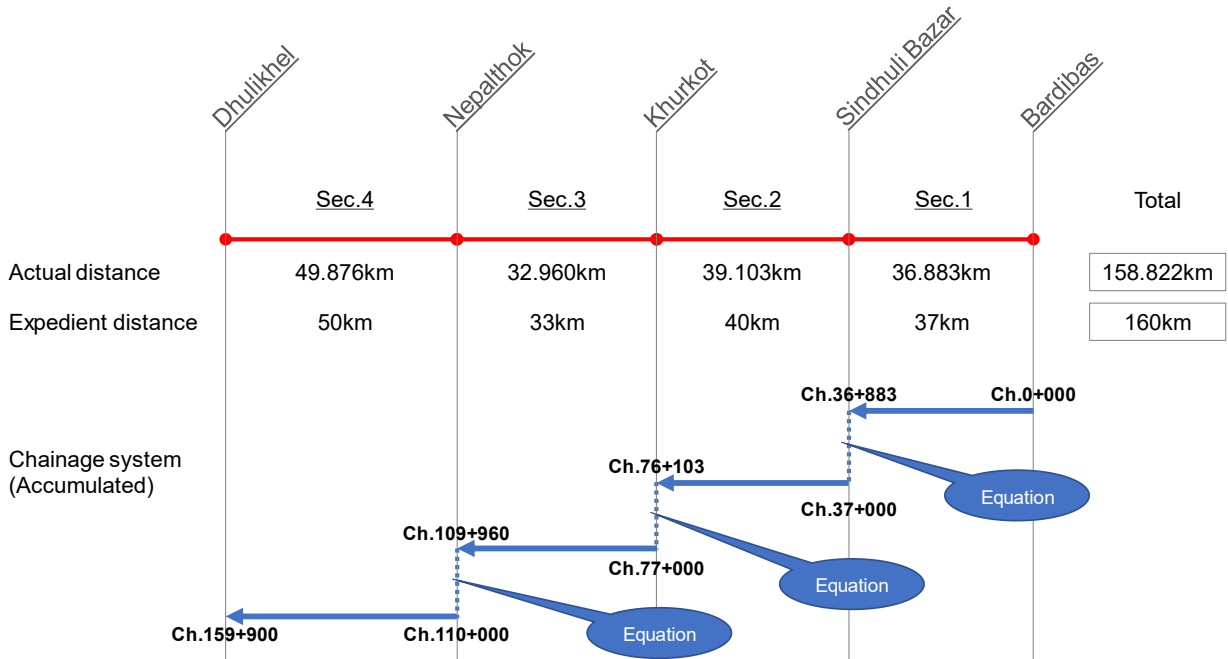


Figure 5-1 Accumulate Chainage with Equation

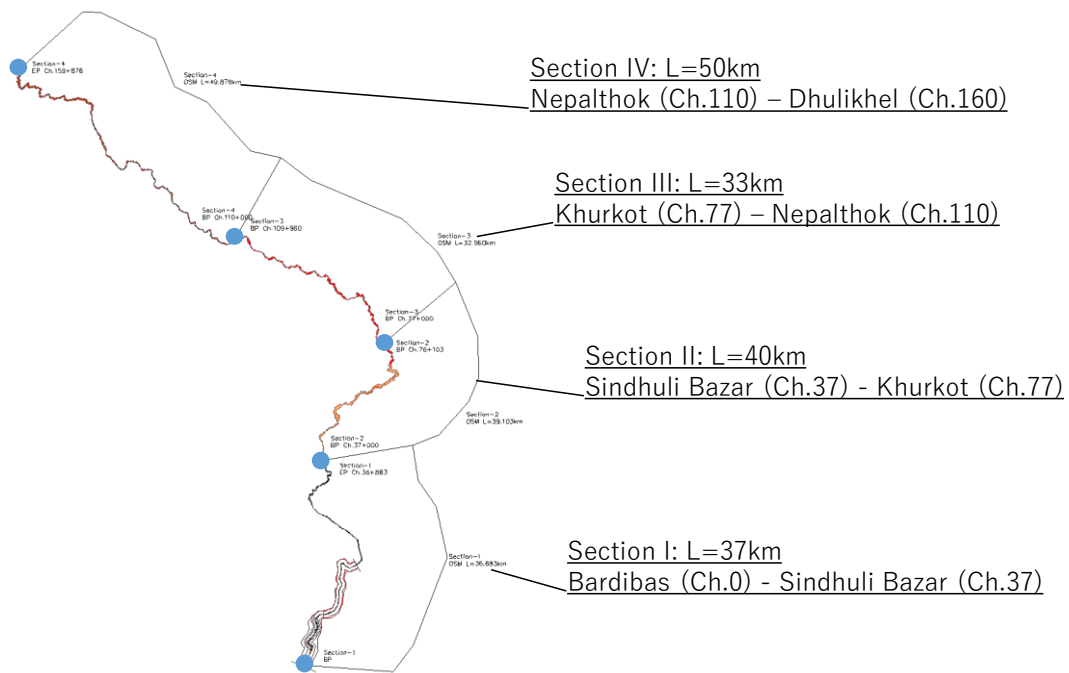


Figure 5-2 Chainage Corresponding to the Section

Regarding the calculation of chainage at particular point, following table (sample) should be used.

Table 5-1 Sample Calculation of Particular Chainage

Old Chainage (d1)	New chainage (d2)	Equation
Section I, 5+000	5+000	Same as d1
Section II, 5+000	42+000	d1 + 37km
Section III, 5+000	82+000	d1 + 77km
Section IV, 5+000	115+000	d1 + 110km

It should be noted that the section boundary in Khurkot was changed during the construction. During the time of construction, the contract package of Section II and III was divided at the point of Ch.35+800 from Chiyabari. However, a kilopost of Khurkot was installed near Khurkot Bas Park where is 3.8km beyond the contract boundary. Therefore, practical appellation of Section II and III should be identified according to whether beyond the kilopost of Khurkot or not.

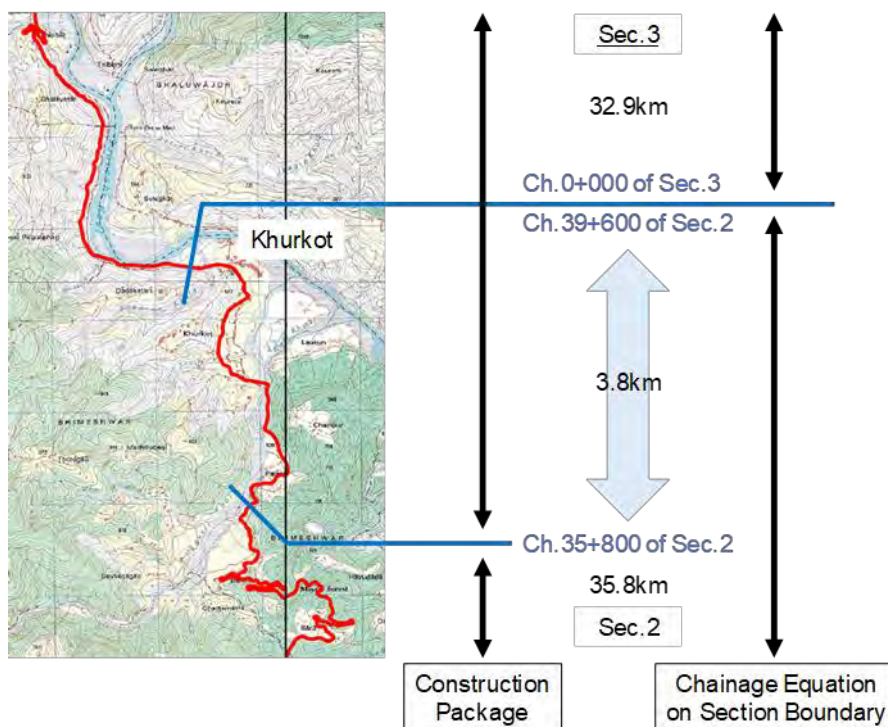


Figure 5-3 Difference Between Construction Package and Road Chainage at Khurkot



Figure 5-4 Beginning Point of Section I (Bardibas)

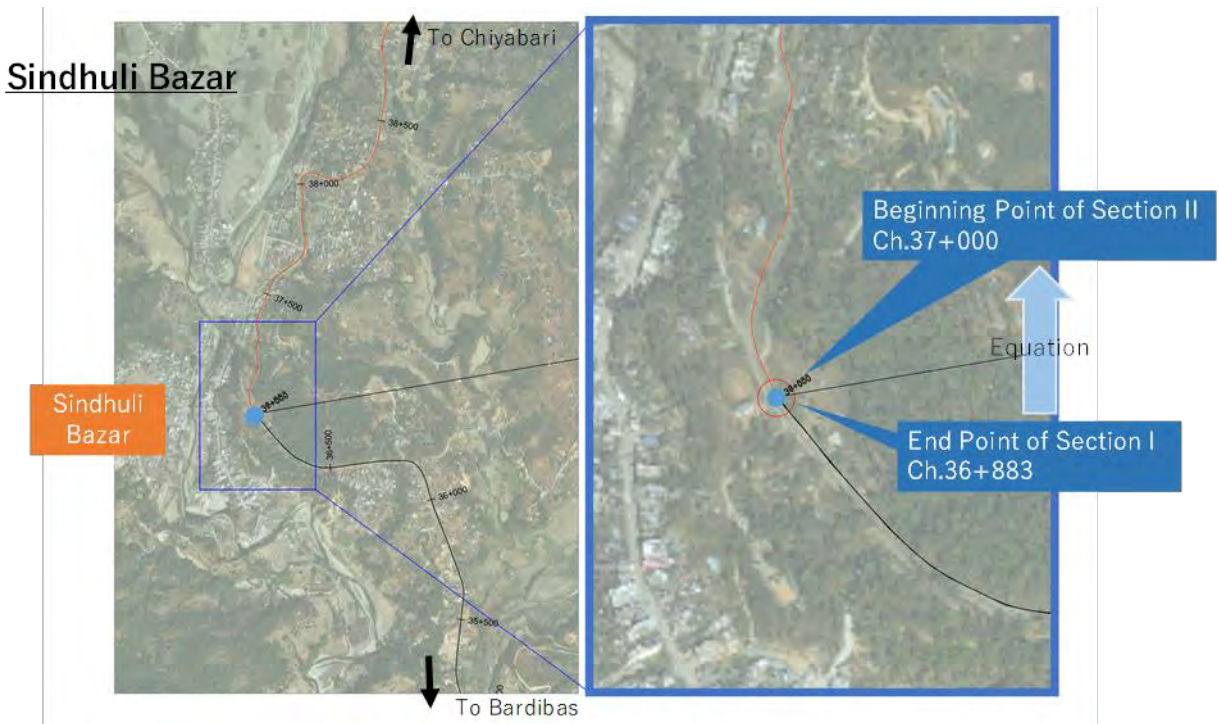


Figure 5-5 Equation Point between Section I and II (Sindhuli Bazaar)

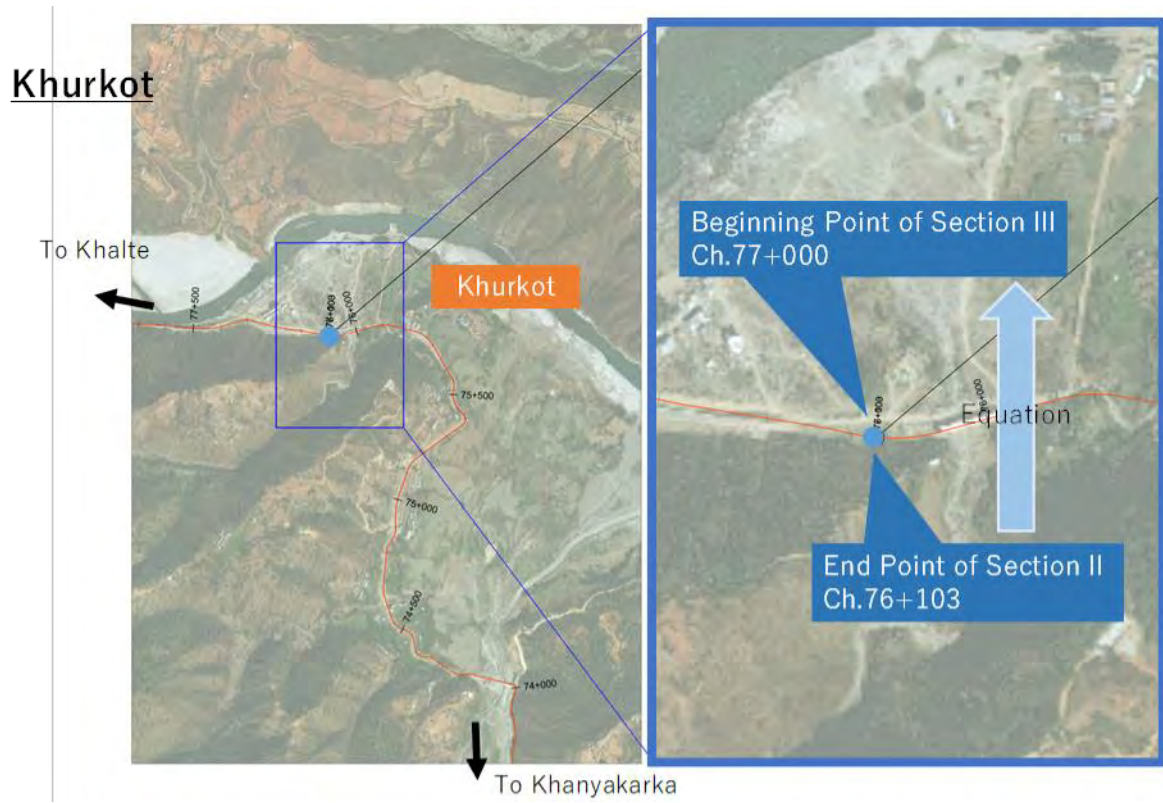


Figure 5-6 Equation Point between Section II and III (Khurkot)

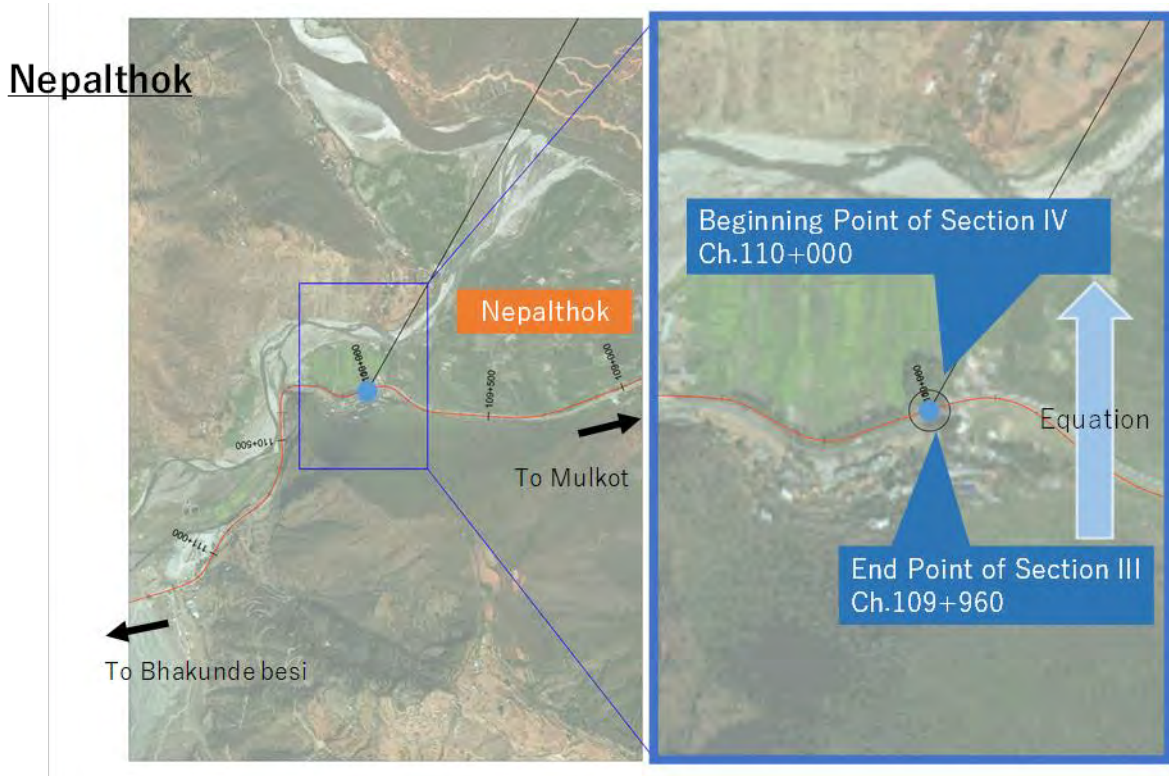


Figure 5-7 Equation Point between Section III and IV (Nepalthok)

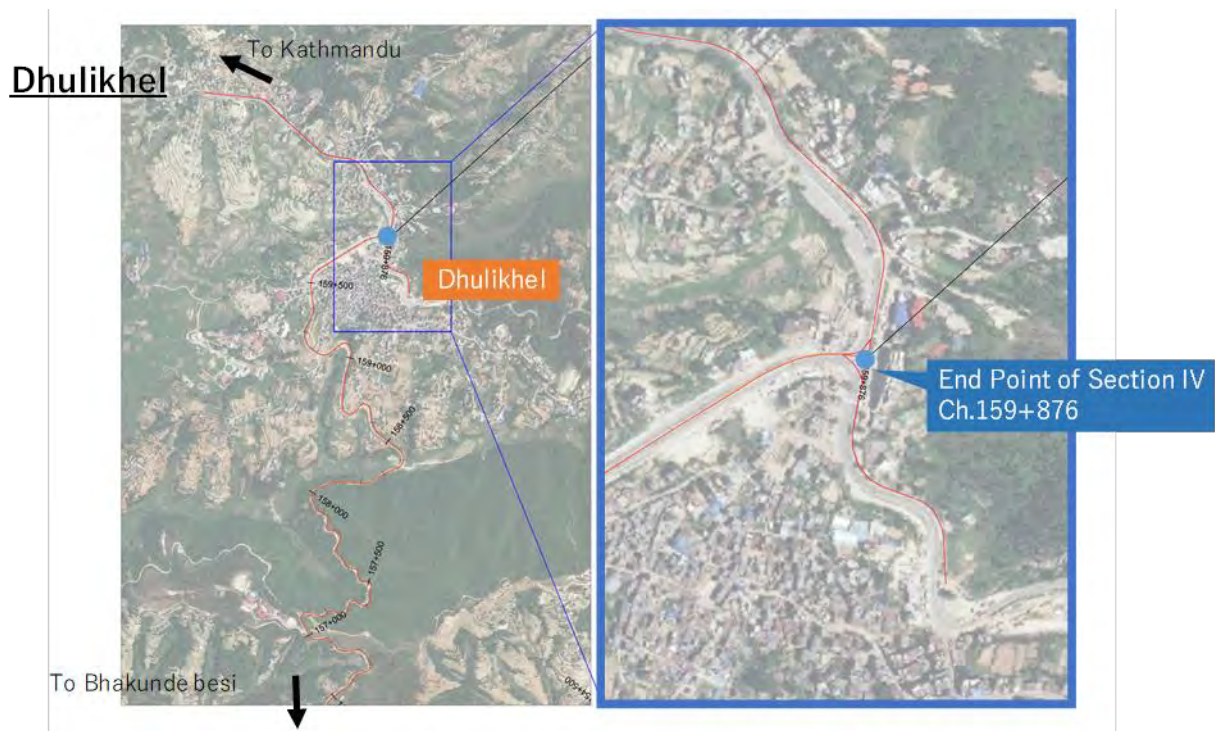


Figure 5-8 End Point of Section IV (Dhulikhel)

Assessment of the EIS Status, Issues and Recommended Measures for Restoration

JICA Expert Team, SR0M2

1 GENERAL

We (participants listed in the following table) visited the site from Dhulikhel to Bardibas to assess the status of all the RIBs and rainfall stations on 2nd and 3rd November 2021. We inspected the infrastructures and explained the situation to the counterparts during the site visit. In this report the status of each infrastructure and remedial measures for the restoration (finalized in consultation with Softwel) will be presented in detail.

Table Participants of Site Visit

Organization	Name	Position
Sindhuli Road Project, DOR	Mr. Rabindra Lal Das	Project Manager
	Mr. Karna Singh Khatri	Engineer
	Mr. Sanjay Sah	Sub Engineer
	Mr. Rabindra Shrestha	Sub Engineer
JICA Expert Team, SR0M2	Mr. Akhilesh Kumar Karna	JICA Expert, EIS / Disaster Prevention
Softwel	Mr. Prashant Malla	Managing Director
	Mr. Sundar Shrestha	Engineer

2 CURRENT STATUS OF EIS INFRASTRUCTURES

2.1 Road Information Board / RIB

2.1.1 Koteshwor RIB

RIB was handed over to DOR Kathmandu Division office as the road is being widened. The division office dismantled the Control house. The control house is planned to be relocated inside the traffic police office. The work has not started yet.



Road widening work and a view of RIB at Koteshwor



Road widening being carried out where there used to be control house

2.1.2 Dhulikhel RIB

RIB at Dhulikhel was restored last year. It was working for some time. However, recently, the supervisor Mr. Rabindra Shrestha found some smoke coming inside the control house and he switched off the devices as well as the solar power input. Following is the list of work done during our site visit.

- Switched on the solar power
- Switched on the RIB
- Made payment for SIM card of RIB

After switching on the solar power supply, the message in the RIB was visible. However the message was garbled due to problem in some pannels. In the evening the RIB was visible online and the message was changed online.



Participants of the site visit



Inverter and switching inside control house



RIB at Dhulikhel



Message is garbled (not clearly visible in the photograph)

2.1.3 Khurkot RIB

Two new RIBs are being constructed in Khurkot. The installation is almost completed. We could view the message displayed temporarily in both the RIBs. The new RIBs are still not connected to the central server. Therefore message cannot be changed from website.



Message board near Police station (For road users from Kathmandu side)

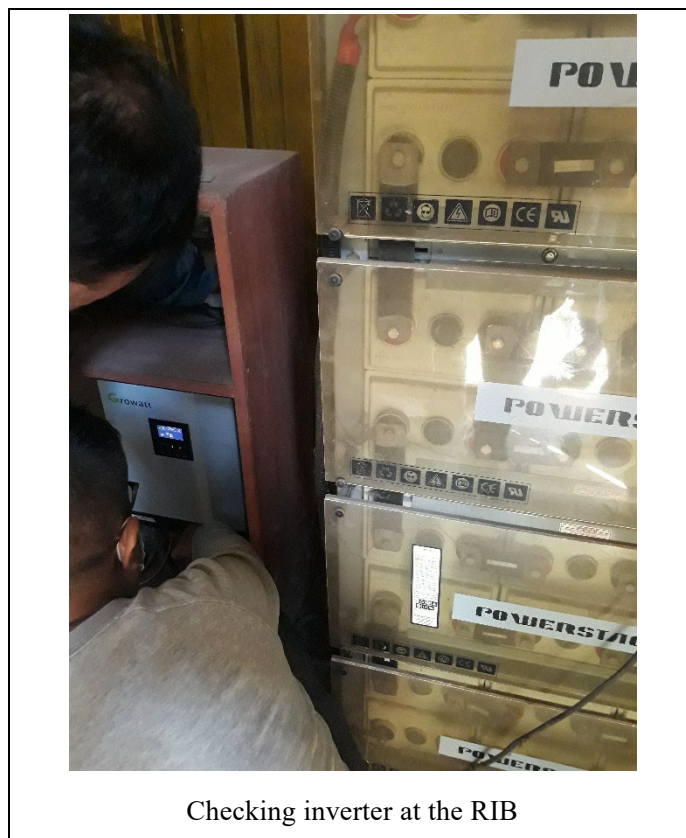


Battery and charger

2.1.4 Sindhuli Bazar RIB

In the year 2019, with the help of Softwel, RIB at Sindhuli Bazar was restored. The Battery was charged using diesel generator as the battery power was not possible to be restored by the solar power. After the charging, the system worked for some time. Later, after few weeks it stopped working as reported by the concerned supervisors. All the power supply (input) and output was turned off by the DOR staff. The list of observation works done at the site are as follows:

- Solar power was switched on and RIB was connected to the power. However, there was no effect on the RIB. It was not able to be switched on. While switching on the RIB, we observed unusual sound coming from the inverter.
- We requested the DOR staffs to let the solar power be kept on.
- Next day while returning from Bardibas, we again observed the RIB to check whether the battery was charged and RIB was working. We observed some improvement in the battery power. However, when RIB was connected to the power supply, same kind of sound was coming from the inverter. The power supply to the RIB was cut to avoid the noise.
- We requested DOR staff to keep the solar power on for charging the battery. After 4-5 days (on 8th November) we requested the DOR supervisor to connect the RIB to power supply and check if the condition has improved. The supervisor reported that there was still the same sound coming out from the inverter after connecting to the RIB.



2.1.5 Bardibas RIB

The building used for installation of RIB at Bardibas had to be dismantled as the land was owned by CIAA (Commission for the Investigation of Abuse of Authority). As such, all solar panels and batteries were removed and stored inside the DOR Bardibas camp.



2.2 Rainfall stations

2.2.1 Min Bhawan rainfall station

We checked the status of Min Bhawan rainfall station. We connected the console to direct electricity and direct connection to the LAN cable for data transfer. We observed the followings:

- The battery seems to be discharged. Inverter is also turning on. The Solar power is not working.
- MCB has problem in one of the switches which connects to battery power.
- Weather console seems to be working properly. As the modem (Dongle connected to router) was not working, we connected the weather console directly to the router using LAN cable. We could find the weather station listed in the weatherlink website. The real time data is also shown in the website.



MCB switched turned off



Weather console connect to direct electricity and LAN cable



Checking the equipments at the rainfall station

2.2.2 Bhaktapur rainfall station

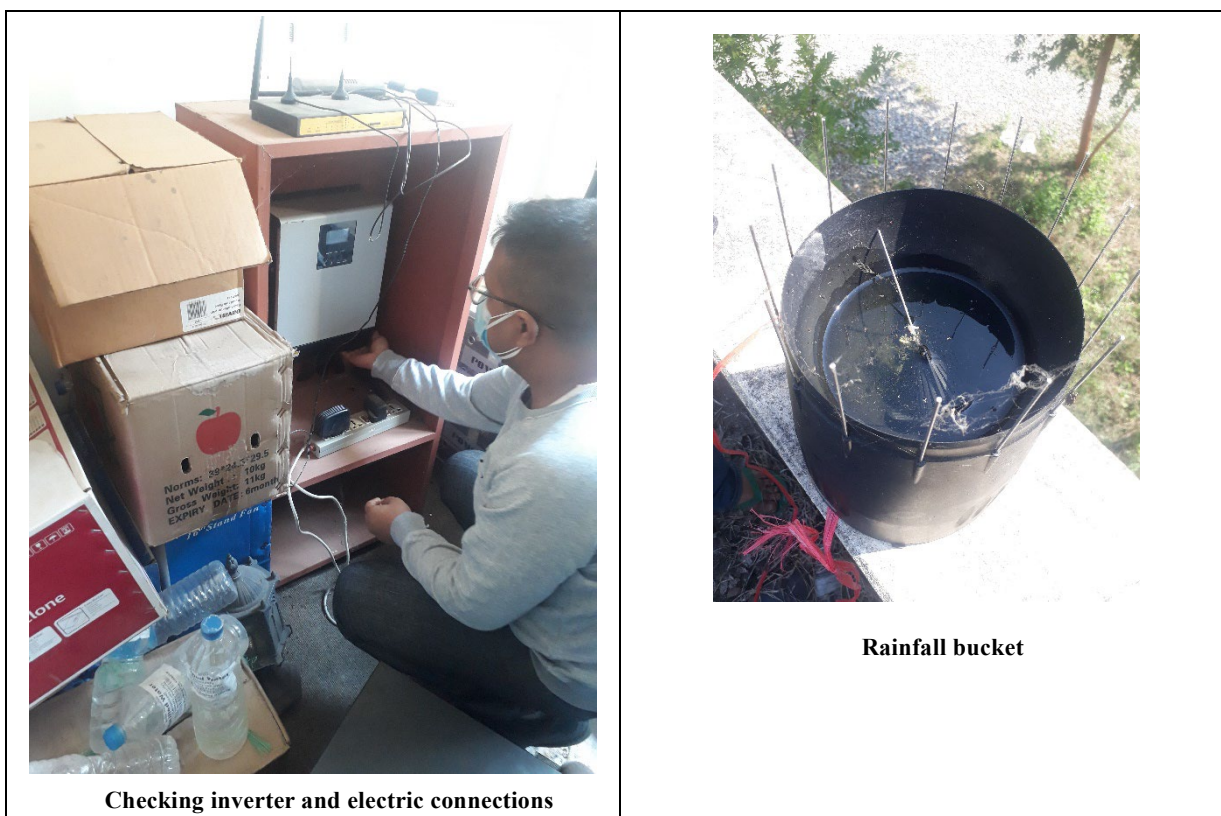
Observations at Bhaktapur rainfall station.

- Electricity and electric equipments seem to be working properly.
- The bucket of the rainfall station was blown away by wind as reported by the staff of Bhaktapur division.
- As the modem (Dongle connected to router) was not working, we connected the weather console directly to the router using LAN cable. We could find the weather station listed in the weatherlink website. The real time data is also shown.

2.2.3 Ramtar rainfall station

This rainfall station was installed by DOR inside the DOR camp at Ramtar. Currently there is one extra solar panel system installed for separate purpose (solar power for general electric supply). It seems that electricity has been interfered with which has been used for powering the rainfall station. List of observations done at the site.

- Checked the inverter. Inverter power is not switching on.
- Rainfall bucket was cleaned.
- There was no display in the rainfall measurement console.



2.2.4 Bhadrakali rainfall station (Dhungre Bhanjyang)

Rainfall station at Bhadrakali is installed inside a public primary school. The rainfall station was working properly until last year however data was not transmitted to the server. According to the teacher at the site, there was very heavy wind last year last year which blew away one of the two solar panels. As a result the electric circuit was damaged. After running for some time, the battery might have discharged. Therefore, the system is not working.

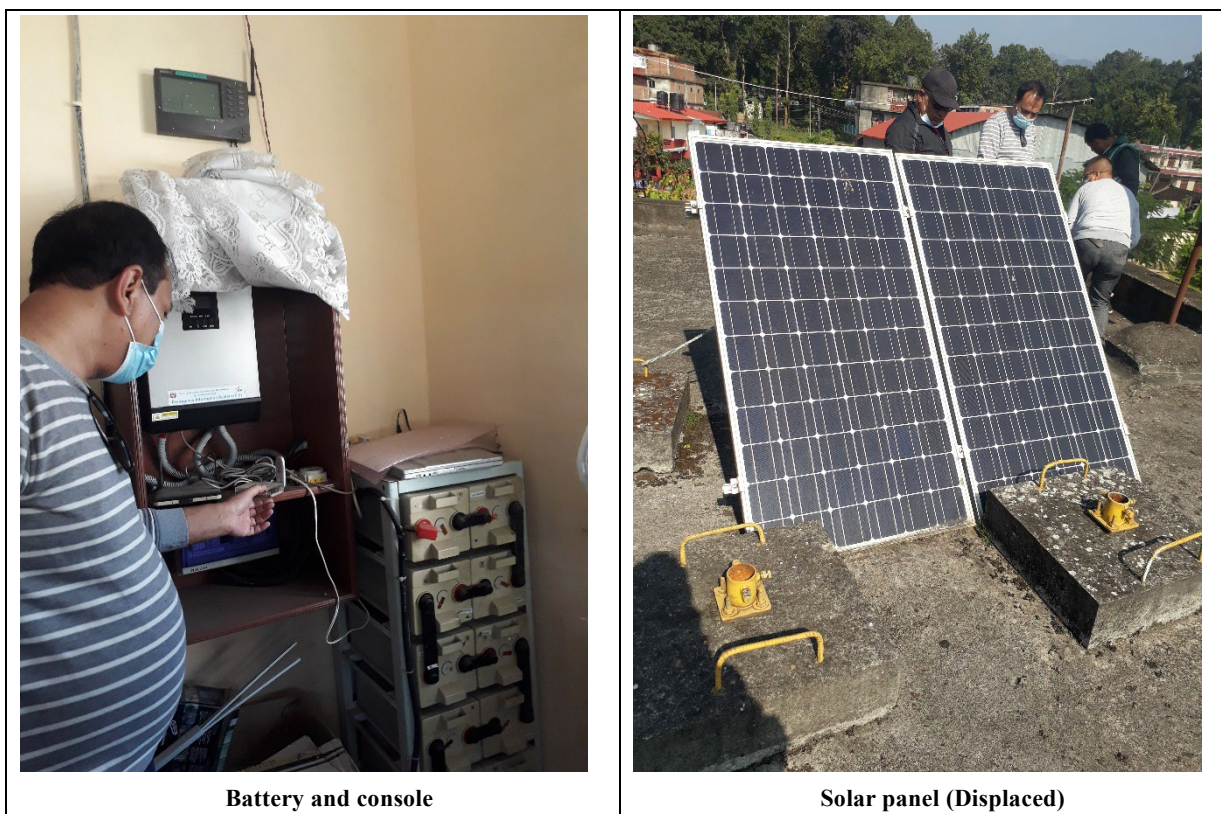


2.2.5 Sindhuli Bazar rainfall station

Rainfall station in Sindhuli Bazar was installed inside the Division office of Irrigation department. On the request of Irrigation office the rainfall station was shifted (by DOR, Sindhuli Road) to the same building where solar panel was installed. Solar panels were removed due to construction works of irrigation office. It was done without any notification to the Sindhuli Road office according to the DOR staff. Now there is no power supply to the rainfall station system (console and inverter). Console was not displaying anything even after connecting to the electricity.

List of works done for observation

- We brought the Vantage Pro (rainfall display) console back to Kathmandu and it is being checked at the Softwel office.
- Bought battery for the console
- Currently trying to update firmware and checking whether the data is being updated in the server.



Battery and console

Solar panel (Displaced)

2.2.6 Bardibas Rainfall station

Bardibas rainfall station was damaged by lightning. Due to the lightning there was damage to the inverter according to the site in charge of Sindhuli road at Bardibas. Due to the lightning even the ncell modem (for communication) was damaged. Therefore the system is not working in Bardibas.



Inverter and electric connection at Bardibas rainfall station



Raifall gauge



NCell Modem possibly damaged due to lightning

3 RECOMMENDATIONS

3.1 Restoration of the RIBs

3.1.1 General recommendations for all the RIBs

- To avoid communication disruption, charge the SIM card once in a month
- Paint all the RIBs to prevent from further rusting
- Check the condition of inverter, the electric connection, RIB display etc from time to time

3.1.2 Koteshwor RIB

The control house was displaced by Kathmandu Division of DOR. Presently it is in the process of getting restored inside the premises of traffic police office. However the work has not started yet.

Recommendation (option-1)

- Have a discussion with the Kathmandu Division to get the control house constructed

Recommendation (option-2)

- Connect the RIB to the grid electricity
- Provide battery power (2-3 hours storage) with inverter
- Make a small metal box (rack) for storing batteries and inverter attached to the RIB. Tentative drawing for the rack is provided below.
- Cost: NRs. 200,000 (needs to be estimated)

3.1.3 Dhulikhel RIB

The RIB is functioning with the solar power supply. We could put it online by paying for the SIM card.

Issues:

- Grid electricity seems to have problem
- The message in RIB is not properly displayed because of damage in the display panel boards
- There are some signs of miscreants pelting stones at the panel board

Recommendations:

- First thing to be done is to replace the faulty panel boards.
- While grid electricity has problem, the power should be used from solar supply
- Grid electricity problem should be checked by an expert electrician.

Cost of restoration:

- Change of boards of the RIB display: NRs 4000 per board (approximate)
- Checking and restoring grid electricity (optional): 10000 (lumpsum)

3.1.4 Khurkot RIB

Two RIBs at Khurkot are in the final stage of completion. The display needs to be connected to the central server. The contract is still undergoing.

3.1.5 Sindhuli Bazar RIB

There is problem in the display of RIB. We observed for few days with input of solar power. Still the output is not working properly.

Recommendations:

- Provide Grid connection to the RIB

3.1.6 Bardibas RIB

Solar panels of the Bardibas RIB was displaced which interrupted the working of RIB.

Recommendation (option-1):

- Find a suitable place and rebuild a control house same as in Dhulikhel for the solar power supply.
- Connect to the solar power electricity.
- Cost: NRs. 500,000 (needs to be estimated)

Recommendation (option-2):

- Connect the RIB to the grid electricity
- Provide battery power (2-3 hours storage) with inverter
- Make a small metal box (rack) for storing batteries and inverter attached to the RIB. Tentative drawing for the rack is provided below.
- Cost: NRs. 200,000 (needs to be estimated)

3.2 Restoration of rainfall stations

3.2.1 General recommendations for all the rainfall stations

- Charge the SIM card once a month to avoid communication disruption
- Check electric connection, console display from time to time
- Clean the rainfall gauge (bucket) once a week or as required

3.2.2 Min Bhawan Rainfall station

The inverter, battery power and MCB needs to be checked in detail to restore solar power. We have connected the console directly to the grid power and LAN cable (for data transfer) and observing the data transfer. The console should be cleaned from time to time. Batteries of the console should be changed once in 5-6 months or as recommended in the weatherlink manual.

3.2.3 Bhaktapur Division (DOR) Rainfall station

Electric connections including battery and solar power seems to be working properly. The rainfall bucket needs to be installed as it seems to be lost. Currently, we have connected the console directly to the grid power and LAN cable (for data transfer) and observing the data transfer.

Recommendations:

- Purchase and install rainfall gauge bucket.
- Connect console to the router using LAN cable for communication.

Cost of rainfall bucket: NRs 10,000

3.2.4 Ramtar Rainfall station

Recommendations:

- Establish solar power supply
- Detailed investigation of electric connections and the inverter.
- Detailed investigation of rainfall devices
 - Status of the console
 - Status of the inverter
 - Communication between rainfall transmitter and the console
 - Communication from console to the weatherlink website
- Correction of electric power supply and the faults in the devices and communication

3.2.5 Bhadrakali (Dhungre Bhanjyang) rainfall station

The solar panel is constructed in opposite direction to that of sunlight. Therefore the power captured by the solar panels is not efficient. Furthermore, one of the solar panels was blown away by the wind. Therefore following actions are recommended.

Recommendations

- Add missing solar panel. It is reported that it has been placed in nearby house.
- Relocation of solar panel to capture the maximum sunlight
- Check the status of inverter and battery after restoring the solar power supply
- Check the status of communication (rainfall transmitter to the console and console to the weatherlink website)
- Most probably the batteries are discharged after long time without power supply, therefore the batteries should be fully charged before using.
- Restore the devices (if there is any issue)
- Restore the communication problem if any

3.2.6 Sindhuli Bazar rainfall station

We brought the weather console to Kathmandu as it was not possible to check its status at site. Console seems to be working well. Following are recommendations for restoring the rainfall station in Sindhuli Bazar.

Recommendations (option-1):

- If the irrigation office still allows to use its premises, it might be possible to relocate the solar panels on one of the roofs of Irrigation office
- After relocating the solar panels, it is necessary to repair the electric connections.

Recommendations (option-2)

- There have been several changes in the system due to the construction and repair works at the Irrigation office. It is necessary to relocate the whole system to a new proper place. It is recommended to relocate the whole system near the RIB.
- For relocation of the rainfall station, communication with the irrigation office is necessary (for handover of all the parts and equipments of rainfall station).

3.2.7 Bardibas Rainfall station

Bardibas rainfall station was damaged by lightning. There was rusting inside the battery house of display console. The rusting was cleaned at the Softwel. Now the console is working without problem. Following

are the recommendations:

Recommendation (option-1)

- Repair the inverter
- Charge the battery for some time using solar power
- Use new modem and SIM card for data communication to the server.

Recommendation (option-2)

- Other recommendations being same as option-1, add grid power as an alternative for power supply.
- Replace the condole power supply unit

4SUMMARY

4.1 Summarized recommendation table: RIBs

RIB location	Recommendation	Cost	Remarks
Koteshwor	Option-1: Wait for the reconstruction of control house by Kathmandu division	0 (No cost involved)	Need to communicate with the Kathmandu division office to accelerate the restoration of control house.
	Option-2: Construct a small battery house at the RIB and connect to grid power supply	NRs. 200,000 (to be estimated)	Existing Battery and solar panels will be wasted
Dhulikhel	- Replace the RIB display pannels	NRs. 24000 (to be estimated)	
Sindhuli Bazar	Connect Grid Supply		
Bardibas	Option-1: Construct control house at appropriate place (using existing battery and inverter) and connect to RIB	NRs. 500,000 (to be estimated)	
	Option-2: Construct a small house for small battery and inverter at the RIB and connect to grid water supply.	NRs. 200,000 (to be estimated)	Existing Battery and solar panels will be wasted

4.2 Summarized recommendation table: Rainfall stations

Location	Recommendation	Cost	Remarks
Min Bhawan			
Bhaktapur			
Ramtar	- Detailed observation of electric connection and communication issues - Remedial measures	To be estimated based on detailed analysis	
Bhadrakali (Dhungre Bhanjyang)	- Relocation of solar panel - Reconnecting power supply	NRs. 15000 (to be estimated)	
Sindhuli Bazar	Option-1: Relocate the solar panel inside Irrigation office premises	NRs. 20,000 (to be estimated)	
	Option-2: Relocated the rainfall station at a proper place (may be near the existing RIB)	NRs. 100,000 (to be estimated)	
Bardibas	Option-1: Repair (or replace) inverter and use new modem for data communication to the server	NRs. 50,000 (to be estimated)	
	Option-2: In addition to the option-1, add grid power supply		

**The Project for
Operation and Maintenance of
The Sindhuli Road Phase 2**

Implementation Report

On

**“Road Safety Awareness Training
for School Teachers”**

July 2022

JICA Expert Team

- Table of Contents -

1. Outline of the Road Safety Awareness Training for School Teachers.....	1
1.1 Background.....	1
1.2 Purposes and Goals of the Training	2
1.3 Mechanism of Road Safety Awareness Training.....	3
1.4 Participants of the Training Program (Trainers, Trainees and Guests).....	5
1.5 Training Venue	5
2. Training Program	6
2.1 Induction Meeting.....	6
2.2 Formal Session of Program at Kavre	6
2.3 Formal Session of Program at Sindhuli	6
2.4 Survey and Survey Result.....	8
2.5 Technical Session of Program at Kavre and Sindhuli.....	11
3. Equipment / Materials Used for the Training.....	13
3.1 Equipment Used for the Training.....	13
3.2 Education Materials Distributed to Schools.....	13
4. Evaluation of the Training	14
4.1 Comments/Evaluation from Trainees	14
4.2 Comments/Evaluation from DoR.....	14
4.3 Comments/Evaluation from JICA Experts	14
5. Some Selected Program Photographs	15
5.1 Day 1 in Bhakundebesi (3 rd June 2022).....	15
5.2 Day 2 in Sindhuli Bazar (5 th June 2022).....	17
6. Media Coverage	19

List of Tables

Table 1 Road Accident Scenario of Bardibas Sindhuli Road	2
Table 2 Questionnaire and Response on Regulatory Traffic Sign.....	8
Table 3 Questionnaire on Warning Traffic Sign.....	9
Table 4 Questionnaire on Informative Traffic Sign.....	9
Table 5 Over All Evaluation of Program from Participants	14

List of Figures

Figure 1 Location Map of the Sindhuli Road (from Bardibas to Dhulikhel).....	1
Figure 2 Mechanism of Training of Trainers.....	4
Figure 3 Response of Teachers on General Questions about Road Safety Precaution Measures.....	10

Annexes

Annex 1	Program Schedule
Annex 2	Lists of Selected Schools
Annex 3	Program Attendance
Annex 4	Presentations on Outline of SROM-2 Project
Annex 5	Presentations on Road Safety Issues in BP Highway
Annex 6	Presentations on Introduction and Road and Road Safety Status of Nepal
Annex 7	Presentations on Main Causes of Road Accidents
Annex 8	Presentations on Precaution Measures to be taken for Safer Road Use Practice
Annex 9	Presentations on Traffic Sign and Signals
Annex 10	Presentations on Road Safety Activities in Sindhuli Road Project
Annex 11	Receipts of Goods
Annex 12	Quick Translation of Published News
Annex 13	Ply Card Designs on Road Safety Slogans
Annex 14	Bunting Designs on Traffic Sign and Signals
Annex 15	Teacher Knowledge Test Questionnaires
Annex 16	Programme Evaluation Form

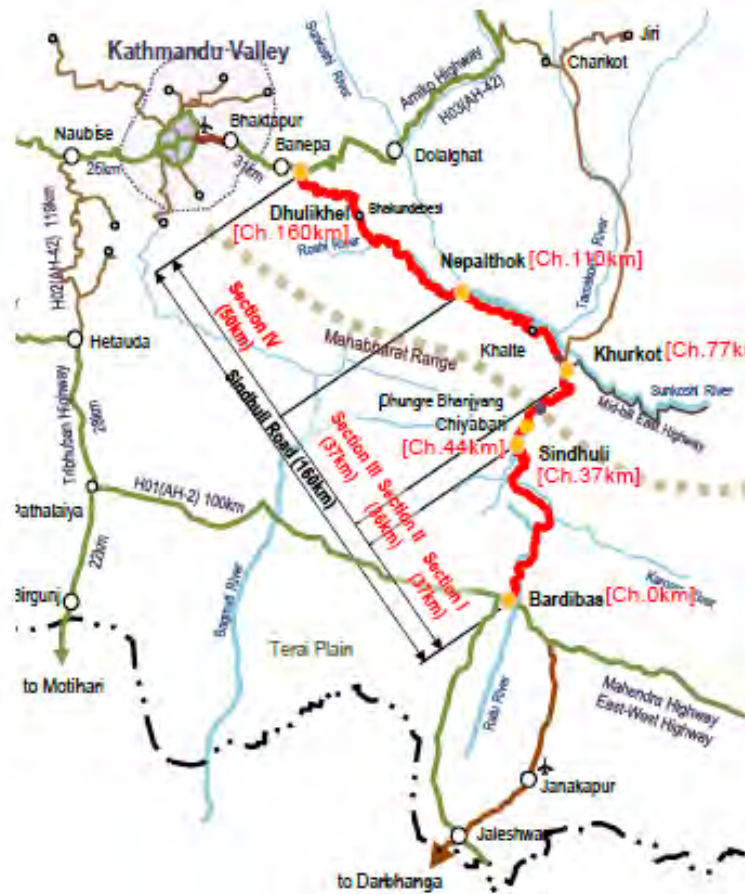
Disclaimer

The report is prepared as per the activities conducted during the “Road Safety Awareness Training for School Teachers” at Bhakundebesi, Kavre and Sindhuli Bazar, Sindhuli on 3 June 2022 and 5 June 2022 respectively. The activities, interpretations and suggestions expressed in this report do not necessarily reflect the view of the JICA, its Board of Executive Directors, or the Government they represent. The material in this work is subjected to copyright.

1. Outline of the Road Safety Awareness Training for School Teachers

1.1 Background

Bardibas to Dhulikhel named as Sindhuli road, a National Highway (NH 13) 160 km in length, has been divided in four sections; section I - Bardibas to Sindhuli Bazar - 37 kilometres, section II - Sindhuli Bazar to Khurkot – 36 kilometres, Section III - Khurkot to Nepalthok – 37 kilometres and Section IV - Nepalthok to Dhulikhel -50 kilometres respectively. The road was constructed under the grant assistance of the Government of Japan with advanced mountain road construction technology, which reduced travel time about five hours traveling from Kathmandu to eastern sector of Nepal and vice versa. The road was opened to the general public in 2015 which increases the commercial activities near roadside including movement of people and commercial vehicle. In the year 2019 traffic counted at Dhulikhel and Bardibas were 11,446 and 7894 (Veh/day) respectively. Increasing number of vehicles especially high number of motorcycles and tipper trucks carrying construction materials were found involved in accident.



Source: JICA Expert Team

Figure 1 Location Map of the Sindhuli Road (from Bardibas to Dhulikhel)

In the year 2015, road accident was recorded with ten fatal, thirty-nine seriously injured, twenty-one minor injured and seven vehicle damages only and in the year 2021 number of accidents were increased to fourteen fatal, sixty-seven seriously injured, thirty minor injured and four vehicle

damages only. The detailed road accident scenario of Bardibas Sindhuli Dhulikhel Road is shown in Table 1 below.

Table 1 Road Accident Scenario of Bardibas Sindhuli Road

Year	Number of Accident					Number of Casualty			
	Fatal	Serious	Minor	Damage only	Total	Fatal	serious	Minor	Total
2015	10	39	21	7	77	17	96	116	229
2016	19	11	11	2	43	19	13	21	53
2017	23	55	22	25	125	27	102	52	181
2018	31	86	62	40	219	42	130	118	290
2019	32	68	45	6	151	38	133	218	389
2020	10	64	6	0	80	13	121	30	164
2021	14	67	30	4	115	14	164	57	235
Total	133	365	167	80	745	164	718	555	1437

Source: JICA Expert Team and DOR

The main causes/risk factors of accidents in Sindhuli road are unsafe road user behaviour, vulnerable road users, narrow road design with 1.5 lane and lack of footpaths and bus stops.

Traffic management should not only review the policy and relevant rules and regulations, but also clear the responsibility to all the components of traffic management subsystem. Although all the three components are important in perfect traffic management, the road users' behaviours cannot be ignored as it relates to the cultural and behavioural aspects of society and the nation.

In this context JICA Expert Team has taken the initiation for conducting Road Safety Awareness Training for school Teachers of the schools located within the Sindhuli road corridor. Major part of this assignment is to orient school teachers about the traffic rules and safety preventive measures to be adopted while using the road so that they can repeatedly educate children in their respective school about traffic safety from an early age.

1.2 Purposes and Goals of the Training

The overall purpose and goals of this program is to give orientation to the school teachers to make them aware of road safety precaution measures to adopt for safer road use so that they can transfer this knowledge to their school children in their respective schools. Main cause of accidents and expected behaviour of each road users need to disseminate through various means of communication to minimize the road accidents and fatalities.

The activities under this program are limited to the following:

General Purpose and Goals

- To minimize the number and seriousness of accidents in Sindhuli road.
- To minimize the accident rate among the risk groups - children, young people, elderly and people with reduced mobility.
- To change the road behavior of the target group.
- To generate and transfer of road safety knowledge through dissemination by the change agents such as teachers group who can improve and play an important role in minimizing the accidents.

- To encourage safe driving.
- To promote safe mobility.

Specific Purpose and Goals

- To educate and make aware school teachers about the traffic rules and safety preventive measures to be adopted while using the road so that they can repeatedly educate children in their respective schools about traffic safety from an early age.
- To educate and make aware to school teachers about various road condition of the country.
- Educate the traffic rules and its importance.
- Educate proper use of traffic signs and signals.
- Motivate the road users to change their behavior for the safe road use.
- Motivate for proper use of safety helmet and safety belt.

1.3 Mechanism of Road Safety Awareness Training

Over 80% of RTAs are occurring mainly due to the drivers' negligence including high speed, drink, and drive, overtaking unsafely, overruling the traffic signs and symbols including road safety parameters, and rules, etc. All these behavioural factors are directly related with psychological aspects. Driving fatigue and sleepiness, and illness and sickness condition are physical factors. Due to these physical factors, accidents are occurred more often. Even though all these are human control factors, drivers do take risky road behaviour for a penny more. Despite it, few drivers are driving even though their vehicles are not in condition. This is also considered to be one of key reasons of the road accident.

Even though JICA Expert Team's evaluation, 8% of total RTA is caused due to pedestrians, comes to third key factor of the RTA. Negligence and lack of knowledge in road safety are the key factors of pedestrians' accidents in the road. Therefore, pedestrians should be oriented so as to make them aware of their mistakes and negligence and change their road behaviour and transform it in their society by alerting and educating others. Society could also play a dynamic role in mitigating and orienting people on road behaviour. Moreover, in the pedestrian category, adolescent and young adults are most influential and vulnerable groups in road mishaps due to their pre-mature road behaviour.

Their reckless behaviour may be triggered at this age group, since the adolescent children traverse through tremendous physical, psychological, and emotional changes. Thus, this is critical period where the teenagers are constantly trying to understand and adopt the changes around them. Side by side, at the age state, they endeavoured to take unnecessary unwanted risks to make their identify in their commune

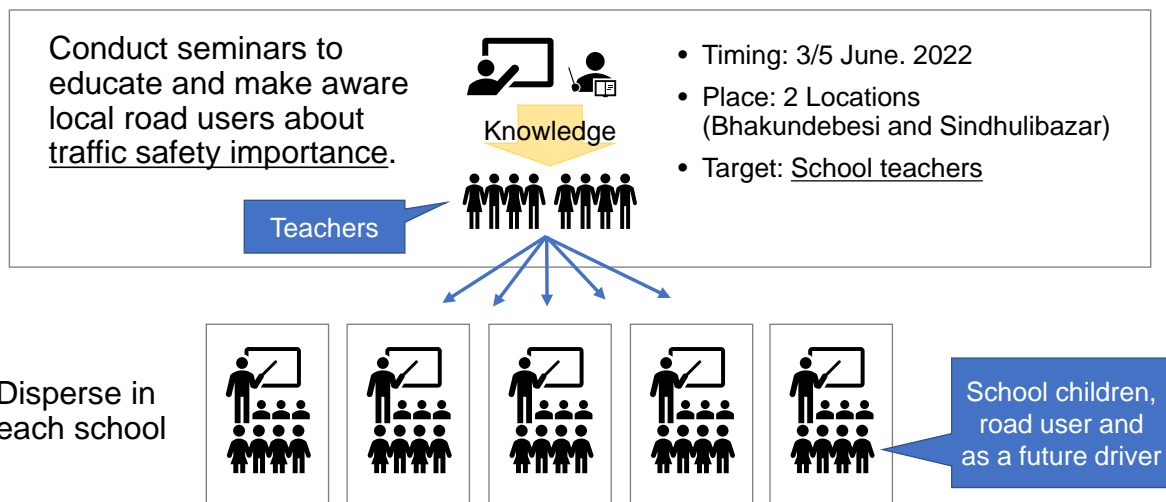
Worrall Council (2010) has also mentioned that 1 in 5 teenagers is involved in a road accident on their way from home to school and only 4 percent cared about their safety. This data shows a red alert about the reckless behaviour of the teenagers.

Road safety education can be organized at different levels. Road safety education is essential when it comes to avoiding traffic accidents. A large number of road accidents occur due to carelessness or unawareness of the rules. For that reason, it's essential to educate children in this area. Children who receive road safety education won't only be less likely to suffer some type of accident, but will also become responsible and knowledgeable adults. They'll become good, careful drivers, pedestrians, cyclists and passengers.

Schools need to play a wider role in ensuring road safety by properly educating and informing the students about the importance of road safety. Traffic education should not be considered to be any

different from any of the other subjects taught in schools nowadays. Road safety education is a life-long process, but it should begin with the young in school, tailoring its message to the audience to teach safe traffic habits from primary school to secondary school, so that safety becomes ingrained as part of the culture and practice of our children. The aim here is to inculcate in children and parents an understanding of the dangers within the traffic environment and how to practice safety as pedestrians and road users. International studies reveal that education department should take necessary steps to include the importance of road safety measures in the school curricula and also the teachers have to well be trained and well equipped to train the students on the road safety measures. The information on road safety measures given by school teachers to the children can have a great impact on the quality of life for children and their families.

Thus, these school teachers are the most effective group who can transfer their gained knowledge to their students in most effective manner. Thus, awakening them in the road safety measures and healthy road behaviours could bring forth the changes in healthy road behaviours and ensure replicability at least in their respective community/school children. However, it requires proper education and training to them. Then only, the expected change could be achieved. Further, one time education is not enough, it requires continuous follow up and frequently knocking them through refresher training. However, all levels of government should commence to honour such road users who acted as the change agent and demonstrate the replicability so that the teacher can serve a resources and advocates for prevention of road traffic accidents among the school children.



Source: JICA Expert Team

Figure 2 Mechanism of Training of Trainers

Therefore, this initiation is rational and considered to be one strategic step towards reducing the RTAs and notable behavioural changes of the said frontier road users that support for underpinning the road safety mission ahead.

The expert team adopted the following procedure for the awareness training

1. Outline of SRM2 Project (15 Minutes)
2. Teachers knowledge and attitude test on Road Behaviour through self - administered questionnaire (15 Minutes)
3. Presentation on Road and Road Safety Status of Nepal (10 Minutes)
4. Introductions on Sindhuli Road and road traffic crash problem in Sindhuli Road (10 Minutes)
5. Presentation on the main causes of Road Accident (20 Minutes)
6. Brain Storming and Discussion from teachers on precaution measures to be taken for safer road use practice (5 Minutes)
7. Presentation on the Safer Use Practice and precaution measures to be taken (55 Minutes)
8. Presentation on traffic Signs and signals (30 Minutes)
9. Feedback from participants through self - administered questionnaire (15 Minutes)

For Program Schedule, please refer to Annex 1.

1.4 Participants of the Training Program (Trainers, Trainees and Guests)

Fifty teachers from thirty different schools located in Sindhuli road corridor were selected for the training program. Teachers were divided in to two groups with the equal number of 25 participants in each group according to the location of schools in Sindhuli road corridor. Chief District Administration Officers, Mayors, Chief District Education Officers, Local Police and Traffic Police were invited from the respective district and municipality as the guest. Five JICA officials and two consultants were involved in the trainer's team.

For the training program schools and school teachers were selected on the basis of following criteria: -

1. School adjacent to the roadway by 1KM either side of the road corridor were prioritized.
2. Schools located at urban/semi urban areas were given priority with potential of higher concentration of vehicles and pedestrian.
3. School with higher number of students was prioritized.
4. Schools located at plain land were prioritized. In such area number of school students bicycling will be high as well as speed of vehicles will be high.
5. Schools located at area where number of pedestrian hits is high were prioritized.
6. Social Science teachers were prioritized.

For the lists of selected school please refer to Annex 2.

1.5 Training Venue

The seminar venues were selected in the two different locations in the Sindhuli road corridor considering the convenience of the participants and keeping in view COVID-19 prevention protocol implemented by Government of Nepal. As the Covid-19 prevention measures only 25 participants were accommodated in a training hall. Before entering the training hall all participants including guest and trainers were requested to sanitize themselves properly and face mask were distributed. The distance of one table to another table was set with minimum distance of 1.5 meters and hall was cleaned with properly with detergent after each break. The selected venues were as follows;

1. Kutumba Resort, Bhakundebesi, Kavre
2. Ganapati Hotel and Resort, Sindhuli Bazar, Sindhuli

2. Training Program

2.1 Induction Meeting

Before starting the Road Safety Awareness Training Program for School Teachers consultants discussed with JICA Expert team to finalize the modality of the program. After finalizing the modality of the program and training materials consultants meet with the concerned authorities of District Administration Office, District Traffic Police, District Police, Principals/School Management Committee of schools and Local Government of Kavre and Sindhuli District respectively to discuss about program and the road safety status of the district. Beside this, team also collected information about the various problems and root causes of road accident in the Sindhuli road corridor. In the induction meeting principles of selected schools were informed about the modality and nature of the program and requested them to nominate the teachers from their respective schools for the participation in the program. In the meeting, date and venue of the awareness training program was informed to all the concerned parties.

2.2 Formal Session of Program at Kavre

In Bhakundebesi formal program was conducted on the scheduled date i.e., on 3 June 2022 at 11:00 a.m. after the registration of the participants. The program started after the introduction of the participants. Mr. Hiroki Shinkai, Chief Advisor, JICA Expert welcomed all the participants and highlighted the objectives of the program. In his welcome speech he emphasized the necessity of “Road safety awareness campaign”. He said that to strengthen the hardware road safety measure, it is also essential for road users to raise their awareness of traffic safety. In particular, it is important to repeatedly educate children about traffic safety from an early age. In his speech he also expected the continuation of the program from the teachers. He sincerely requested the teachers who have participated in this program to continue and implement traffic safety education to their schools on the regular basis. At the end of his welcome speech he expressed his gratitude to all the participants for their participation in the program by accepting the invitation of the organizers.

After the welcome speech of Mr. Shinkai, Chief Guest Mr. Amar Dip Sunwar- Assistant Chief District Officer, Kavre told that he felt highly honoured and privileged to JICA to have been given the opportunity to address everyone on this special occasion. In his speech he said that in recent days there are more cars, scooters, motorbikes, and buses etc. on the road. In the past it was safe for children to travel on the road giving minimum attention to road safety, but things have changed since then. Therefore, Road safety education is very much essential in district as road traffic is becoming increasingly busy. He further added that this awareness campaign training will help teachers to develop skills and abilities to distinguish between passengers, pedestrian, low traffic and heavy traffic situation which can help to reduce the number of injuries and deaths caused by road accidents. He also requested all the teachers to take this opportunity to learn from the experts and disseminate the road safety knowledge to their schools students which they learned from the training.

2.3 Formal Session of Program at Sindhuli

Similar to Bhakundebesi formal program at Sindhuli Bazar was conducted on the scheduled date i.e., on 5 June 2022 at sharp 11:00 a.m. after the registration of the participants. The program started after the introduction of the participants. Mr. Hiroki Shinkai, Chief Advisor, JICA Expert welcomed all the participants and highlighted the objectives of the program. In his welcome speech he emphasized the necessity of “Road safety awareness campaign”. He said that to strengthen the hardware road safety measure, it is also essential for road users to raise their awareness of traffic safety. In particular, it is important to repeatedly educate children about traffic safety from an early age. In his speech he also expected the continuation of the program from the teachers. He sincerely requested the teachers who

have participated in this program to continue and implement traffic safety education to their schools on the regular basis. At the end of his welcome speech he expressed his gratitude to all the participants for their participation in the program by accepting the invitation of the organizers.

After the welcome speech from Mr. Shinkai, Ms. Nakamura - Representative of JICA Nepal addressed the program. In her speech she expressed her happiness as she was able to attend the road safety awareness training to school teachers. She said that Sindhuli road strengthen project is the symbol of friendship between the people of Nepal and Japan which is very important to overall development of Nepal especially to Sindhuli and adjoining districts. With the construction of road and movement of the traffic it brings immense benefit to people and economy. It also supports the enabling to deliver the services to the people by extending the education and health care facilities, smoothing the prop agriculture product and other goods and services.

However, due the traffic movement, there is also a risk to the traveler and road users to the accident; therefore to avoid the accident it is necessary to use the road wisely and safely. As teachers are important part of the society, their link and bond with students and parents is very strong, hence their effort to road safety is very important. Thus, this training program will help the school teachers to strengthen their knowledge and capacity in road safety. She is confident that teachers will spread the knowledge earned from the training to the students and overall society. Finally, she thanked the DoR team and JICA experts for taking this initiation.


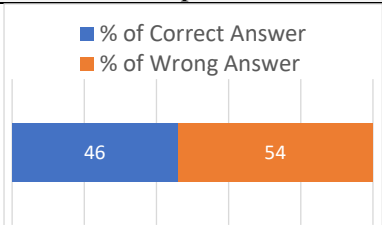

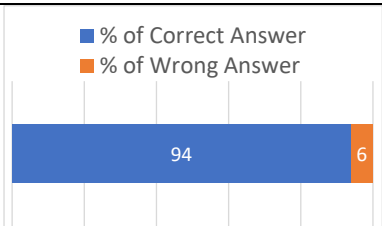
As a chief guest Mr. Upendra Kumar Pokheral – Mayor of Kamala Municipality, Sindhuli delivered his speech. In his speech he thanked to the organizers for taking such affirmative action at the district level. He also emphasized that such program should be continued in future also to get the positive impact. In order to deliver the benefit of road safety education to the grass root level stakeholders, Mr. Pokheral committed to contribute from his institution as well. He also added that to minimize the accident rate, pedestrian, drivers and local citizen should also be made aware to follow the traffic rules and regulations to make the mission success. Additionally, he also said that due to the high movement of traffic on the Sindhuli Road it is also important to widen the road at least at the bends of the road and requested the JICA to take this initiation at the earliest.

2.4 Survey and Survey Result

In order to evaluate the actual knowledge of the teachers about the traffic rules, a self-administered questionnaire was distributed to the participants. All the participants were requested to give answers to every question given in the questionnaire with their own knowledge and experience. There were 18 questions in the questionnaire. Out of 18 questions, 6 were related to the traffic signs and signal and rest of the 12 questions were about the general traffic rules. In each question four options were given and teacher has to choose one correct option. The result of survey below summarizes knowledge and behaviour of teachers towards traffic signs, signals and traffic rules.

Traffic signs and signals were divided in to three different types namely regulatory, warning and informative and from each type 2 questions were asked. On regulatory traffic sign, all of the teachers were aware about the ‘no parking sign’ out of 50 participants 94 percent of the teachers gave the correct answer, similarly in ‘stopping traffic sign’ only 46 percent of the teachers gave the correct answer. The detail response of the regulatory traffic sign is shown in the graph presented below.


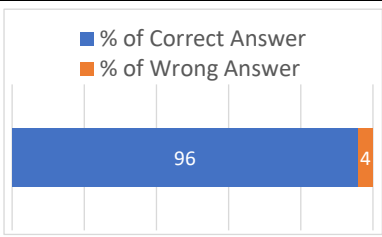

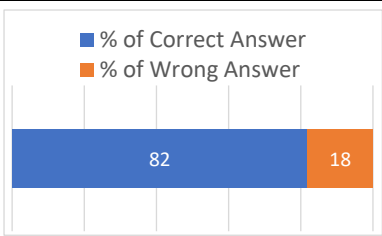
Table 2 Questionnaire and Response on Regulatory Traffic Sign

Question	Option	Response
1. What is the meaning of this traffic sign? 	a) No Entry b) No Stopping c) No Overtake d) No Horn	 <p>■ % of Correct Answer ■ % of Wrong Answer</p> <p>46 54</p>
2. What is the meaning of this traffic sign? 	a) No Parking b) No Entry c) Hotels d) No right turn	 <p>■ % of Correct Answer ■ % of Wrong Answer</p> <p>94 6</p>

Source: JICA Expert Team

Likewise, two questions were asked on the warning traffic sign; 96 percent of teachers were aware about traffic sign on ‘Dangerous Deep’, while only 82 percent of teachers were known to ‘Road Narrow on the Right’ which is shown in the graph presented below.


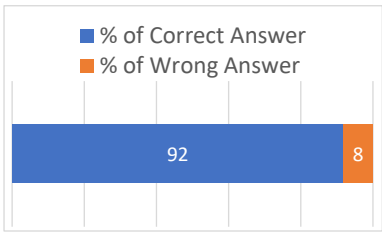

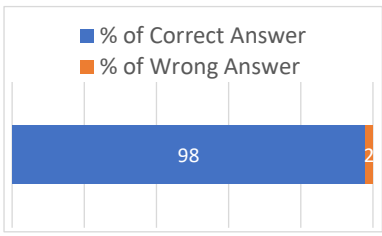
Table 3 Questionnaire on Warning Traffic Sign

Question	Option	Response
1. What is the meaning of this traffic sign? 	a) Narrow Bridge b) Road Hump c) Steep Hill Upward <u>d) Dangerous Deep</u>	
2. What is the meaning of this traffic sign? 	<u>a) Road Narrow on the Right</u> b) Narrow Bridge c) Dangerous Deep d) No Overtake	

Source: JICA Expert Team

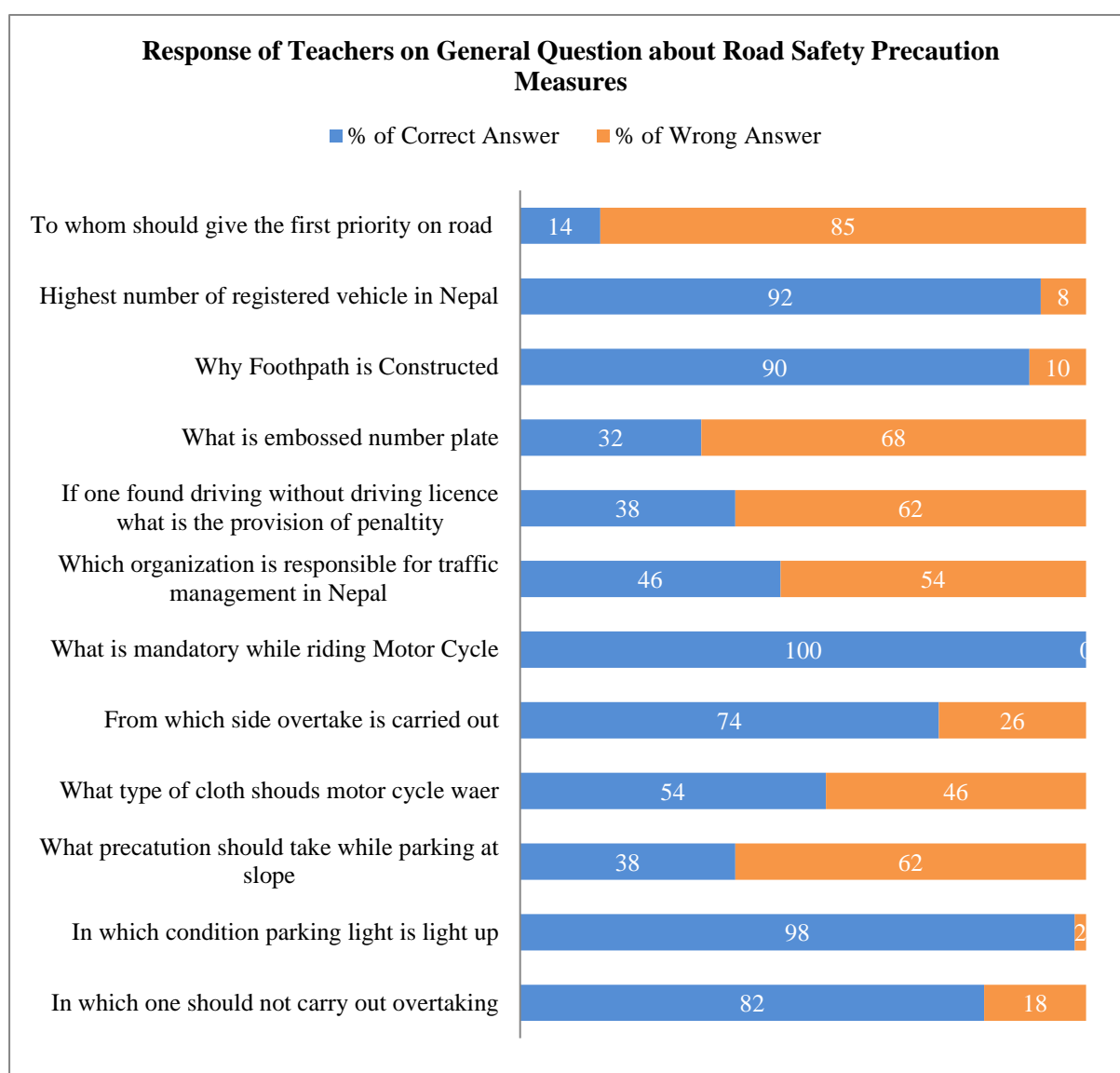
In the same way two questions were asked on the informative traffic sign almost 92 percent of the teachers were known about the ‘Pedestrian crossing’ and 98 percent of the teachers were aware about the ‘2 KM ahead petrol pump’ which was very impressive. The detail response of the informative traffic sign is shown in the graph presented below.

Table 4 Questionnaire on Informative Traffic Sign

Question	Option	Response
1. What is the meaning of this traffic sign? 	a) River Bank <u>b) Pedestrian Crossing</u> c) Men at Work d) School Area	
2. What is the meaning of this traffic sign? 	<u>a) 2 KM Ahead Petrol Pump</u> b) Parking Area c) Petrol Pump Ahead d) Hotel	

Source: JICA Expert Team

Teachers were also asked twelve general questions on how they behave on the road as the precaution measures. In this section, on the first question almost all the teachers agreed that ambulance should be given first priority on road instead of pedestrian. In the next question, 98 percent of the teachers were aware that motorcycles are the highest number of vehicles registered in Nepal. Similarly, 90 percent teachers are fully aware about the purpose of footpath and rest 10 percent do not know the main objective of footpath on the road which is very much frustrating. Only 32 percent of the teachers were able to give the answer about the embossed number plate and 38 percent of teachers know the consequences of penalty for driving vehicle without the driving licence. Only 32 percentages of the total participants know about the precautionary measures at the time of parking in the slope area of the road. 54 percent of the teachers gave the correct answer that shining colour should be used while riding motor cycle. All of the participants were aware about the mandatory use of helmet while riding on a motor cycle. However, 82 percent of the teachers knew that overtake should be done only from the right side. This survey result clearly indicates that they have only limited knowledge on the road safety precaution measures. The detail responses of the teachers are presented in the graph below:



Source: Field Survey 2022

Figure 3 Response of Teachers on General Questions about Road Safety Precaution Measures

2.5 Technical Session of Program at Kavre and Sindhuli

After the formal session Mr. Shinkai highlighted the outline of the SROM-2 project. In his short presentation he recalled the history of Sindhuli road from the feasibility stage to the completion phase. He also elaborated the technical detail of the Sindhuli road and how SROM-2 project is continually working for the road improvement and Traffic Safety Measures.

As per the objective of the program, programme was divided in to 6 different sessions.

Session 1

In the first session of the program, Mr. Bindu Shamsher Rana – JICA Expert presented the main causes of Road Accident in Sindhuli road. In his presentation, he highlighted that High Speed, Driving under the influence of alcohol and/or drugs, Over loading (Passenger/Goods), High involvement of Motorcycle (40 %), Head –on Collision, High Pedestrian casualties, Reckless driving (Not following lane discipline), Lack of footpath and Bus stop and Drivers Fatigue are the major cause of road accidents on Sindhuli highway. He also presented road accident detail and the section wise Traffic Accident and Traffic volume of Sindhuli Road. Moreover Mr. Rana also tried to familiarize the participants about the accident Black Spots identified in the Sindhuli Road.

Session 2

To promote road safety the orienteer begun session 2 by introducing the types of roads that exists in urban and rural roads of Nepal. In his presentation he presented the Total Road length in Nepal, Types of Road in Nepal, and registered vehicle by type and road accident scenario in Nepal.

Session 3

Similarly, in session 3, consultants presented the main causes of road accident in Nepal. Consultants categorised the causes of road accidents as follows:

1. Human Negligence
 - Drivers Negligence
 - Passengers Negligence
 - Predestines Negligence
2. Mechanical Fault
3. Poor Weather Condition
4. Poor Road Condition
5. Lack of proper Traffic Management and
6. Negligence of Road Neighbours

Session 4

In Session 4 orienteers mainly focused on the precautionary measures of safe road use. In the presentation, orienteers talked about Safety Measures to Avoid Road Accident. The orienteer highlighted the points like crossing the road from the road where there is pedestrian sign, zebra crossing, sub-ways and overhead bridge. The orienteer talked about traffic rules and golden rules of traffic-stop look and listen. Furthermore, the orienteer's then talk about not crossing the road from bend, not travelling the vehicle by over-loading or jumping from bars to cross the roads.

The orienteer also focused on little things that should be considered while crossing in rural and urban roads like beware about snakes, pit, landslides and wearing bright cloths in night time.

Session 5

In session 5 participants were introduced about the Road Traffic Sign and Signals. Road traffics signals were divided in three different categories namely, Informative, Warning and Regulatory.

Session 6

Session 6 was the last session of the training program which was presented by Mr. Shambhu Prasad Acharya – Acting chief of Suryabinayak- Dhulikhel, Dhulikhel -Sindhuli -Bardibas Road Project. In his presentation, he highlighted the Road Safety Activities carried out by his project Office in Sindhuli road.

At the end of the 6th session time was allocated for the questions from the participants. All the questions raised by the participants were logically addressed by the presenters to the full satisfaction of the participants. Finally with closing remarks from Mr. Shambhu Prasad Acharya – Acting chief of Suryabinayak-Dhulikhel, Dhulikhel-Sindhuli-Bardibas Road Project the program was formally ended.

All the Presentation was comprised by Audio/Video/photo about road safety education, traffic rules, traffic signs and signals. Ply Cards, Flyer and Buntings/Posters were displayed / distributed on Traffic signs and signals.

Please refer annex 4 to annex 10 for the presentation presented in training program.

3. Equipment / Materials Used for the Training

3.1 Equipment Used for the Training

The equipment used by the consultant to conduct the training program was listed as below:

1. Dell Laptop – Latitude 3390 two in one with Core i5 processor
2. Sony Bluetooth speaker with wireless microphone – SRS HG1 90 Watts
3. Acer Multimedia Projector- 5000 Lumens
4. Sony Voice Recorder – ICD-UX533F
5. Nikon DSLR Camera – D5300
6. Prolink Slide Changer with Laser Pointer

3.2 Education Materials Distributed to Schools

The constant team distributed the following education materials to each of the participants participated by representing from 30 different schools from the Sindhuli road corridor.

1. Ply Card Set-containing 15 different coloured ply cards with different road safety slogans with interactive cartoons pictures.
2. Poster/Flex Bunting with the size of 6 feet by 4 feet displaying different road traffic signs and signals
3. 8 GB Toshiba USB stick containing all the Power-point presentations, audio, video clips presented in training program.
4. T-shirt printed with Road safety Slogan and photograph of Sindhuli Road
5. Book about how to use road safely published by DoR.

Beside these education materials consultant team also distributed the stationery set to all the participants which includes the standard plastic folder, gel pen, spiral notebook, pencil, eraser, and sharpener.

4. Evaluation of the Training

4.1 Comments/Evaluation from Trainees

Almost all the participants welcomed this fruitful initiation. They considered the program as a huge success on its mission. The entire participants considered this program as the beginning of the mission not the end. Teachers expected that this training program would definitely contribute to lessen the road accidents. This program tried to equip all the teachers with the required skills and knowledge they needed to teach their students in coming days.

The consultant team also distributed the self-administered questionnaire to all the 50 participants for overall evaluation of the program. Out of 50 participants only 6 participants rated that time allocated for the training program was sufficient while 31 participants rated that time allocated for the training program was average while rest of 13 participants rated that time allocated for the training program was insufficient. Participants were also asked about the necessity of the program for other school teachers who were left out in this training program. The teachers urged to extend and expand this mission to other school teachers who were left in this program. Rest of the evaluation response form participants are presented in the Table 5 below;

Table 5 Over All Evaluation of Program from Participants

Description	Response in Number (Out of 50 Participants)			
	Highly Effective	Effective	Average	Need to Improve
Topics covered in the presentation	30	20	0	0
Program addressed the stated objectives	20	30	0	0
Training materials used in training	24	25	1	0
Presentation of the experts	14	36	0	0
Ability of participants to train their School students what they learned	6	40	4	0
Food provided during training program	6	33	10	1
Overall evaluation of the program	8	38	3	1

Source: JICA Expert Team / Field Survey 2022

4.2 Comments/Evaluation from DoR

Mr. Shambhu Prasad Acharya – Acting chief of Suryabinayak-Dhulikhel, Dhulikhel-Sindhuli-Bardibas Road Project stated that the training program was extremely helpful to understand the basic of road safety precautionary measures. Applying these learned knowledge will certainly help to reduce the road accident in the Sindhuli road corridor. He further added that the materials provided will really help the teachers to teach their students about basics of road safety precautionary measures as these training materials contained a lot of interactive pictures, videos and messages which students will enjoy during their learning.

4.3 Comments/Evaluation from JICA Experts

Road safety education is very much essential in day to day life as road traffic is becoming increasingly busy. Awareness campaign training will help teachers to develop skills and abilities to reduce the risk of road accident and number of injuries and deaths caused by road accidents. JICA Expert requested all the teachers to take this learned opportunity to teach their schools students on the regular basis so that it can bring some positive changes in the society.

5. Some Selected Program Photographs

5.1 Day 1 in Bhakundebesi (3rd June 2022)



Welcome Speech by Mr. Hiroki Shinkai - Chief Advisor-SROM2



Speech by Mr. Amar Deep Sunwar- Assistant Sunwar CDO, Kavre



Participants Learning in Training Program



Participants Learning in Training Program



Presenter Presenting in Training Program



Presenter Presenting in Training Program



Question and Answers in the Training Program



Training Materials Distributing to School Teachers



Training Materials Distributing to School Teachers



**Closing Remarks by Mr. Shambhu Prasad Acharya
Acting chief of Suryabinayak-Dhulikhel,
Dhulikhel-Sindhuli-Bardibas Road Project**



Group Photograph



Group Photograph

5.2 Day 2 in Sindhuli Bazar (5th June 2022)



Welcome Speech by Mr. Hiroki Shinkai - Chief Advisor-SROM2



Speech by Mr. Upendra Kumar Pokheral- Mayor of Kamalamai Municipality, Sindhuli



Addressing the Participants by Ms. Nakamura - JICA Nepal



Presenter Presenting in Training Program



Presenter Presenting in Training Program



Participants Learning in Training Program



Participants Learning in Training Program



Question and Answers in the Training Program



**Closing Remarks by Mr. Shambhu Prasad Acharya
Acting chief of Suryabinayak-Dhulikhel,
Dhulikhel-Sindhuli-Bardibas Road Project**



Group Photograph

6. Media Coverage

The program was also covered by the local as well as national print media. The published news by media is as follows:


Please refer to Annex 12 for English Translation.



News Published in Gorkhapatra National Daily on 6 June 2022



News Published in Prabhat Local Daily on 6 June 2022

 **JICA Nepal Office-JICA**
6月9日 -

Road Safety Awareness for school teachers in Sindhuli!

The Department of Roads and the JICA Expert Team on the Technical Cooperation Project "Operation and Maintenance of Sindhuli Road Phase 2" organized road safety awareness training sessions at Bhakundebsi on June 3, 2022 and at Sindhulimadi on June 5, 2022. The knowledge dissemination training included knowledge and attitude test to teachers on road behavior through self-administered questionnaire and delivered presentation on road conditions and road safety status of Nepal, introductions on BP highway, road traffic accident problem, the safer use practice and precaution measures to be taken on road and traffic signs and signals.


In the training session at Sindhulimadi on June 5, 2022, the Mayor of Kamalamai Municipality, Sindhuli district, Mr. Upendra Kumar Pokhrel was the Chief Guest of the seminar. The training was facilitated by various professionals mainly by Mr. SHINKAI Hiroki, Chief Advisor of the Project and Mr. Bindu S. Rana, former project director and JICA Expert Team Coordinator, representatives from the Nepal Traffic Police, and Project Directors and Officials from Roads Board Nepal and Divisional Engineer from Department of Roads.

The total number of participants were more than 50, primarily consisting of representatives and teachers from schools in Bhakundebsi and Sindhuli Bazar of Sindhuli district. The training program was conducted with precautions against COVID-19.

This training program aims to internalize the learnings of the teachers and further disseminate the message of road safety to the students, parents as well as the public.

The organizers expect that this program will play a positive role in identifying the core issues of road accidents and devising ways in ensuring road safety.

#JICA
#JICANepal
#Nepal
#SDGs
#SDG3
#GoodHealthAndWellBeing



42

Source: JICA Nepal Office Facebook

Facebook Article

The Project for the Operation and Maintenance of the Sindhuli Road Phase-2
Road Safety Awareness Training for School Teachers

Program Schedule

Venue: **Bhakundebesi : Kutumba Resort**

Date and Time: June 3, 2022 11:00 to 16:00 Hrs.			
Time	Min	Activities	In Charge
11:00 - 11:10	0:10	Registration of Participants	
11:10 - 11:15	0:05	Welcome Speech and Highlight the Objectives of the Program	PD,DOR / PM, Sindhuli Road
11:15 - 11:20	0:05	Self Introduction of Participants	
11:20 - 11:25	0:05	Remarks on Need of Road Safety Awareness Training Program for School Teachers	Chief District Education Officer (Kavre)
11:25 - 11:40	0:15	Outline of SROM2 Project	Mr. H Shinkai, Chief Advisor, JICA Expert Team
11:40 - 11:55	0:15	Teachers Knowledge and Attitude Test on Road Behavior Through Self - Administered Questionnaire	Traffic Safety Trainer, JICA Expert Team
11:55 - 12:05	0:10	Presentation on Road and Road Safety Status of Nepal	Traffic Safety Trainer, JICA Expert Team
12:05 - 12:15	0:10	Introductions on BP Highway and Road Traffic Crash Problem in BP Highway	Mr. B.S. Rana, JICA Expert Team
12:15 - 12:35	0:20	Presentation on the Main Causes of Road Accident (Specific to Accident in Sindhuli Road)	Traffic Safety Trainer, JICA Expert Team
12:35 - 13:20	0:45	Lunch Break	
13:20 - 14:20	1:00	Example Lectures of Traffic Safety Awareness to be Practiced at Each School - Brain Storming and Discussion from participants on precaution measures to be taken for safer road use practice - Presentation on the Safer Use Practice and precaution measures to be taken	Traffic Safety Trainer, JICA Expert Team
14:20 - 14:50	0:30	Presentation of Traffic Signs and Signals	Nepal Traffic Police
14:50 - 15:00	0:10	Introduction of Equipment / Material to be Distributed for School Children	Traffic Safety Trainer, JICA Expert Team
15:00 - 15:10	0:10	Question & Answer	
15:10 - 15:25	0:15	Feedback from Teachers	Traffic Safety Trainer, JICA Expert Team
15:25 - 15:35	0:10	Remarks	Chief of Police
15:35 - 15:45	0:10	Closing Remarks	PD,DOR / PM, Sindhuli Road
15:45 - 16:00	0:15	Tea & Coffee & Socialization	
Total Duration	5:00	hrs.	

The Project for the Operation and Maintenance of the Sindhuli Road Phase-2
Road Safety Awareness Training for School Teachers

Program Schedule

Venue: Sindhuli bazar: Ganapati Hotel and Resort

Date and Time: June 5, 2022 11:00 to 16:05 Hrs.			
Time	Min	Activities	In Charge
11:00 - 11:10	0:10	Registration of Participants	
11:10 - 11:15	0:05	Welcome Speech and Highlight the Objectives of the Program	PD,DOR / PM, Sindhuli Road
11:15 - 11:20	0:05	Self Introduction of Participants	
11:20 - 11:25	0:05	Remarks on Need of Road Safety Awareness Training Program for School Teachers	Chief District Education Officer (Sindhuli)
11:25 - 11:30	0:05	Welcome Speech	JICA Nepal Office
11:30 - 11:45	0:15	Outline of SR0M2 Project	Mr. H Shinkai, Chief Advisor, JICA Expert Team
11:45 - 11:55	0:10	Introductions on BP Highway and Road Traffic Crash Problem in BP Highway	Mr. B.S. Rana, JICA Expert Team
11:55 - 12:10	0:15	Teachers Knowledge and Attitude Test on Road Behavior Through Self - Administered Questionnaire	Traffic Safety Trainer, JICA Expert Team
12:10 - 12:20	0:10	Presentation on Road and Road Safety Status of Nepal	Traffic Safety Trainer, JICA Expert Team
12:20 - 12:40	0:20	Presentation on the Main Causes of Road Accident (Specific to Accident in Sindhuli Road)	Traffic Safety Trainer, JICA Expert Team
12:40 - 13:25	0:45	Lunch Break	
13:25 - 14:25	1:00	Example Lectures of Traffic Safety Awareness to be Practiced at Each School - Brain Storming and Discussion from participants on precaution measures to be taken for safer road use practice - Presentation on the Safer Use Practice and precaution measures to be taken	Traffic Safety Trainer, JICA Expert Team
14:25 - 14:55	0:30	Presentation of Traffic Signs and Signals	Nepal Traffic Police
14:55 - 15:05	0:10	Introduction of Equipment / Material to be Distributed for School Children	Traffic Safety Trainer, JICA Expert Team
15:05 - 15:15	0:10	Question & Answer	
15:15 - 15:30	0:15	Feedback from Teachers	Traffic Safety Trainer, JICA Expert Team
15:30 - 15:40	0:10	Remarks	Chief of Police
15:40 - 15:50	0:10	Closing Remarks	PD,DOR / PM, Sindhuli Road
15:50 - 16:05	0:15	Tea & Coffee & Socialization	
Total Duration	5:05	hrs.	

Road Safety Awareness Training for school Teachers

List of Selected School

Program Date: June 3, 2021

Program Venue: Kutumba Resort, Bakundabasi

S.N	Name of the School	Address	Name of the Principle	Number of Teachers Participated
1	Debisthan Secondary School	Baluwa -1	Mr. Naryan Prasad Nepal	2
2	Pashupati Basic School	Mulkot -5	Ms. Nirmala Kumari Shrestha	1
3	Dirghapradip Secondary School	Khalte -6	Mr. Shankar prasad Upreti	2
4	Bhimsen Secondary School	Roshi -11 (Mamti)	Mr. Subarna Raimajhi	2
5	Roshi Secondary School	7 (Kavre)	Mr. Bindu Prasad Dhungana	2
6	Mangal Janbijaya Higher Secondary School	Mangaltar -9 (Roshi)	Mr Basu Thapa	2
7	Janak Secondary School	Bhakundebesi	Mr. Pradip Pokharel	2
8	Hanuman Secondary School	Dhulikhel , Kamu	Mr. Manohar Thapa	2
9	Janata MA VI	Khaniyakhark, Golanjor	Mr. Manoj Kumar Sah	1
10	Jana Joti Ma Vi	Khurkot, Golanjor -7	Mr. Shatrudhan Yadav	2
11	Madhyamik Bidhyalaya	Nayakharka, Golanjor -5	Mr. Lekha Bahadur Basnet	1
12	Nabha Joti Primary school	Dhulikhel	Mr.Sanjay Chochchhe	1
13	Kaldevi Secondary School	Danda Gaun, Dhulikhel	Mr. Ranjit Rai	2
14	Purna Sajgeevni School	Dhulikhel	Ms. Gayatri Timilsina	1
15	K U High school	Dhulikhel	Mr. Rupak Khatri	2

Road Safety Awareness Training for school Teachers

List of Selected School

Program Date: June 5, 2021

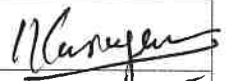
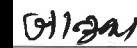


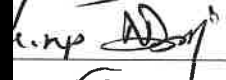


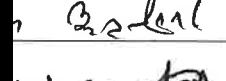
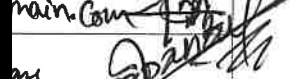

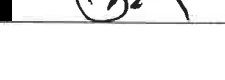
Program Venue: Hotel Ganapati, Sindhulibazar

S.N	Name of the School	Address	Name of the Principle	Number of Teachers Participated
1	Gut Bazar Secondary School		Mr. Hari Prasad Dhimal	2
2	Panchakanya Lower secondary school	Ghumaunchainpor- 6	Mr. Laxman Rimal	1
3	Janjagriti Ma Vi.	Patu -3 (Bardibas)	Mr. Jateshwor Das	2
4	Shree Deurali Higher Secondary School	Bardibas	Mr. Indra Bahadur Lama	2
5	Shree Deorali Secondary School	Mithila Na Pa -11 Chure	Mr. Ram Kumar Pandey	1
6	Shree Jana Jagriti Secondary School	Kamlamai -9 (Bhiman)	Mr. Krishna Prasad Niraula	2
7	Shree Rastriya Saraswoti Secondary school	Kalapani -3 (Bardibas)	Mr. Chandra BK	2
8	Shree Janta Secondary School	Mahottari Bardibas	Mr. Dipak Baral	2
9	Shree Scholar Academy High School	Kamlamai -9 (Bhiman)	Mr. Pabin Paudel	2
10	Shree Saheed Primary School	Kamalamai -8 (Panesi)	Ms. Menuka Subedi	1
11	Five star English Boarding School	Sunkoshi -3	Mr. Divya Darshan	2
12	Kamala Secondary School	Kamaiala mai -4	Mr. Kamlesh Choudhary	1
13	Gaumati Ma Vi School	Kamamai- 6	Mr. Dipak Budhathoki	2
14	Jan Joti Primary School	Ratmata Bazar -3	Mr. Bhuwan Acharya	1
15	Prgatisil Secondary school	Ratmata- 3	Mr. Chakra Bahadur Shrestha	2

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers
Program Attendance

Date 3rd June 2022,

Venue: Kutumba Resort, Bhakundebesi

S.N.	Name	Institution	Contact No.	Email	Signature
1	Narayan Prasad Dahal	Shree Paschupati Boudha			
2	Januka Acharya	Shree Janajyoti primary			
3	कुशी शौतम	श्री नवव्रती प्रा. वि.			
4	Chakra Bahi Shrestha	Shree pragadisteeel			
5	Ngudup Dorjee Lama	Kathmandu University High school			
6	Ram Chandra Thapa	"			
7	सविता चौलागाई	श्री प्रजाश्रील मा.वि.			
8	अमृत प्र. तिमालिना	श्री मा.वि. ठुलुवजार			
9	निमसा श्रेष्ठ	श्री मा.वि. ठुलुवजार			
10	सपना पराजुली	श्री प्रिमेडवर मा.वि.मान्ती			
11	उर्मिला शेरचला	श्री प्रिमेडवर मा.वि.मान्ती			

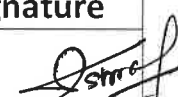
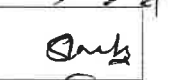
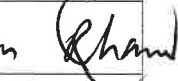
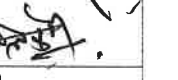


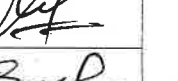




The Project for the Operation and Maintenance of the Sindhuli Road Phase -2

Road Safety Awareness Training for school Teachers

Program Attendance

Date 3rd June 2022,

Venue: Kutumba Resort, Bhakundebesi


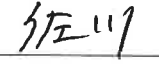








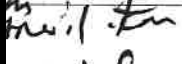
S.N.	Name	Institution	Contact No.	Email	Signature
12	Shyam Kumar Shrestha	Devasthan Secondary se			1.com 
13	Sority Kumar Sunuwar	Hanuman Secondary			gmb 
14	Rajendra Bdr Chand	Devasthan Secondary Sch			si/eam 
15.	Kapil K.C.	Hanuman Secondary School			
16	Sonu Maya Lama	Roshi Ma. VI			
17.	Til Kumar Shrestha	Roshi Ma. VI			@com 
18.	Ramsharan Sigdel.	Tanok sec. School.			
19	Kamal Bdr Raut	Five Star Eng Boas. sch			
20.	Santosh Sapkota	Shree Kalideri sec. Sch			
21	Kalpna Humagain	"			
22	Netra Basnet	Purna Sanjivani sec			

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers

Program Attendance

Date 3rd June 2022,

Venue: Kutumba Resort, Bhakundebsi

S.N.	Name	Institution	Contact No.	Email	Signature
23	Hiroki SHINKAI	JICA Expert.			
24	Natsuko Sagawa	JICA Expert			
25	Yohsei Onomura	JICA Expert			
26	Shiva Raj Adhikari	"			
27	Brendhan Shrestha	" "			
28	Santosh Khadka	Traffic Police.			
29	Karan Phasal	prestige			
30	Niraj Dhakshyal	consultant Prestige			
31	Rupesh Shrestha	Nepal Police			
32	Chetna Thapa	RBN			
33	Sonu Basu Prajapati	RBN			



The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers

Program Attendance

Date 3rd June 2022,

Venue: Kutumba Resort, Bhakundebsi

S.N.	Name	Institution	Contact No.	Email	Signature
34	Shambhu pd. Acharya	DOR			gmail.com Sun
35	Gyanendra Pd. Kalana	DOR			m. gump
36	Ananta Baral	DOR			m. nym
37	Karna Singh Phetri	DOR			m. K
38	Ramesh Pd Adhikari	Shree Mangal Samabida			l.com K
39	Narayan Dahal	Shree mangal Samabida			A
40	Harkar Aslan	Shree Janak Secondary			l.com K
41	Saraj Kharel	Contact/Presy			mail.com K

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2




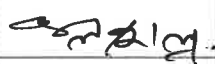

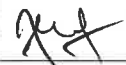


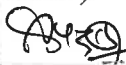


Road Safety Awareness Training for school Teachers

Program Attendance

Date 5th June 2022,

Venue: Kutumba Resort, Bhakundebesi

Ganapati Hotel & Resort, Sindhuli Bazar

S.N.	Name	Institution	Contact No.	Email	Signature
1.	Sumitra Kumari Basnet	Janajyoti Sec. School			
2.	Mahesh Dhungana	Shree Janata Sec. School			
3.	Rima Kumari Bhandari	Shree Janata Sec. School			
4.	Kamala Baral	Shree J. Ja. S. School B.			
5.	Shakuntala Shrestha	Shree Gaumati S. School			
6.	Bishm Thapa	Shree Saraswati S. S.			
7.	Apsara Rayamajhi	Shree Kamala Secondary			
8.	Sani Kumari Bhandari	Shree R. S. Majhi Kalap			
9.	Dipak Kumar Paudyal	Shree Gaumati Sec. Madhibara			
10.	Rajan Bastola	Shree Dirgha Pradip M. V			
11.	Rukmani Subedi	" " " "			

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers
Program Attendance

Date 3rd June 2022,Venue: Kutumba Resort, Bhakundebesi
Gawa Pati Hotel & Resort, Sindhuli Bazar.

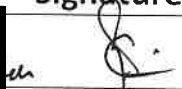



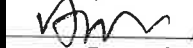
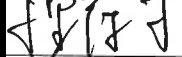


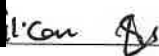
S.N.	Name	Institution	Contact No.	Email	Signature
11	Urbaashi Kumari Khadka	Shree Deurali sec. school			
12	Jamuna Kumari Kafle	shree Janajyoti sec. bhini			
13	Rasita Khadka	Shree Mavi Nayakhari			
14	Muna Kaphle	Shree Panchakanya B.S.			
15	Januka Khadka	Shree Deurali Sec. School			
16	Chet Bahadur Khadka	Shree Deurali sec			
17	Niro Kumari Chalise	Shree Shahid P. Pannesi			
18	Santosh Khadka	Scholar's Academy			
19	Mandira Thapa	Scholar's Academy			
20	Santosh Shrestha	Shree Deurali - M.A.V.I			
21	Lal Bahadur Stha	Shree Janajyoti S. Khurka			

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers

Program Attendance

Date 3rd June 2022,

Venue: Kutumba Resort, Bhakundebesi
 Ganapati Hotel & Resort, Sindhuli

S.N.	Name	Institution	Contact No.	Email	Signature
23	Chetna Thapa	RBN			
24	Baburam Devkota	Workshop Dmg			
25	JE Janga Karki	Traffic police			
26	Sabita Baral	shree jagadagrif			
27	Anam prasad pokharel	M.B pata			
28	Chhetri Omwara	JICA expert team			
29	Hiroki SHINKAI	" 9			
30	Brideshan Khana	" "			
31	Shiva Raj Adhikari	" "			

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers

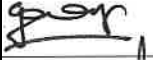
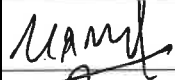



Program Attendance

Date 5th June 2022,
Ganapati Hotel and Resort, Sindhuli bazar

S.N.	Name	Institution	Contact No.	Email	Signature
32	Birula Singh	JICA			
33	Suresh Rana	"			
34	Ayuko Nakamura	"			
35	Sagar Dhakal	Kamalimai Nagarpalik			
36	Dr. Roshan Koizalga	"			
37	Uendra Kr. Pokhrel	Mayor Kamalimai			
38	Raj Kumar Kark	Kantipur			
39	Niraj Dhakshadul	Consultant / Presteg			
40	Basan Khanal	"			
41	Manoj Kumar Sah	Janta se - school			

The Project for the Operation and Maintenance of the Sindhuli Road Phase -2
Road Safety Awareness Training for school Teachers
Program Attendance

Date 5th June 2022,
Ganapati Hotel and Resort, Sindhuli bazar

S.N.	Name	Institution	Contact No.	Email	Signature
41	Gyanendra Kalaunee	DOR			
42	Ananta Baral	DOR			
43	Parno Singh Phortri	DOR			
44	Shambhu Pd. Acharya	DOR			
45	Saroj Kharel	Constitak/Pres			
46	Dwanika Kotle	Pravatsamachar dai			