Government of Nepal
Ministry of Federal Affairs and Local Development
Central Level Project Implementation Unit
Earthquake Emergency Assistance Project
Lalitpur, Nepal

Earthquake Emergency Assistance Project
(ADB Loan 3260-NEP)

Detailed Project Report

Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road

CH: 0+000 – 16+140.40 Km
Ramechhap

Section II: Detail Engineering Survey, Design and Estimate

Volume 1: Main Report (Final)

August 2016

Prepared by:

Joint Venture of Gaurav Integrated Development Associates Nepal P. Ltd, NEST (P) Ltd. and JAARSA Engineering Consultancy (P) Ltd, Kathmandu, Nepal

on behalf of

AF-Iteco Ltd. Switzerland

ACKNOWLEDGEMENT

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We would further like to acknowledge DDG, SDE of DoLIDAR, Mr. Vijaya Muni Bajracharya, DTO, Er. Dilli Raj Adhikari of DDC Ramechhap, CISC team, Engineer Saroj Acharya DTO,, Sub Engineer, the local people of the project area and all the individuals involved in with this project for their kind co-operation and help at every step during the preparation of this report.

Last but not least, team would like to thank technical and supporting staffs of Gaurav Integrated Development Associates Nepal (P) Ltd/NEST (P) Ltd/Jaarsa Engineering Consultancy (P) Ltd. JV who have done remarkable assistance to complete the assignment.

Gaurav Integrated Development Associates Nepal (P) Ltd
NEST (P) Ltd
Jaarsa Engineering Consultancy (P) Ltd.
August, 2016

EXECUTIVE SUMMARY

The detailed engineering survey, design and cost estimate for rehabilitation and reconstruction of Devitar – Phulasipokhari section of Devitar – Doramba – Paseban – Kolibagar Road has been prepared for ADB funded Emergency Earthquake Assistance Project (ADB L0an 3260-NEP) following the principles of build back better. The road traverses through Phulasi VDC of Ramechhap District. The length of the Devitar – Phulasipokhari road section proposed for rehabilitation and reconstruction to gravel standard is 16.140 km.

The existing road starts from Sankhebeshi (Zero kilo), Phulasi VDC-1 and ends to Pokharidada, Phulasipokhari of Phulasi VDC-8. The alignment traverses through ward no's 1, 2, 4, 6 and 8 of the VDC. Throughout the length the existing road, surface is earthen and condition is moderate and undulated. Landslides are present in few sections of the alignment. Landslides in the existing alignment are in chainages 2+000, 3+640, 11+250, 12+800. In several sections of the existing alignment, the longitudinal grade is greater than 12%. In chainages, 1+980 to 2+060, 3+920 to 3+995, 8+620 to 8+670, 11+925 to 11+985 the existing gradient is greater than 15%. The existing road width varies between 3m to 5m.

During the design, existing road alignment has been followed as far as possible; however the alignment has been shifted in some places especially at loops to maintain the geometric design parameters and at problematic areas of steep gradient. Nepal Rural Road Standard (2055) 2nd revision, December 2014 has been adopted for the design. The maximum and minimum grade adopted in the design is 12% and 0.5% respectively. The road has been designed to gravel standard.

Unnecessary heavy cut/fill has been avoided as far as possible. However, this could not be avoided to some extent especially in loops, where the combined effect of design grade limitation and abrupt change of topography contour could induce such consequences and at sections with steep existing gradients. At chainage 9+390 to 9+410, due to the critical existing topography, reinforced soil wall structure with Teramesh System (TMS) facing has been proposed. This includes providing and fixing flexible Geogrids as primary reinforcement for composite soil reinforcement system, made of polyester core with polyethylene coating including secondary reinforcement of Teramesh system (TMS) with Zinc and PVC coated including laying of Geo textile, drainage gallery filling with boulder.

For pavement design, CBR value is calculated from results of DCP test and from this the required thickness of sub-base has been calculated. From the results of DCP test and judging economic in gravel road, the thickness of sub base 175 mm has been adopted. Capping layer of 100 mm has been provided over sub base in sections where sub base thickness required is higher than 175 mm from result of DCP test and pavement design. Bio-engineering works have been proposed in places prone to landslides and erosions. For spoil management, the proper locations along the site have been identified.

The design was reviewed during joint field verification by team of Consultant and CISC. The comments and feedback received by the consultants have been incorporated in preparing the final design. After the discussion with the CISC team, for the sections having gradient higher than 8%, cobble pavement has been proposed in the design. On this consideration the total length which requires cobble pavement is 5.57 km.

The cost estimates are based on applicable DoLIDAR norms. In cases where DoLIDAR norms are not available, DOR norms have been used. The unit item rates for each item have been calculated on the basis of approved district rate for fiscal year 2072/73. While calculating item rates, it is assumed that a qualified contractor will undertake construction following mechanized approach for road works.

The cost of civil works has been estimated to be Rs. 235,026,994.25. The total cost for rehabilitation and reconstruction to gravel standard including contingencies consisting of small miscellaneous expenses, work charge staff and VAT as per GON rules is calculated to be Rs. 296,134,012.76. The per km cost including Base coast and VAT is Rs. 16,454,394.16. It is envisaged that the construction works can be completed within 18 months from award of contract and estimates are based on it. Provision of physical contingency 10% has been indicated in the cost estimate.

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SALIENT FEATURES

Features	**Description**
Name of the Road	Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road
Scope	Reconstruction and Rehabilitation
Location	
Region:	Central Development
Zone:	Janakpur
District:	Ramechhap
VDC/Municipality	Phulasi VDC, Wards – 1, 2, 4, 6 and 8
Major Settlements	Sankhebeshi, Aarubote, Harre, Chinne, Phulasi
Length	16.140 km
Starting Point	Zero Kilo, Sankhebeshi, Phulasi VDC-1
End Point:	Phulasipokhari, Phulasi VDC-8
Beneficiaries Population in ZOI Phulasi VDC	Households – 120, Population – 1000
Geographical feature	
Terrain	Mid-Hills
Altitudinal Range	647 m to 1823 m
Climate:	Tropical to Sub-tropical
Geology:	Lesser Himalayan Rocks (Phyllite and Gneiss), Colluvium, Alluvium and Residual Soil
Meteorology:	Unevenly Distributed Precipitation Controlled by Monsoon
Design Standard	
Standard	NRRS 2055, 2nd Revision December 2014
Existing Surface:	Earthen
Proposed Pavement:	Gravel, Cobble for grade >8%
Geometrics	
Right Of Way:	10 m on either sides (Center line)
Formation Width:	6.25 m (includes 1m drainage & 0.75 m Shoulder)
Carriage Way Width:	3.75 m
Shoulder Width:	0.75 m on either side
Maximum Gradient	12%
Minimum Gradient	0.5%
Lane	Single
Pavement Standard	**Gravel / Cobble for grade >8%**
Gravel Length	10.56 km
Cobble Length	5.57 km
Structures (Qty/No.)	

Features	**Description**
Drainage Structures	
a) Side Drain	Throughout the alignment at hill side
b) Causeway	2 (RCC)
c) Slab Culvert	1
d) Pipe Culvert	61
e) Irrigation Crossing	15
Retaining Structures	
a) Stone masonry Wall	11,305.47 cu.m.
b) Gabion Retaining and Breast Walls	10,159.42 cu.m.
c) Reinforced Soil Wall with Teramesh System	240 sq. m.
Earth Work	**Road works**
a) Excavation/Cutting	257,382.93 cu.m.
b) Embankment/Filling	17,091.15 cu.m.
Pavement	
a) Gravel	12,265.59 cu.m.
b) Cobble	1, 728.14 cu.m.
Cost Estimate (Rs.)	
a) Civil Works (Base cost)	235,026,994.25
b) 13% VAT (of a)	30,553,509.25
c) Total (a+b)	265,580,503.50
d) Per km Cost (Including Base cost and VAT)	16,454,394.16
e) Work Charge Staff and Small Miscellaneous Expenses @ 3% (of a)	7,050,809.83
f) Physical contingency @ 10% (of a)	23,502,699.43
g) Grand Total (c+e+f)	296,134,012.76

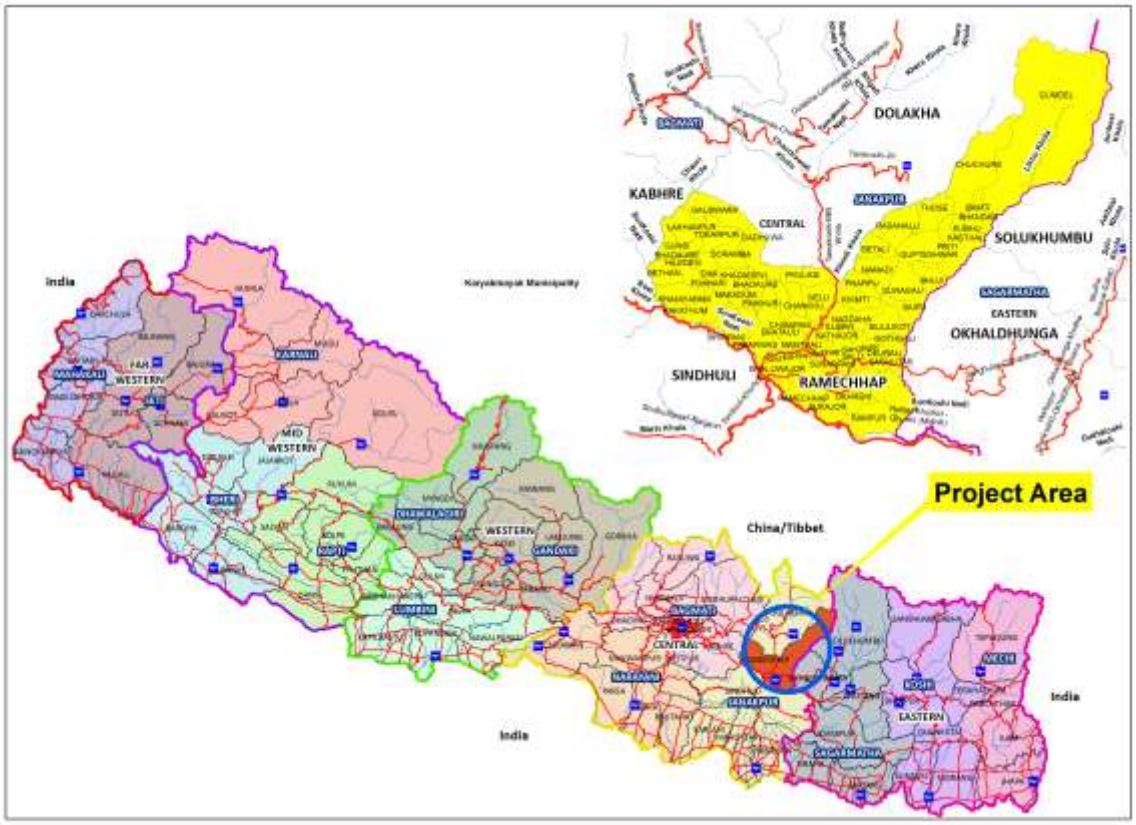

Figure 1: Map of Nepal showing Ramechhap District

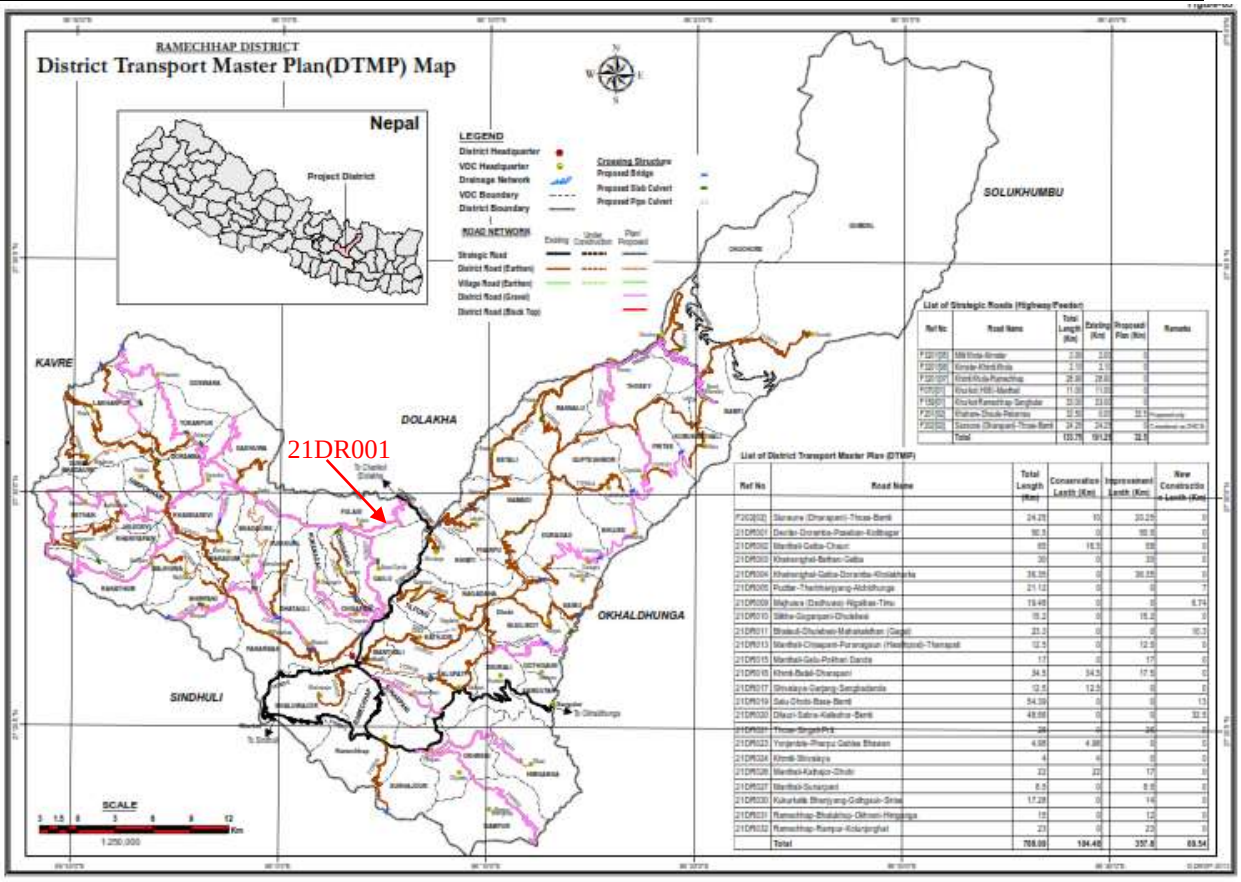

Figure 2: Devitar - Phulasipokhari Road in Ramechhap DTMP Map

Figure 3: Devitar – Phulasipokhari Road Alignment

ACRONYMS/ ABBREVIATIONS

ADB	Asian Development Bank
BM	Bench Mark
BOQ	Bill of Quantities
c/c	Center to Center
DCP	Dynamic Cone Penetration
DCPI	Dynamic Cone Penetration Index
DDC	District Development Committee
DoR	Department of Roads
DoLIDAR	Department of Local Infrastructure Development and Agriculture Roads
DRCN	District Road Core Network
DRILP	Decentralized Rural Infrastructure and Livelihood Project
DTO	District Technical Office
FY	Fiscal Year
GON	Government of Nepal
Km	Kilometer
MT	Metric Tonne
m	Meter
mm	Millimeter
m^2	Square Meter
m^3/cum	Cubic Meter
NRRS	Nepal Rural Road Standard
NA	Not Applicable
PCC	Plain Cement Concrete
RCC	Reinforced Cement Concrete
Rs.	Nepalese Rupees
rm	Running Meter
SDC	Swiss Agency for Development and Co-operation
TOR	Terms of Reference
VDC	Village Development Committee
VAT	Value Added Tax

1. INTRODUCTION

1.1. Project Background

The rehabilitation and reconstruction of local roads network damaged due to major earthquake of 25 April 2015 and May 12 2015 has high priority for the Government of Nepal (GoN) . The Asian Development Bank (ADB) funded Earthquake Emergency Assistance by Project (ADB Loan 3260-NEP) is aimed to accelerate the recovery and reconstruction of the local roads damaged by the earthquake. The rehabilitation and reconstruction of about 385 km of rural roads damaged by the earthquake and landslides in 10 of the earthquake hit districts (Dolakha,Kavrepalanchowk, Laitpur, Chitwan, Sindhuli, Solukhumbu, Okhaldhunga, Ramechhap, Gorkha and Lamjung). 16.141 km long Devitar – Phulasipokhari section of Devitar – Doramba – Paseban – Kolibagar Road of Ramechhap district is one of the roads proposed for rehabilitation and reconstruction under EEAP.

As part of the Technical Assistance from Swiss Agency for Development and Cooperation (SDC) also provided technical assistance to EEAP. AF-Iteco, Switzerland,currently providing services as Central Implementation Support Consultants (CISC) for Decentralized Rural Infrastructure and Livelihood Project-Additional Financing has been entrusted to act as Consultant for this project and has given the assignment for preparation of Detailed Project Reports for rehabilitation and reconstruction of selected rural road subprojects of Dolakha and Ramechhap to Joint Venture of Gaurav Integrated Development Associates Nepal (P) Ltd, NEST (P) Ltd and Jaarsa Engineering Consultancy (P) Ltd.

1.2. Project District and Proposed Road

The Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road lies in Ramechhap district. Ramechhap, the project district, is located in the Janakpur Zone of the Eastern Development Region of Nepal. The district is located within 27° 28' to 27° 50' latitude and 85° 50' to 86° 32' longitude. The district borders with Okhaldhunga and Solukhumbu Districts in East, Sindhupalchowk and Kavrepalanchowk Districts in West, Dolakha District in North and Sindhuli District in South.

The total area of Ramechhap district is about 1,546 km^2, among which 38.28% is agricultural land, 42.78% is forest area, 7.39% is cattle pasture land and rest 11.55% is others. The total population of the district is 202,646 as per last census of 2011, out of which 93,386 are male and 109,260 are female. The population density is 137 people per sq. km, household size is 5.26 people. Ramechhap is mainly accessed through Kathmandu, Dhulikhel, Nepalthok and Khurkot Road, the section of BP Highway. Only light vehicles are allowed to travel through the road. For heavy vehicles, the route to Ramechhap is from Khadichaur of Sindhupalchowk district which is the link road of Araniko Highway connecting through Charikot of Dolakha district and Manthali of Ramechhap to capital city, Kathmandu.

The road passes through Phulasi VDC of Ramechhap District. DDC has proposed to upgrade the 16.141 km section of the road. The road section starts from Sankhebeshi (Zero kilo), Phulasi VDC-1 and ends to Pokharidada, Phulasipokhari of Phulasi VDC-8. The alignment traverses through ward no's 1, 2, 4, 6 and 8. The proposed road passes through various settlements. The major settlement areas are Sankhebeshi at 0+000 km, Aarubote at 0+900 km, Harre village at 8+000 km to 9+000 km, Chinne Village at 11+000 to 11+400 km and Phulasipokhari at 15+500 km. The status of the road of the project along the alignment is earthen existing track. Stone soling is present in some of the high grade loop sections.

1.3. Scope of Works

The detailed engineering survey, design and cost estimate for rehabilitation and reconstruction. of Devitar – Phulasipokhari Road section has been carried out by the Consultants.

Accordingly the scope of works covers:

a. Detailed engineering survey of the road including fixing centreline.

b. Detail design the road to DOLIDAR's NRRS 2055, 2nd Revision December 2014.

c. Prepare drawings including alignment plan, design profile, design cross-section and typical drawings

d. Prepare detailed cost estimate

e. Prepare technical study report

2. ENGINEERING SURVEY AND STUDY

2.1. Desk Study

During the process of desk Study, the available reports and maps were collected and reviewed. All relevant guidelines, norms, specification were collected. Nepal Rural Road Standard (NRRS 2055) and DoLIDAR Norms & Specification has been studied and referred for adoption of design standard and specification.

2.2. Field Survey

After the desk study, engineering team comprising of highway engineer, surveyor and local supervisor had been mobilized in field. The team contacted DTO office and with co-operation with staffs of DTO, the team mobilized to the site. The DTO team at Manthali of Ramechhap assisted the survey team during their field works.

2.3. The Survey Team

The survey team for detailed survey work of Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road constitute of Civil Engineer and Surveyors.

The key team members are:

Civil Engineer: Sabin Bajracharya

Surveyor: Sudip Karki

2.4. Topographical Survey

Survey Procedure

Detailed engineering survey was carried out for the design work of the road. The accuracy and effectiveness of design work depend on the accuracy of survey works, hence due care was given during survey works.

The fieldwork consists of detailed engineering survey of the project road. The linear traverse method was adopted for the survey and topographical survey was conducted for the proposed alignment. The topographic survey of the sites was carried out in detail using TOTAL STATION and survey points were recorded. It was ensured that the density of the survey points was adequate to prepare the detailed topography of the site. Contours were thus generated on scale 1:1000 with the details like contours at interval of 1m, channel bifurcation and merging points, survey control point, settlements/villages, utility services, etc.

The RL of center point of the cross section were measured using TOTAL STATION instrument readings. The observation of horizontal angles at each right and mean of two was done with both left and right faces and mean of two was used for calculation to eliminate errors due to eccentricity and centering. The TOTAL STATION instrument carried out profile leveling at an interval of 20 m and at all points where sudden changes of topography was observed. During the field works, all the data needed were recorded and registered.

BM was established where deemed necessary and fixed.

Instrument Station

During survey, the instrument was placed on the site from where forward and backward is clearly seen while taking maximum detailed points for detailing.

Bench Marks (BM)

In this study, the local coordinates and Benchmark values have been used. The bench marks are used as reference point during construction phase. At site, the benchmarks have been placed in permanent structures and the Benchmark numbers has been clearly written with enamel paints. *(Refer Annex 1: Schedule of Control Points for detail BM list and Descriptions)*

2.5. Topography and Geomorphology

2.5.1 Topography

Geographically, the road area lies in the hilly terrain. The existing road track passes through area with bed rock, soil and vegetation covers.

The road alignment is located in Lesser Himalaya (Middle Mountain) physiographic region. The elevation is in the range from 647 m to 1823 m above sea level (msl) but actually the elevation of the Lesser Himalaya or Middle Mountain in the Mid-Eastern Nepal range from 1,000 m to 1,800 m msl except the elevation of the river valley.

The altitude range of physiographic region is shown in Table.

Table 1: Physiographic Region

S.N.	Physiographic Region	Altitude Range (m) amsl
1.	Middle Mountain	700-2000
2.	High Mountain	2000-2500
3.	High Himalayan	2500-8000

Source: Department of Survey, GON/Nepal, 1998

2.5.2 Geomorphology

Geologically, the study area lies in Ranimata and Ulleri formation. The area surrounds mainly phyllites and augen gneisses with bands of schists, carbonates and quartzites. The dominant rock types along the road alignment are also phyllites, quartzites, schists and gneisses. The common soil types include colluvial, alluvial and residual soils

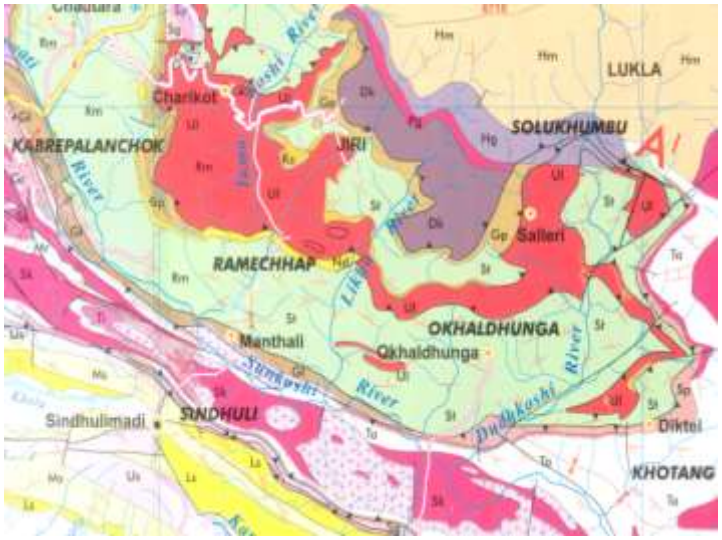

Figure 4: Location of Sub-project in Geological Map

Table 2: Geology and Soil Type Along Road Alignment

Section	Chainage	Elevation (m asl)	Aspect	Geology	Soil Type
Sankhebeshi – Phulasipokhari	0+000 – 16+140	647 – 1823	North – West	Phyllite, Gneiss, Schist, Quartzite	Colluvial, Alluvial, Residual

Table 3: Geology and Soil Type along Road Alignment

S. No	Geological Classification		Slope grade	
	Major Classification	Minor classification	Cut Slope	Fill Slope
1	Soil	Colluvium Alluvium Residual	1V:0.33H	1V:1.5H
2	Rock	Ordinary Medium	1V:0.20H	1V:1.5H
3	Rock	Hard	1V:0.16H	1V:1.5H

Source: Department Of Road, GoN

2.6. Vegetation Survey

The vegetation in the project area has been controlled by altitude and aspects. The project area is dominated by trees characteristic of Sub-tropical Pine Forest like Salla (Pinus Patula), Alder (Alnus nepalensis). Additionally, there are representations of Sub-tropical Broadleaved Forest like Chilaune (Schima wallichii).

The trees reported alongside of the road alignment include Salla (Pinus Patula), Gobre Salla (Abies pindrow, Uttis (Alnus nepalensis), Duthilo (Ficus nerifolia), Kafal (Myrica esculenta), Katush (Castanopsis indica), Khanyo (Ficus semicordata), Taki (Bahunia purperea), Lakuri (Fraxinus floribunda), Okhar (Juglans regia), Paiyu (Prunus cerasoides), etc.

Shrub species include Jhadi banmara (Lantana camara), Bilaune (Maesa chisia), Jhingani (Eurya acuminata), Aiselu (Rubus ellipticus, Rubus paniculatus), Clematis sps., Lokta (Daphne bholua), etc. Ground vegetations include Dhursul (Colebrookia oppositifolia), Rudhilo (Pogostemon benghalensis), Banmara (Eupatoreum adenophorum), Blumea sps, Bukiphool (Osbeckia sps.), Datiwan (Achyranthus sikkimensis), Gandhe (Ageratum conizoides), Kuro (Bidens pilosa), Titepati (Artemisia sps.), Kuro (Xanthium strumarium), Sisno (Utricia diocia), Amriso (Thysanolena maxima), Urena lobata, Eubhorbia sps and various other grasses like Imperata cylindrica, Brachiaria sps, Echinochloa sps, Pennisetum sps, Cynodon dactylon, etc.

2.7. Construction Material Survey

The construction materials survey was conducted to assess the availability of the materials within the proposed alignment. Quarry sites are identified for the materials like gravel, aggregates, sand, stone, boulders, etc. which could be extracted from quarries. For the materials like cement, R.C. pipes, HDP pipe, geo-textiles, etc. market survey is conducted to identify the location for procurement. The table below shows the location of different quarry sites and market for procurement of construction materials.

Table 4: Possible Quarry Sites

Material	Site	Distance
Gravel	Milti Khola, Ramechhap – Dolakha Border	2 km from Zero kilo (Sankhebeshi)
Sand	Milti Khola	2 km blacktopped road
	Dhobi Khola, Japhe, Dolakha	4 km from Zero kilo (Sankhebeshi)
Boulder	Milti Khola	2 km from Zero kilo (Sankhebeshi)
	At site of roadway cutting	
Aggregate	Dhobi Khola, Japhe, Dolakha	4 km from Zero kilo (Sankhebeshi)
	Roadway Cutting	

2.8. General Inventory

During the survey, no side drains were observed along the existing road alignment. However, retaining structures like gabion walls, gravity wall and breast wall along, several chainage were observed. During the design, priority has been given to protect the existing gabion walls as much as possible. Despite this, the retaining structures have to be dismantled while improving the grade of alignment as per NRRS.

The table below shows the locations of existing retaining structures in the existing alignment.

Table 5: Existing Structures along Road Alignment

Chainage		Length	Existing Structure Type	Remarks
From	To			
0+480	0+520	40	Gabion	Dismantle not required
0+730	0+800	70	Dry	Dismantle not required
0+810	0+830	20	Gabion	"
1+050	1+080	30	Gabion	"
1+100	1+120	20	Dry	Gabion Proposed
1+200	1+230	30	Dry	"
1+440	1+450	10	Gabion	Dismantle not required
1+660	1+770	110	Gabion	Dismantle required for grade improvement
1+840	1+860	20	Stone Masonry	"
1+880	1+900	20	Gabion	Dismantle not required
1+900	1+960	60	Gabion	Dismantle required for curve improvement
1+960	2+010	50	Gabion	Masonry wall Proposed
2+120	2+170	50	Gabion	Dismantle required (New gabion proposed)
2+210	2+320	110	Gabion	Dismantle required
3+040	3+100	60	Gabion	Dismantle not required
4+270	4+280	10	Gabion	"
4+600	4+630	30	Gabion	New gabion proposed
4+800	4+820	20	Dry	Dismantle not required
5+250	5+260	10	Gabion	Dismantle required (New gabion proposed)
5+700	5+720	20	Dry	Dismantle not required
6+030	6+060	30	Gabion	Dismantle required (New gabion proposed)
6+310	6+330	20	Gabion	Dismantle required (New gabion breast proposed)
7+120	7+150	30	Gabion	Dismantle not required
8+030	8+040	10	Gabion	"
8+160	8+180	20	Gabion	Dismantle required (New gabion breast proposed)
8+180	8+210	30	Gabion	Dismantle not required
8+270	8+280	10	Gabion	New gabion proposed
8+390	8+400	10	Dry	Masonry breast wall proposed
8+830	8+840	10	Gabion	Dismantle required (New gabion breast proposed)
9+110	9+120	10	Gabion	Dismantle not required
9+170	9+190	20	Gabion	"
9+270	9+320	50	Dry	Gabion Proposed
9+700	9+710	10	Dry	Masonry gravity wall proposed
11+850	11+860	10	Dry	Masonry breast wall proposed
13+000	13+010	10	Stone Masonry	Dismantle required for grade improvement

Also, it was observed that in the road section didn't have any cross drainage structures. Earthen drains are present in few sections of the existing alignment. Masonry side drains are proposed to substitute the existing earthen drains. Further, the existing gradient of road profile lies within the limiting gradient permitted by NRR standards.

2.9. General Alignment Description

The Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road alignment lies in the hilly region of Nepal. The elevation of the road alignment increases gradually from the starting to the end point of the road. The hill slope along the road alignment is steep because the road alignment passes through the hard soil. The road alignment starts from Zero kilo, Phulasi VDC-1 and passes through various villages to Phulasipokhari – Phulasi VDC - 8. The total length of the road is 16.14 km and existing width varies from 3m to 5m. However in new design, the proposed road width shall be 5.25m except at extra widening, passing places and bus bays area

In existing road alignment, at several sections longitudinal grade is greater than 12%. The sections having existing grade greater than 12% are listed in table below:

Table 6: Existing High Grade Sections

Chainage		Existing Grade	Remarks
From	To		
0+545	0+640	14.52 %	
1+575	1740	14.09 %	
1+760	1+860	13.00 %	
1+980	2+060	15.67 %	
2+160	2+320	14.15 %	
3+920	3+995	15.00 %	
5+225	5+309	13.50 %	
5+630	5+680	14.90 %	
6+045	6+110	14.00 %	
7+390	7+450	14.90 %	
8+620	8+670	15.00 %	
9+070	9+240	13.36 %	
10+970	11+270	13.00 %	
11+925	11+985	15.00 %	
12+530	12+690	14.14 %	
12+950	13+030	14.60 %	
13+105	13+290	13.08 %	
13+590	13+760	13.40 %	

The existing high grade obtained beyond permissible gradient from survey are considered and reduced to limiting gradient as per NRRS in upgraded design. The gradient has been maintained below 10% wherever possible. In stretches where the grade exceeds 10%, the grade has been maintained below 12% as per NRRS. The chainage vs. altitude is presented in following figure 5.

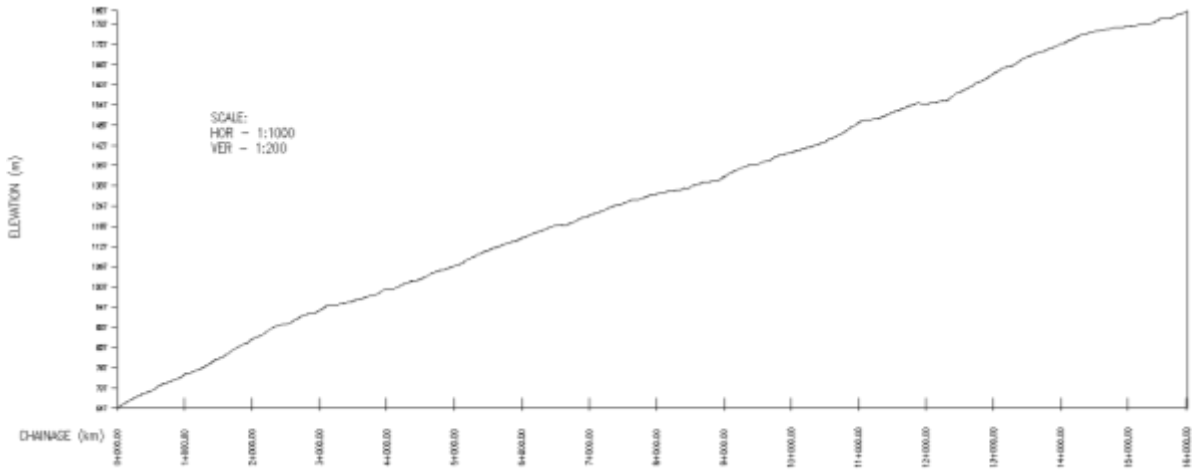

Figure 5: Chainage vs Altitude Graph of Road Alignment

2.10. Land Use Pattern

The land use pattern along the road corridor was recorded during field survey. The land use pattern of along the road alignment is shown in table 7 below:

Table 7: Land use along the road alignment

Chainage		Description
From	To	
0+000	0+100	Settlement Area
0+100	0+350	Barren land and few trees (Lede Khola Crossing)
0+350	2+000	Mixed Forest and Cultivation Area, Settlements Scattered
2+000	2+400	Landslide Area, Vertical Cliff
2+400	3+200	Cultivation Area, Scattered settlement
3+200	7+900	Community Forest Seti devi
7+900	9+000	Settlement Area (Harre village), Cultivation Area
9+000	9+640	Mixed Forest Area and few cultivated lands
9+640	10+920	Mixed Forest and Cultivation area, Scattered Settlements
10+920	11+400	Settlement Area (Chinne Village), Cultivation Area
11+400	11+750	Mixed Forest and Cultivation area
11+750	12+200	Phulasi village, Cultivation area
12+200	13+380	Forest area, Scattered settlements
13+380	15+500	Mixed forest and cultivation area, Few houses
15+500	15+760	Settlement Area (Pokharidada), Phulasipokhari
15+760	16+140	Cultivation Area, Forest area starts

Source: Field Survey, 2016

2.10.1 Passing Bays and Bus Lay Bys

In general, passing bays are located at interval of 300m following the NRRS (2055) 2nd revision December 2014 and bus lay bys location are fixed along nearby major settlements. However, ensuring proper visibility and to minimize the maximum cut/fill due to extra width governed, the location of passing bays are shifted at several locations which do not comply the NRRS. Total numbers of 18 passing bays are proposed at appropriate locations. 2 bus lay bys near settlement areas have been proposed. *(Refer Annex 2 for detail locations of passing places and bus lay bys)*

2.10.2 Cross Drainage and Irrigation Crossing

Depending upon the nature of road profile, type of natural drainage system, pipe culverts, causeways and slab culverts are proposed at different sections of road. 27 numbers of pipe culverts of dia. 0.9m and 34 numbers of pipe culverts of dia. 0.6m have been proposed for cross drainage structures. Total

numbers of 1 slab culvert of 4m span have been proposed in the road alignment. Also, total number of 2 causeways of 14m length has been proposed as required. 15 numbers of 0.45m dia. pipes are recommended for irrigation crossings wherever required during the time of road construction. (*Refer Annex 3 for detail locations of cross drainage structures)*

2.10.3 Retaining Structures

Retaining structures are designed to restrain soil to unnatural slopes and are used to those areas where landscape of the lands needs to be reshaped. Stone masonry walls and gabion walls are proposed based on their appropriateness.

Gabion Masonry Wall

Based on the suitability of the kind of structures, gabion walls are proposed for high cut slopes and terraces, where higher walls are required. Also, the walls are proposed on the areas having poor foundation and seepage condition due to its flexibility for certain differential settlement and some slope movements. Besides, the wall is proposed on the hill sides to restrain against slope movement at landslide zones.

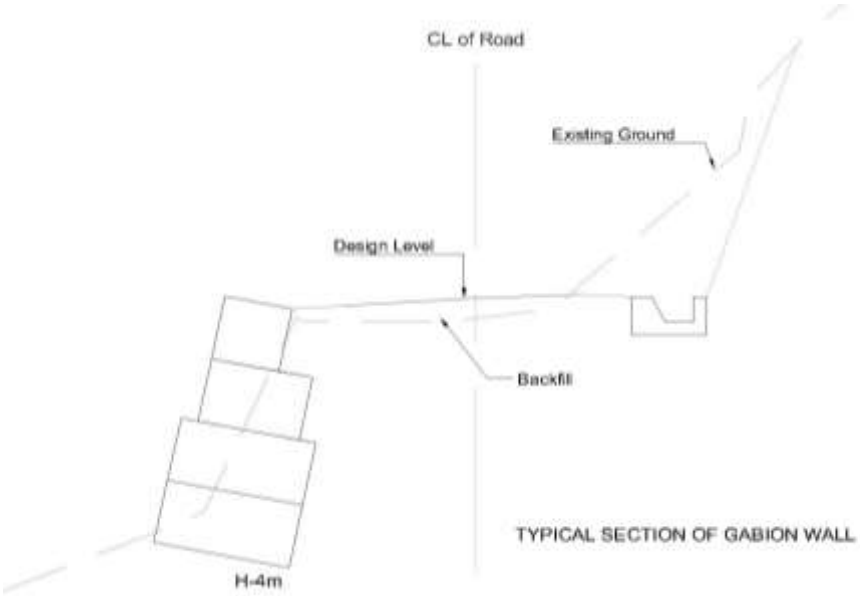

Figure 6: Typical Road Cross Section Showing Gabion Wall

Stone Masonry Wall

Stone Masonry gravity walls are designed on the valley side where the road section becomes narrow due to existing settlement to both sides. Besides, the walls are designed to the locations where rocks exists beneath the foundation as well as the wall is designed where the height of wall do not exceed more than 3m. For the slope and foundation width of the wall, DoLIDAR approach manual, Overseas Road Note 16, DRSP and RAIDP manual is followed.

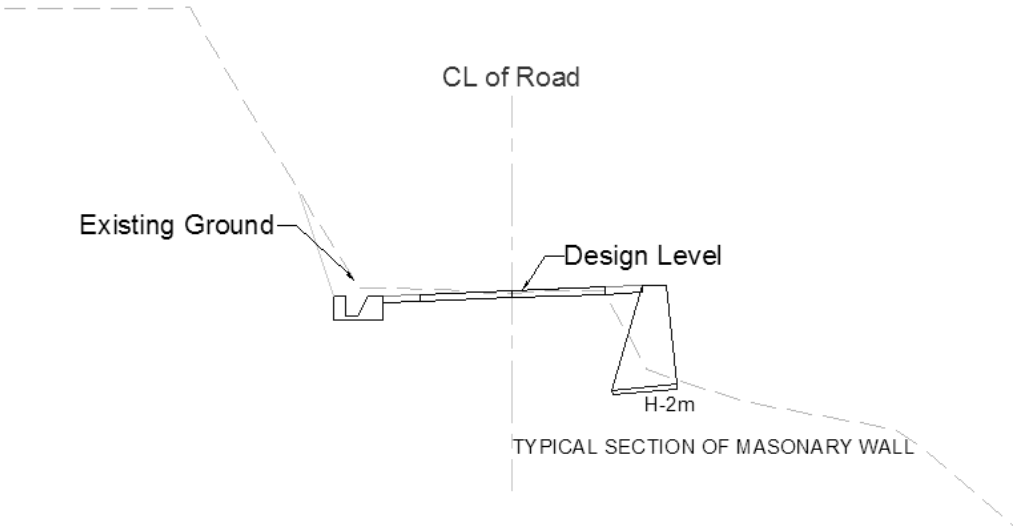

Figure 7: Typical Road Cross Section Showing Stone Masonry Wall

Reinforced Soil Wall with Teramesh System Facing

Construction of conventional type gabion wall especially for more height wall is not suitable due to failure in external stability of retaining wall. This may be due to improper design, poor workmanship, inadequate self weight of wall, use of inferior type of filter material as back fill etc. So, it is necessary to find out suitable type of retaining structure which structurally stable. For this, reinforced soil wall with Teramesh system facing is one of the suitable types of structure.

This reinforced soil wall consists of fixing flexible Geogrids as primary reinforcement for composite soil reinforcement system, made of polyester core with polyethylene coating including secondary reinforcement of Teramesh system (TMS) with zinc and PVC coated including laying of geotextile and drainage gallery filling with boulder.

In the road alignment, the reinforced soil wall with Teramesh system facing has been proposed at Ch: 9+390 to Ch: 9+410 for distance of 20 meters.

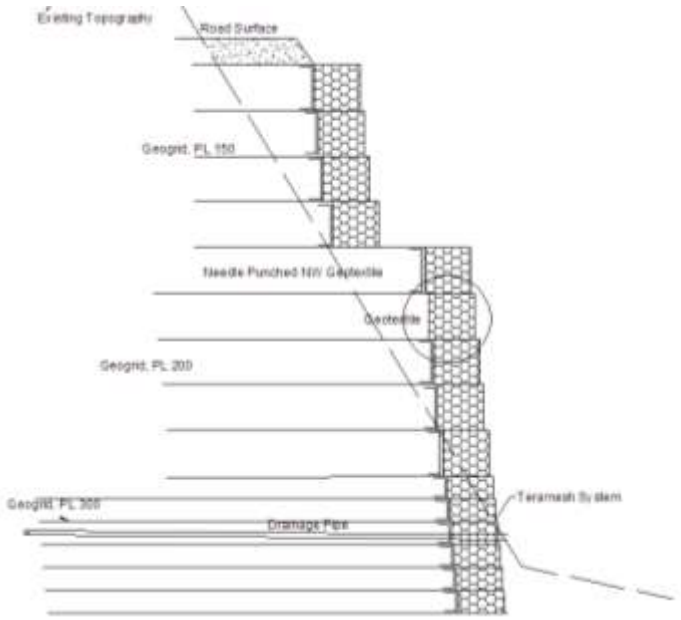

Figure 8: Typical Road Cross Section Showing Reinforced Soil Wall

2.11. Traffic Safety Measures

Traffic safety measures are important component for roads. Traffic safety is important to reduce the chance of accident occurring. For prevention of serious accidents in hill roads, safety barriers are essential. The delineator posts at the loops and steep valley slopes are significant for traffic safety purpose.

2.12. Data Entry and Analysis

After the completion of topographical survey, confirmation was done ensuring the density of points is enough to produce contours at an interval of 1m. For some areas re-survey were done at the same time to increase the density of point to fill some voids. The data recorded in total station were extracted in excel sheet and with the help of SW-DTM inbuilt with Auto CAD, the data were processed. During this time, the redundant data were first eliminated from the list and final contour was drawn.

Likewise, the existing road centerline and road edges were plotted on the contour with the help of SW-DTM. For the design of new alignment, profile and road width, SW-Road was used with necessary changes in alignment on the existing road alignment.

3. ROAD CORRIDOR COMMUNITY PROFILE

3.1. VDCs along Road Corridor

The proposed Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road passes through the Phulasi VDC of Ramechhap District of Central Development Region of Nepal. The road section starts from starts from Sankhebeshi (Zero kilo), Phulasi VDC-1 and ends to Pokharidada, Phulasipokhari of Phulasi VDC-8. The alignment traverses through ward no's 1, 2, 4, 6 and 8. The proposed road passes through various settlements. The major settlement areas are Sankhebeshi at 0+000 km, Aarubote at 0+900 km, Harre village at 8+000 km to 9+000 km, Chinne Village at 11+000 to 11+400 km and Phulasipokhari at 15+500 km. The status of the road of the project along the alignment is earthen existing track. Stone soling is present in some of the high grade loop sections.. The road connects western part of Ramechhap district with the district headquarter in Manthali through Charikot – Manthali road and rest of the country through B.P. Highway via. all - weather connectivity.

Table 8: Demographic Features of Influence VDCs

S N.	Influenced VDC	Total HHs	Total Population
1.	Phulasi	1284	5733
	Total	**1284**	**5733**

Source: Census 2011, Central Bureau of Statistics, Nepal

Table 9: Population Composition of ZOI Survey Households

Name of Road/District	Total HHs	Female Headed HHs	Total Population	Caste Wise Population					
				Brahmin	Chhetri	Thakuri	Dalit	Janajati	Others
Devitar – Phulasipokhari Road Ramechhap	120	50	1000	-	50	-	150	800	-
Ethnic Groups	No of HHs					%			
Brahmin/Chhetri	20					11.8			
Janajati	120					70.6			
Dalit	30					17.6			
Total	170					100			

Source: Social Field Survey, 2016

3.2. Cast Ethnicity

The population of Phulasi VDC is dominated by Chhetri (42%) followed by Tamang (27.1%) and Magar (7%). Other castes include Newar, Kami, Sarki, Ghartibhujel, Sanyasi, Hill-Brahmin, Damai, Sherpa, Rai, etc. The area is a home to diverse ethnic or indigenous communities like Newar, Tamang, Majhi, Sherpa, Gharti/Bhujel and Magar and occupational castes like Damai/Dholi, Kami, Sarki and other indigenous people. In Devitar – Phulasipokhari Road, Categorization of ethnic groups based on household as shown in table above classified into three major ethnic groups: Brahmin/Chhetri, Janajati (Indigenous Community), and Dalit. The survey shows 70 percent of the households belong to Janajati group. Similarly, Brahmin/Chhetri comprised about 11 percent of the households and 17 percent from Dalit.

3.3. Occupation

The people here have major occupation as agriculture. Besides, people are involved in horticulture and livestock farming. Minority of the people here are involved in business and government offices. People here are also involved in labor works for daily income. The social field survey data in the project area shows that 75% of the male population was engaged in paid work including farming, livestock farming, business and other types of employment; 15% of female are involved in these works. 25% of the male population was not able to earn an income from their daily activities. 85% of female are not involved in any income generating activities. This high proportion of women in unpaid

work is an indicator of their hardship in their own house, and also their low involvement in economic activities.

3.4. Education and Health Status

In the project district, about 35% of people are literate population who can both read and write. The population those who can only read is 2.9% and 62% population are not educated. In project alignment, the number of school sited is only one, in Chinne village. Children travel for 2 – 4 hours from far distant places to reach here for education.

Only one health care service was placed along the road alignment at chainage 12+600. There are no any hospitals in the project area. For severe health problems, people here have to travel to Manthali, the district headquarter. However, due to many trainings and programs by different government and non-government organizations involved in health improvements and awareness towards health and sanitation, the health status of people has improved.

4. DESIGN STANDARDS AND PARAMETERS

4.1. Geometric Design Standard

The geometric design standards and parameter are strictly followed from NRRS published by DoLIDAR 2nd Revision December 2014, with the salient features, as outlined in the table below. The design standards adopted for the upgrading of the road are that of fair weather earthen road with low traffic volume. The roads can be upgraded in a compatible manner as the traffic volume increases and availability of resources justify additional inputs.

Table 10: DoLIDAR Standard

S. No	Road Components	Design Standards	Remarks
		Hills	
1.	**Carriageway Width (m)** • Traffic < 100 VPD • Traffic>100VPD<400VPD	3.00 3.75	
2.	**Shoulder Width (m)**	0.75	On both sides
3.	**Roadway Width (m)** • Traffic < 100 VPD (see notes below) • Traffic>100VPD<400VPD	4.50 5.25	Excludes width of drain, parapet & retaining wall top
4.	**Right of Way (m)**	20.00	10m RoW on either side from the road centerline
5.	**Design Speed** • Ruling • Minimum	25 20	
6.	**Stopping Sight Distance (m)**	20.00	
9.	**Radius of Horizontal Curves (m)** • Ruling • Minimum	≥20.00 12.50	
10.	**Hairpin bends**		
	Desirable Spacing (m)	100	100 m spacing is desirable but may be less as per site condition.
	Minimum Radius (m)	12.5	Exceptional Case: 8.5m
	Minimum Roadway width at apex(m)	5.5	For curves with radius <12.5m provide 7.00 width
11.	**Gradient (%)**		
	Ruling	7	
	Limiting	10	
	Exceptional	12	Up to 15% in hill roads for short stretch of 50m in unavoidable situation except in hairpin bends.
	Maximum for Bridge approach	6	
	Minimum in hill roads	0.50	
12.	**Extra Widening (m)**		
	For curve radius ≤ 20m	1.5	
	For curve radius 20 -60 m	0.60	
	For curve radius > 60 m	Nil	

S. No	Road Components	Design Standards	Remarks
		Hills	
13.	**Camber minimum (%)**		
	Earthen Roads	5	Hills: Unidirectional camber sloping either towards hill side or valley side
	Gravel Roads	4	Hills: Unilateral camber in carriageway sloping towards hill side
	Bituminous Roads	3	Hills: Unilateral camber in carriageway sloping towards hill side
14.	**Passing zone/Bus lay Byes**	**Passing zones:** width of carriage way width 5.5m and length about 12 m along outside edge and 30 m along inside ie. Towards the carriageway side and each end tapered gradually towards the carriageway. **Bus Lay Bys**: minimum width additional 3 m (ie. total minimum carriageway width is 6m) and and length about 12 m along outside edge and 30 m along inside ie. Towards the carriageway side and each end tapered gradually towards the carriageway.	
15.	**Traffic Signs and Road Safety**	As detailed in the NRRS 2013	
16.	**Carriageway Width (cross-drainage structures)**		
	Culvert	4.5	Distance between parapet walls
17.	**Road side drains**	**Hill roads:** trapezoidal drain with masonry (1:4) back wall and 10cm thick M-15 grade concrete sloped bed throughout the road length as required **Built up areas:** Drain as specified in DoLIDAR Technical Guideline with adequate cover slabs for crossings.	
Surfacing Options			
1.	**Gravel Surface**	**Hill roads :** 15cm gravel surfacing in carriageway to be extended in the hill side shoulder up to inner edge of the drain. Tapering gravel hard shoulder (15cm to 6cm) in the valley side with slope towards the valley.	

5. ENGINEERING DESIGN

The design parameters adopted for Devitar - Phulasipokhari Road follow DoLIDAR Nepal Rural Road Standard (2055), 2nd Revision December 2014.

5.1. Road Classification

The proposed road has been classified as District Road Core Network (DRCN) and assigned Code No. is 21DR001.

5.2. Design Speed

The design speed has a crucial role in geometric parameters of the roads. The design speed depends on various factors like; super elevation, sight distance, radius and length of horizontal curve, , extra widening of pavement, and the length of vertical curve (summit and valley) etc. According to the design standards followed, the ruling design speed adopted 25km/hr in flat section. However at hairpin bends, horizontal curve and steep sections, the adopted design speed as per NRRS is 20km/hr.

5.3. Right of Way

As per the design standard of DoLIDAR, right of way adopted for Devitar – Phulasipokhari Road, Section of Devitar – Doramba – Paseban - Kolibagar Road is 10 m either side.

5.4. Roadway Width

Roadway width adopted for the proposed road is 5.25m. It includes 3.75 m width Carriageway width and 0.75m of shoulder on either side.

5.5. Extra Widening

It is necessary to widen the carriage way at sharp horizontal curves for the free movement of vehicles. Only mechanical widening has been proposed to compensate the extra width occupied by the vehicle on the sharp curve. For this, the inner part of the curve is proposed for widening as per NRRS as listed below in table 11.

Table 11: Extra widening

SN.	Radius		Extra widening(m)
	From	To	
1	0	20	1.5
2	20	60	0.6
3	60	1000	0

5.6. Sight Distance

Since, the road is located in hill area; stopping sight distance must be secured properly. In this project, a minimum of 20 m is secured for design speed 20 km/hr and 25 m is secured for the flat section having design speed of 25 km/hr.

5.7. Horizontal Curvature

In each intersection, points are provided. As per the DoLIDAR Standards, the minimum radius of horizontal curve is taken as 12.5m.

5.8. Vertical Curvature

Spiral vertical curve is provided for vertical intersection points.

5.9. Longitudinal Section

A general minimum gradient of 0.5% was adopted in very flat conditions. Maximum grade of 12% permissible as per the DoLIDAR Standard was adopted. The gradient at loop should be up to 4% but due to geography of the alignment at loops, this gradient of 4% is difficult to maintain. However, the grade permissible by the design guidelines is maintained.

5.10. Pavement Surface

Gravel pavement surface is proposed for the alignment having grade less than 8%. Cobble pavement is proposed in the alignment where grade exceeds 8%. In this project, out of total length of 16.14 km, the length that require cobble pavement is 5.57 km. However, this length may vary during construction period since for short lengths of either gravel or cobble pavement, the continuity of the preceding pavement is preferred.

5.11. Cross Section

The cross section at every 10m chainage point was considered to obtain the existing ground condition. The cross section design was carried out taking plan and profile under consideration.

5.12. Passing Bays and Bus Lay Bys

For passing bays, width of carriage way width is 5.5m and length about 12 m along outside edge and 30 m along inside ie. towards the carriageway side and each end tapered gradually towards the carriageway. For bus lay bys, minimum width is additional 3 m (ie. total minimum carriageway width is 6m) and length about 12 m along outside edge and 30 m along inside ie. towards the carriageway side and each end tapered gradually towards the carriageway. The passing bay and bus lay bys has been proposed in such a way that no additional retaining structure is required. *(Refer Annex 2 for detail locations of passing places and bus lay bys).*

5.13. Water Management Measures

An utmost consideration is given to water management during design and their estimate. Depending upon the nature of existing natural channel and road profile, appropriate cross drainage types are proposed for water management. For this, Pipe culverts, Slab Culverts, Causeways and irrigation crossings are proposed in along the road as per need.

For surface water management, side drainage towards hill side with varying sizes are proposed along the whole road stretches and the hill side camber principle is adopted for proper management of surface water. The minimum size of cross drainage adopted pipes of 600 mm except for irrigation channel. For crossing of irrigation channel, the minimum diameter of pipes proposed is 450mm. *(Refer Annex 3 for detail locations of Cross Drainage Structures)*

5.14. Side Drains

Side drains are required to prevent structural damage to the road. The water collected from surface runoff is required to be collected and drain off from nearby rivulet, culverts or cross drainage to protect the exiting road structures. For this, different kinds of side drains could be used as appropriate.

In this project, stone masonry trapezoidal type side drainage is proposed along the whole stretches towards hill side since the road is designed with only one camber slope towards hill side. In gully areas, with drain at both sides, trapezoidal drain is proposed at hill side where as modified tick type drain have been proposed in valley side. The total width of drainage proposed is 1m in width and depth 0.5m. In some stretches, the depth of drainage varies as per site requirements. Also, covered type side drainage is proposed in settlement/ market area for total stretch of 300m. The size of the cover is proposed as 1.0X0.50X0.15m. Further, cascade type side drainage is proposed along the road stretches having its gradient greater than 5%. The typical drawing for side drains is included in Volume 3 drawings.

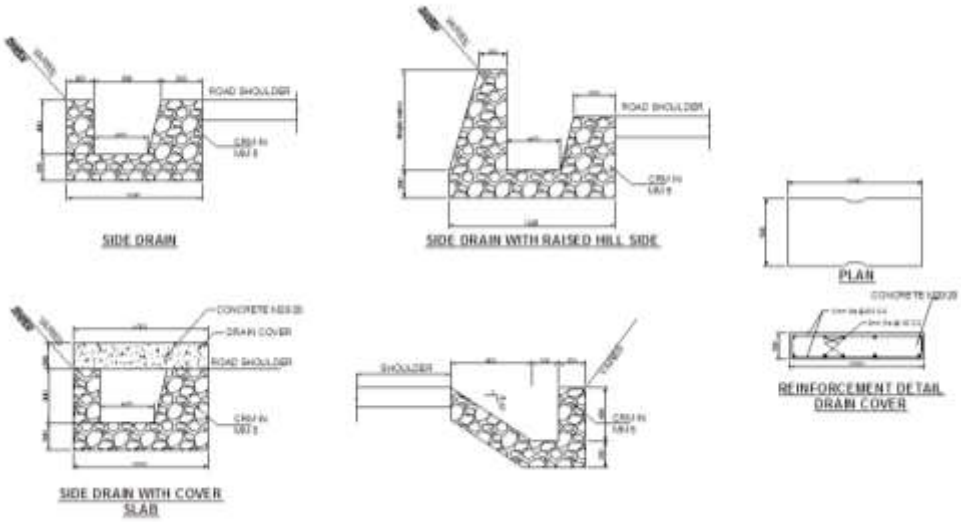

Figure 9: Typical Drain Proposed

5.15. Dynamic Cone Penetration Test and Pavement Design

The existing road is planned to be rehabilitated and reconstructed with gravel surface. For determining the thickness of the gravel base and sub-base the strength of sub-grade has to be determined. There are number of tests which can be used to measure strength properties of sub grade soil. All these test are empirical and are useful in their correlation in design. For the evaluation of sub grade strength, Dynamic Cone Penetration Test was conducted.

It was originally developed as an alternative for evaluating the properties of flexible pavement or sub grade soils. The conventional approach to evaluate strength and stiffness properties of asphalt and sub grade soil involves a core sampling procedure and a complicated laboratory testing such as resilient modulus, Marshall Tests and others. Due to its economy and simplicity, better understanding and reduce cost and effort DCPT is widely carried out. DCPT consists of upper and lower shafts. Upper shaft has a 8 kg drop hammer with a 575 mm drop height and is attached to the lower shaft through anvil. Lower shaft contains an anvil and a cone attached at the end of the shaft. The cone is replaceable and has a 600 cone angle. A reading device, an additional rod is used as an attachment to the lower shaft with marks at every 5.1mm.

The basic principle involved in the operation of this apparatus is the measuring of the resistance offered by the pavement layers to the penetration of a standard cone driven by the hammer freely falling through a height. The amount of penetration (in mm) of the cone is generally reported in terms of the average penetration per blow, DCPI (mm/blow). The greater the value of DCPI indicates softer sub grade soil and vice versa.

The dynamic cone penetration test in the alignment was conducted at interval of 500m. In the road alignment, the properties of sub grade soil differ in different chainages. The DCP test is generally carried out at the interval of 250m. In relatively uniform areas, testing at interval of 500m is acceptable. During the field visit, it was observed that at the average interval of 500m the properties of sub grade is uniform and does not differ very much.

There are various methods of calculation of CBR value from penetration index. In this design, Overseas Road Note 8 was followed to calculate the CBR value. According to Overseas Road Note 8,

$$log_{10}(CBR) = 2.48 - 1.057\ log_{10}\left(\frac{mm}{blow}\right)$$

Pavement performance depends greatly upon the quality and uniformity of materials incorporated into the pavement structure. Careful monitoring of material quality and the dimensions of pavement layers during construction improves overall compliance with specifications as well as in-service performance of the pavement.

In this project for pavement design, Overseas Road Note 8 is used for calculation of CBR value. After calculation of CBR value by Overseas Road Note 8, it is classified in six classes according to Road Note 31. The required thickness of gravel is calculated based on classes. The details of the pavement design calculations are attached in Annex 4. For the design, considering the results of DCP test and judging economic in gravel road, the uniform thickness of sub base 175 mm has been adopted. Capping layer of 100 mm has been provided over sub base in sections where sub base thickness required is higher than 175 mm from result of DCP test and pavement design. Further on, the road having gradient higher than 8% will not be suitable for gravel pavement only, because it has been observed from the past experiences, that there is high possibility to rutting of road surface due to rain water as well as tractive force of vehicles plying along the road. To minimize the problem in the project road, cobble pavement has been proposed for the high gradient above gradient 8% in 5.57 km stretch out of total 16.14 km.

6. ENGINEERING DESIGN AND DRAWINGS

The engineering design is prepared based on Nepal Rural Road Standards published by DoLIDAR. Despite this at some locations, the design differed with the guidelines set by DoLIDAR due to the nature of topography, settlement and local issues.

The engineering drawings are prepared with the use of AutoCAD as drafting tools. In drawings, plan profile and cross-sections are published and presented for the whole length of road. However, for the road structures like; passing bys, retaining walls, cross drainage, side drains, traffic safety, etc. only typical standard drawings with necessary detailing are shown in drawings. For scaling of the drawing, given ToR and standard practices are followed. All required drawings are placed in "Volume3: Design Drawing". Some typical sample of plan, profile and sections are placed below

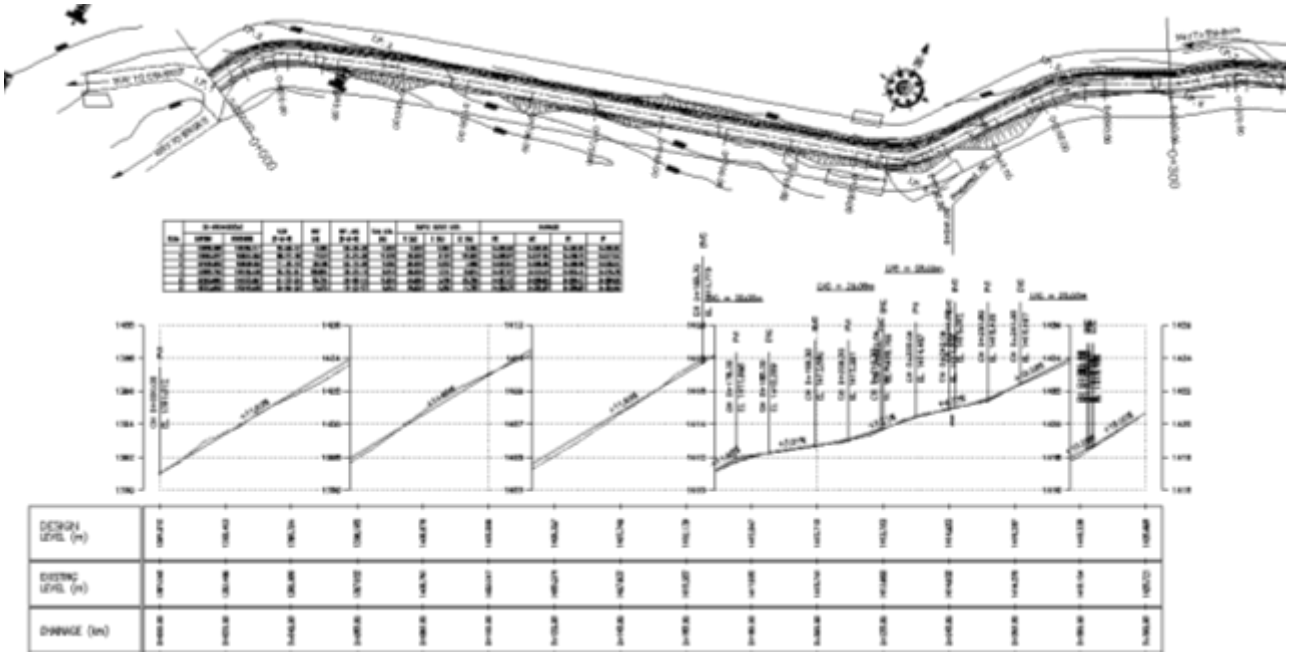

Figure 10: Plan and Profile Sheet Sample

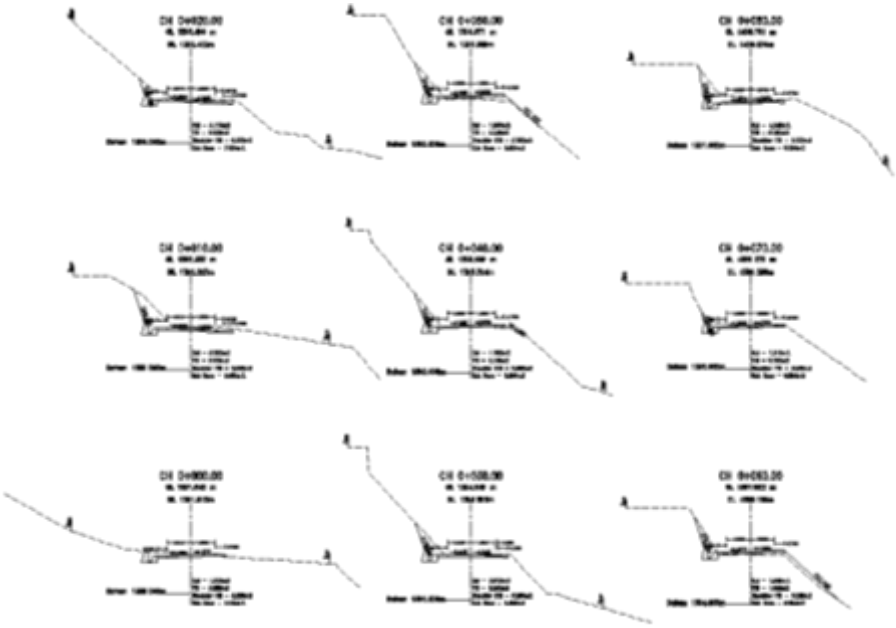

Figure 11: Cross Section Sheet Sample

7. ENGINEERING ESTIMATES

7.1. The Project Cost Estimate

The cost of the project has been worked out based on the quantity estimate derived from engineering design and unit rates of each work items. The cost estimate makes provisions for general items e.g. cost of insurance, provision of site offices, cost of lab tests etc and they are based on rates for similar items in similar projects. A nominal provision for day works has also been made in cost estimate. The detailed cost estimate has been provided in Volume 2 Cost Estimate of the technical report.

The cost of civil works has been estimated to be Rs. 235,026,994.25. The total cost for rehabilitation and reconstruction to gravel standard including contingencies consisting of small miscellaneous expenses, work charge staff and VAT as per GON rules is calculated to be Rs. 300,105,968.96. The per km cost excluding contingencies is Rs. 16,454,394.16. It is envisaged that the construction works can be completed within 18 months from award of contract and estimates are based on it. Provision of physical contingency 10% has been indicated in the cost estimate.

The abstract of costs is presented as Annex 5 of this report. The summary cost estimate is presented in table 12 below.

Table 12: Summary Cost Estimate

S. No.	Description	NRs.
1.	Civil Works	235,026,994.25
1.1	General Works	6,704,000.00
1.2	Site clearance, Earthworks	35,072,092.60
1.3	Structures- Stone Masonry	72,377,166.72
1.4	Structures- Gabion and Reinforced Soil Wall	49,608,475.93
1.5	Drains, Cross drainage structures	20,010,430.13
1.6	Pavement	44,454,179.17
1.7	Road furniture, Traffic Signs	2,647,994.83
1.8	Bio engineering	3,583,154.82
1.9	Day works	569,500.00
2.	13% VAT (of 1)	30,553,509.25
3.	Sub-Total (1+2)	265,580,503.50
4.	Per km Cost (Including Base Cost and VAT)	16,454,394.16
5.	Work Charge Staff and Small Miscellaneous Expenses @ 3% (of 1)	7,050,809.83
6.	Physical contingency @ 10% (of 1)	23,502,699.43
7.	Grand Total (3+5+6)	296,134,012.76

7.2. Quantity Estimate

For estimating the cost of the project, detailed quantity estimation had been done for each item of works to be included in the project activities. The detail quantity estimates have been provided in Volume 2 cost estimate and the summary sheet of quantity estimation. *(Refer Annex 6 for summary of quantities)*

7.3. Analysis of Rates

For estimating the cost of each item of works, prevailing norms of DoLIDAR and DOR for rate analysis has been used throughout. Rate analysis of each of the items has been carried out according to the approved norms of DoLIDAR and approved district rates of Ramechhap District and as

mentioned there in the. Kathmandu District rates for materials (cement, Steel, Hume Pipe etc.) for the Fiscal Year 2072/2073 with transportation have been followed.

For rate of earthwork quantities, rate for earthwork excavation by machine and manually for roadway and drain and for foundation of structure is adopted 95% and 5% as carried out by DOR. The detailed analysis of rate and the approved district rates are provided in Volume 2, The Cost Estimate.
.

8. ENVIRONMENT PROTECTION MEASURES

The road alignment passes along a hilly terrain which contains slides at different chainages. The chainages which require proper bio-engineering works and landslide rehabilitation are included in Table 13.

Table 13: Proposed Chainages for Bioengineering Works and Area

Landslide Chainages (km)		Approximate Area in m^2
From	To	
2+000	2+100	5000
3+640	3+700	900
11+250	11+280	450
12+800	12+860	1200
As required during construction works	200	
Total	**7750**	

During field visit, it was observed that the nature of slide at chainage 2+000 to 2+100 area is large and sensitive. The location requires special consideration during construction period. Gabion walls and toe walls have been proposed in the design as noted essential during the site visit Bioengineering is mandatory in this location. Also, bioengineering works has been proposed in other locations where landslides have occurred though small in scale. In many locations, where erosion has been witnessed, gabion breast walls have been proposed.

Suitable materials obtained from excavation will be used for embankment filling, and backfilling of structures. Despite this, the surplus excavated materials obtained will be disposed at construction site as required. Wherever possible, the surplus spoil will be used to fill eroded gullies, quarries and depressed areas. Dry stone toe walls are required in some locations for disposal of spoils. The main sites recommended for spoil disposal are listed in table 14 below:

Table 14: Recommended Spoil Disposal Sites

Chainages	Recommended Spoil Disposal Sites
2+000	Kholsi, Cliff Area in valley side of the road
3+600	Kholsi, Toe wall recommended in valley side downwards
6+080	At valley side, spoils can be disposed
12+380	Kholsi Area

Source: Field Survey, 2016

9. CONCLUSION AND RECOMMENDATIONS

The Devitar – Phulasipokhari Section of Devitar – Doramba – Paseban - Kolibagar Road is presently earthen track and its rehabilitation and reconstruction to gravel standard will provide better access to the people of settlements along road corridor and it will help in getting the better benefit of the road which results in better living standard of the local people.

This road is the connectivity to numerous VDC's of the district like Dadhuwa, Pinkhuri, Doramba, etc. The alignment from Pokharidada to Doramba has been looked after by LRIP project, so the road improvement up to Pokharidada was major priority of the district. This road alignment provides easy access to people from different VDC's of western region of Ramechhap district to the district headquarter, Manthali. All the settlements along the proposed road alignment and its neighborhood have immense potential of vegetable, fruit and other cash crops production. People can increase the production of cereal crops and cash crops so that it can be exported. This will increase the cash flow in the area.

While considering the improvement of the road to gravel standard, provisions have been made for adequate cross drainage as well as side drains. However for the preservation of gravel surface it is important that surface water does not flow through the road surface. As such it is recommended that during rainy season in construction phase the adequacy of side drains and cross drainage shall be observed and modification as required shall be made to preserve the road asset.

Annex 1: Bench mark List and Description Cards

S. No.	Easting	Northing	RL	Remarks
1	411253.000	3042192.000	650.000	BM1
2	411258.471	3042202.941	648.513	BM2
3	411199.414	3042153.068	658.677	BM3
4	410779.209	3041574.404	856.611	BM5
5	410670.616	3041775.369	935.397	BM6
6	410213.906	3041700.882	970.982	BM7
7	410222.269	3041710.104	974.254	BM8
8	410190.179	3041507.072	1051.717	BM9
9	410210.306	3041540.060	1054.214	BM10
10	410328.146	3040994.842	1192.044	BM11
11	410331.529	3040963.852	1190.946	BM12
12	410426.597	3040680.161	1266.026	BM13
13	410403.261	3040726.491	1266.958	BM14
14	410239.169	3040780.986	1274.724	BM15TAP
15	409289.658	3040628.778	1344.690	BM16
16	409252.893	3040569.814	1350.271	BM17
17	408356.130	3040255.449	1468.734	BM19
18	408320.312	3040222.860	1476.992	BM20
19	407674.732	3040166.755	1552.572	BM21
20	407608.377	3040183.854	1554.376	BM22
21	407309.129	3040433.189	1611.734	BM24
22	406127.559	3040769.292	1762.122	BM25
23	405697.081	3040818.525	1778.391	BM26
24	405439.165	3040741.100	1793.241	BM27
25	404951.057	3040655.872	1824.733	BM29
26	405202.447	3040676.736	1806.297	BM28

Annex 2: Passing Bays and Bus Lay Bys

SN	Chainage	Length (m)	Width		Transition Length (m)
			Left(m)	Right (m)	
1	0+380	12	1.75	0	9
2	0+848	12	0	1.75	9
3	1+771	12	0	1.75	9
4	2+472	12	1.75	0	9
5	3+005	12	0	1.75	9
6	4+180	12	0	1.75	9
7	4+915	12	1.75	0	9
8	5+705	12	0	1.75	9
9	6+575	12	0	1.75	9
10	7+300	12	0	1.75	9
11	9+785	12	0	1.75	9
12	10+155	12	1.75	0	9
13	10+780	12	1.75	0	9
14	11+045	12	1.75	0	9
15	11+450	12	1.75	0	9
16	11+710	12	0	1.75	9
17	12+175	12	3	0	9
18	13+960	12	1.75	0	9
19	15+055	12	1.75	0	9
20	15+535	12	3	0	9

Annex 3: Cross Drainage Structures

Proposed Pipe Culverts

SN	Chainage	Length (m)	Diameter (m)
1	0+518	7.5	0.6
2	0+961	7.5	0.6
3	1+221	7.5	0.9
4	1+434	7.5	0.9
5	1+692	7.5	0.9
6	1+949	7.5	0.9
7	2+089	7.5	0.9
8	2+321	7.5	0.9
9	2+745	7.5	0.9
10	3+862	7.5	0.6
11	4+158	7.5	0.9
12	4+478	7.5	0.6
13	4+771	7.5	0.6
14	5+141	7.5	0.6
15	5+352	7.5	0.6
16	5+635	7.5	0.6
17	5+899	7.5	0.6
18	5+978	7.5	0.9
19	6+178	7.5	0.9
20	6+425	7.5	0.9
21	6+541	7.5	0.6
22	6+671	7.5	0.6
23	7+202	7.5	0.9
24	7+411	7.5	0.6
25	7+595	7.5	0.9
26	7+672	7.5	0.9
27	7+981	7.5	0.9
28	8+132	7.5	0.9
29	8+266	7.5	0.9
30	8+446	7.5	0.9
31	8+618	7.5	0.6
32	9+082	7.5	0.9
33	9+141	7.5	0.9
34	9+175	7.5	0.9
35	9+351	7.5	0.6
36	9+481	7.5	0.6
37	9+891	7.5	0.6
38	10+011	7.5	0.6
39	10+732	7.5	0.6
40	10+979	7.5	0.6
41	11+061	7.5	0.6
42	11+303	7.5	0.6
43	11+572	7.5	0.6
44	11+721	7.5	0.6
45	11+838	7.5	0.6
46	11+951	7.5	0.6
47	12+198	7.5	0.6
48	12+375	7.5	0.9
49	12+564	7.5	0.9

SN	Chainage	Length (m)	Diameter (m)
50	12+789	7.5	0.6
51	13+039	7.5	0.6
52	13+259	7.5	0.6
53	13+852	7.5	0.6
54	14+042	7.5	0.9
55	14+249	7.5	0.6
56	14+326	7.5	0.9
57	14+431	7.5	0.6
58	14+698	7.5	0.9
59	15+171	7.5	0.6
60	15+608	7.5	0.6
61	15+881	7.5	0.9

Proposed Causeways

SN	Chainage	Length (m)
1	0+153	14
2	0+287	14

Proposed Slab Culverts

SN	Chainage	Length (m)
1	3+663	4

Annex 4: Dynamic Cone Penetration Test and Pavement Design

Data

i. Single lane carriageway

ii. Number of commercial vehicles as per last count(P)= 15 veh/day (including both direction)

iii. Number of years between the last count and the year of completion of construction= 2 years

iv. Traffic growth rate per annum(r) = 7.5 (according to Guidelines- IRC-37-2001, in the absence of adequate data, it is recommended that an average annual growth rate of 7.5 percent may be adopted.)

v. Design life(n) = 10 years

vi. Vehicle damage factor (F) = 0.5 (according to Guidelines- IRC-37-2001, in the absence of adequate information on axle load, VDF may be adopted from the following table.)

Indicative VDF Values		
Initial traffic volume in terms of Number of commercial vehicles per day	Terrain	
	Rolling/Plain	Hilly
0-150	1.5	0.5
150-1500	3.5	1.5
More than 1500	4.5	2.5

vii. Lane Distribution factor(D) = 1 i.e 100% of total traffic in both direction, (according to Guidelines- IRC-37-2001, for single lane road the design should be based on total number of commercial vehicles in both directions).

Traffic forecasting

Initial traffic in the year of completion of construction (A)

$A = P (1+r)^n$

$=15(1+0.075)2$

=17.334 commercial vehicles per day

Cumulative number of standard axles (sa) to be carried for in the design (N)

$$N = \frac{365x ((1+r)^n-1) \times A \times D \times F}{r}$$

$$= \frac{365x((1+0.075)10-1)x17.334x1x0.5}{0.075}$$

= 44753.67 sa

=0.44753 msa

However with the upgrading of roads the additional traffic may be attracted or diverted through this road. The diverted traffic for the road is assumed 50%. This makes the design traffic value as 1.5*0.44753 = 0.671 msa.

Hence as per Overseas Road Note 31, this traffic falls into Class T2 (0.3 msa to 0.7 msa).

Therefore, referring to ORN 31, the pavement thicknesses for granular road-base materials is calculated with this traffic class T2 and sub grade strength classes based on the range of CBR values.

Summary of Pavement Thickness

Chainage		Adopted Sub Base Thickness (mm)	Capping Layer (mm)	Remarks
From	To			
0+000	7+000	175	-	
7+000	7+500	175	100	
7+500	8+000	175	-	
8+500	9+500	175	100	
9+500	10+500	175	-	
10+500	12+500	175	100	
12+500	14+000	175	-	
14+000	14+500	175	100	
14+500	16+000	175	-	
16+000	16+140	175	100	

Annex 5: Abstract of Cost

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
1	**General**				
1.1	Insurance of works, plants, materials, loss and damage to equipments, Contractor's workmen and employees and third party insurance against damage to other persons and property as per GCC clause 13.	L.S.	1.00	1,200,000.00	1,200,000.00
1.2	Provide site office at places having rooms size: 3m*4m each at location acceptable to the project manager within the contract package with accommodation facilities as specified in special provision	month	18.00	15,000.00	270,000.00
1.3	Carry out additional tests for material and works as required and instructed by the Engineer.(GCC Clause No. 33.1)	PS	1.00	200,000.00	200,000.00
1.4	Relocation of the utilities (water supply, telephone, etc,) and services as instructed by the Engineer as per DoLIDAR-Technical Specifications for Labour Based Construction Work of Agricultural & Rural Roads (Tech. Spec. for LBCWARR Clause No. G-10.	PS	1.00	400,000.00	400,000.00
1.5	Carry out maintenance of the existing road to keep the road serviceable throughout the contract period. Also provide and maintain traffic safety, control measures and temporary diversions during construction including water spraying thrice a week to avoid dust pollution as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. G-12.	month	18.00	38,000.00	684,000.00
1.6	Supply and provide rental Four Wheel Drive Double cap Pickup Vehicle with full option including fuel, driver' wages, major & minor maintenances etc for the Engineer for supervision works as specified	month	18.00	150,000.00	2,700,000.00
1.7	Provide and installation of project information board of size 1.80 mx1.2 m along with iron posts including excavation, concreting, backfilling etc all complete as per DoR Standard Specification for Road and Bridge Works (SSRBW) July 2001,Section-108	No.	3.00	10,000.00	30,000.00
1.8	Provision and maintenance of labour camps payable monthly in equal installments as per DoR Standard Specification for Road and Bridge Works (SSRBW) July 2001,Section-109 (3)	month	18.00	20,000.00	360,000.00

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
1.9	Establish, maintain and operate laboratory at the site with equipments furnishing required for testing specified quality of the materials as per DoR-SSRBW, Section-511	month	18.00	20,000.00	360,000.00
1.10	Environmental Mitigation Works as per EMP and as Instructed by the Engineer(DOR Section 109)	P.S.	1.00	300,000.00	300,000.00
1.11	Social Compliance and safeguards as per Resettlement Action Plan and GESI and as instructed by the Engineer(DOR Section 109)	P.S.	1.00	200,000.00	200,000.00
	Sub-Total				**6,704,000.00**
2	**Site Clearance**				
2.1	Site Clearance : Clearing and Grubbing including cutting of all types of plants as per DoLIDAR-Technical Specifications for Labour Based Construction of Agricultural and Rural Roads (Tech. Spec. for LBCWARR) Clause No.: 1-1.5(a), 1-1.5(b) & 1-1.6	m^2	48,421.20	25.35	1,227,477.42
	Sub-Total				**1,227,477.42**
3	**Earthworks**				
3.1	Excavation in roadway and drain in all types of soil and rock materials including removal and satisfactory disposal of all materials at approved environmentally safe tipping area as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 2-1	m^3	257,382.93	97.25	25,030,489.94
3.2	Excavation in foundation in structure in all types of soil materials including removal and satisfactory disposal of all materials at approved environmentally safe tipping area as per DoLIdar-Tech. Spec, for LBCWARR Clause No. 2-5	m^3	6,698.98	121.73	815,466.83
3.3	Construction of embankments, shoulders and other miscellaneous filling and backfilling in structure with approved materials as per design and drawing as per DoLIDAR-Tech. Spec. for LBCWARR Clause No.2-5	m^3	17,091.15	100.83	1,723,300.65
3.4	Transportation of material beyond the initial lead within 1 km distance with safe disposal sites as instructed by the engineer.	m^4	120,171.54	52.22	6,275,357.81
	Sub-Total				**33,844,615.23**
4	**Structural/ Side Drain/Cross Drainage Works**				
	Stone Masonry				

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
4.1	Supply & place un-coursed random rubble stone masonry works in MM 5 cement sand mortar in the line & level all complete stone masonry work including full compensation for all labour, materials and other incidentals required to complete the work as per the specifications and drawings. It includes full compensation for using specially dressed stones on the face of wall with batter and provisions for weep hole as necessary as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 8	m^3	11,305.47	6,401.96	72,377,166.72
	Sub-Total				**72,377,166.72**
	Gabion Works				
4.2	Supply machine made fabrication of gabion boxes of different sizes with hexagonal mesh size of 100 mm x 120 mm including rolling, cutting and weaving (mesh wire 3.0 mm, selvedge wire 3.9 mm, binding wire 2.4 mm, all heavy zinc coated wires),assembling, placing in position, packing and filling of gabion create with rubble stone and tying by 2.4 mm binding wires all complete as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 17-1.4, 17-5 & 17-6	m^3	10,159.42	4,079.46	41,444,947.51
4.3	Supplying and providing of Reinforced Soil wall Structure with Teramesh System (TMS) Facing: fixing Flexible Geogrids (eg. Paralink) as primary reinforcement for composite soil reinforcement system, made of polyester core with polyethylene coating including secondary reinforcement of Terramesh system (TMS) as per specification Clause 2402 with Zinc +PVC coated including laying of Geo textile, drainage gallery filling with boulder all complete as per Specification	m^2	240.00	29,141.60	6,993,984.00
4.4	Provide and place Geo-textile all complete as per drawing and specifications as per (DOR-SSRBW Section No.: 2404)	m^2	7,074.00	165.33	1,169,544.42
	Sub-Total				**49,608,475.93**
4.5	Supply & place P.C.C. works M 10/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	m^3	382.31	9,291.82	3,552,355.70
4.6	Supply & place P.C.C. works M 15/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	m^3	5.25	11,756.98	61,724.14
4.7	Supply & place P.C.C. works M 20/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	m^3	45.00	14,432.22	649,449.90
4.8	Supply & place P.C.C. works M 25/20 as	m^3	57.69	18,194.94	1,049,666.08

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
	per DOR-SSRBW,July 2001,Section 2000				
4.9	Supply and place formwork for concrete works with all complete as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 9	m^2	279.11	706.45	197,177.25
4.10	Supply & place TMT high tensile strength steel reinforcement of specified grade (Fe 500) for RCC works including bending, centring & binding in position as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 10	Ton	9.32	108,030.19	1,006,841.37
4.11	Supply, Laying, fitting and fixing of hume pipe class NP3. It includes all operations required to complete the work and the jointing of pipes with 1:2 cement sand mortar as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 15-5 and 15-6				
4.11.1	450mm (for irrigation purpose)	rm	112.50	6,758.54	760,335.75
4.11.2	600mm	rm	255.00	7,743.86	1,974,684.30
4.11.3	900mm	rm	202.50	14,336.75	2,903,191.87
4.12	Supply & place100 mm Dia. HDPE Pipe ($6kg/cm^2$) for weep hole as per Nepal Standard & directed by Engineer	rm	406.00	545.74	221,570.44
4.13	Supply & place Heavy Duty Steel pipe (Dia 50 mm) for railing as per Nepal Standard & directed by the Engineer	rm	29.60	323.98	9,589.80
4.14	Backfilling works with approved soil materials with compaction as per DoLIDAR-Tech. Spec. for LBCWARR Clause No-2.5.4	m^3	6,159.77	1,063.21	6,549,129.06
4.15	Supply and Place graded filter in backfilling in structures and cross drainage works as per (DOR-SSRBW Section No.: 2404,3110)	m^3	487.91	2,202.69	1,074,714.47
	Sub-Total				**20,010,430.13**
5	**Pavement Works**				
5.1	Preparation of sub grade for rehabilitation works as per DoR-SSRBW (Standard Specification for Road & Bridge Works, 2001) SECTION No. 1003	m^2	93,924.82	17.32	1,626,777.88
5.2	Providing, laying, spreading, watering, leveling and compaction of natural sand gravel sub base grading as specified and according to the designed camber all complete as per DoR-SSRBW SECTION No. 1201	m^3	12,265.59	2,185.27	26,803,625.85
5.3	Providing, laying, spreading, watering, leveling and compaction of capping layer of approved materials according to the designed camber all complete asper DoR-SSRBW, Section 1004	m^3	1,506.59	1,844.19	2,778,438.21

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
5.4	Supplying and preparing 20 cm thick stone pitching work on the prepared granular bedding with stone available at site	m^3	446.80	2,556.63	1,142,302.28
5.5	Providing, laying, spreading, watering, leveling and compaction of 12 cm thick natural sand gravel sub base grading for cobble pavement as specified and according to the designed camber all complete as per DoR-SSRBW SECTION No. 1201	m^3	2,860.29	2,185.27	6,250,505.92
5.6	Supplying and preparation of 5 cm thick granular material and sand with mixing red soil and spreading in layer, watering, compacting and all complete.	m^2	23,835.72	70.45	1,679,226.47
5.7	Breaking and supplying of rock for cobble manually and chisel dressing it in the 8 cm sizes with all complete	m^3	1,728.14	1,317.76	2,277,273.76
5.8	Supplying and construction of 8 cm thick coble pavement (Braked Coble) on the prepared granular material bedding with spreading the spall/ Granular material and compacting with Steel Roller with all complete	m^3	1,728.14	1,097.15	1,896,028.80
	Sub-Total				**44,454,179.17**
6	**Road Furniture/Traffic Sign Boards**				
6.1	Supplying and placing standard RCC kilometer post (place at each km) all complete including painting, and writing etc. all complete as per specification and drawings (DOR-SSRBW SECTION No. 1501)	Nos.	12.00	2,860.97	34,331.64
6.2	Supplying and placing standard RCC kilometer post (place at 5km interval) all complete including painting, and writing etc. all complete as per specification and drawings (DOR-SSRBW SECTION No. 1501)	Nos.	4.00	6,431.25	25,725.00
6.3	Supplying and fixing in place R.C.C. delineator and guard post including excavation, painting, and erection etc. all complete as final drawing (DOR-SSRBW SECTION No. 1504)	Nos.	1,760.00	1,259.83	2,217,300.80
6.4	Supplying and erecting traffic sign in place including 50 mm dia steel tube, 2mm thick steel plate, cement concrete, painting, writing and supporting steel angle nut and bolt etc complete as per DoR-SSRBW SECTION No. 1501)				
6.4.1	60 cm dia circular, 60 cm equilateral triangle and 60 x 45 cm rectangular shaped sign (Single post)	Nos.	100.00	1,665.93	166,593.00

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
6.4.2	1.2m x 0.75 m size bigger traffic sign with back support and two or more post	Nos.	61.00	3,344.99	204,044.39
	Sub-Total				**2,647,994.83**
7	**Bio-engineering Work**				
7.1	Slope trimming work DoLIDAR : 4 Spec. Clause No.: 2-1.3.2,2-1.8 and 2-1.95	m^2	7,750.00	73.83	572,182.50
7.2	Construction of Rip-rap drain with the stone pitching work of 20 cm thick and 1.2 m wide as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 8	rm	500.00	520.29	260,145.00
7.3	Dry stone check/toe walls for segmentation and support of slopes DoLIDAR Tech. Spec. clause No. 8	m^3	291.20	2,746.19	799,690.52
7.4	Brush layering work: including preparation of terraces of 30 - 40 cm wide and laying live cuttings of selected Species along the terrace @ 5 cm c/c with 2/3 of cuttings in to terrace and leaving one bud and up to 1/3 of the cuttings sticking beyond the terrace edge (Cutting can be of assuro,simali etc of 45 - 60 m length) DoLIDAR Spec. Clause no.70-6.7 b	rm	1,200.00	117.57	141,084.00
7.5	Planting rooted grass slips on slopes < 45° including preparation of slips on site. Operation includes digging planting holes to a maximum of 5 cm depth with metal or hardwood peg, depending on nature of soil. The planting drills should be spaced 10 cm apart as per Bio engineering information of DOR	m^2	7,750.00	231.10	1,791,025.00
7.6	Planting containerized tree and shrub seedlings, including pitting, transplanting, composting and placing tree guards, on toe of embankment slopes in plain areas, not less than 8 m from the road centre line. Pit size 30 cm diameter×30 cm depth. Compost volume ¼ of the volume of pit, mixed with original soil as per Bio engineering information of DOR	Nos.	310.00	61.38	19,027.80
	Sub-Total				**3,583,154.82**
8	**Day works**				
8.1	Supply of labour as required as per preamble and as instructed by the Engineer.				
8.1.1	Skilled labour	day	150	670.00	100,500.00
8.1.2	Unskilled labour	day	400	535.00	214,000.00
8.2	Supply of excavator for maintenance of road as required and instructed by engineer	hr	180	1,000.00	180,000.00
8.3	Provide Built up Drawing as completed	L.S.	1.00	75,000.00	75,000.00

Pay Item No.	Description	Unit	Quantity	Rate (NRs.)	Amount (NRs.)
	Sub-Total				**569,500.00**
	Total Base Cost				**235,026,994.25**
	13% VAT				**30,553,509.25**
	Total				**265,580,503.50**
	Per Km Cost (Including Base Cost and VAT)				**16,454,394.16**
	Work Charge Staff and Small Miscellaneous Expenses @ 3%				**7,050,809.83**
	Physical Contingency @10%				**23,502,699.43**
	Grand Total				**296,134,012.76**

Annex 6: Summary of Quantities

S No.	Description	Unit	Total
1	**General**		
1.1	Insurance of works, plants, materials, loss and damage to equipments, Contractor's workmen and employees and third party insurance against damage to other persons and property as per GCC clause 13.	L.S.	**1.00**
1.2	Provide site office at mid-section of the road having rooms size: 3m*4m each at location acceptable to the project manager within the contract package with accommodation facilities as specified in special provision	mth	**18.00**
1.3	Carry out additional tests for material and works as required and instructed by the Engineer.(GCC Clause No. 33.1)	PS	**1.00**
1.4	Relocation of the utilities (water supply, telephone, etc,) and services as instructed by the Engineer as per DoLIDAR-Technical Specifications for Labour Based Construction Work of Agricultural & Rural Roads (Tech. Spec. for LBCWARR Clause No. G-10.	PS	**1.00**
1.5	Carry out maintenance of the existing road to keep the road serviceable throughout the contract period. Also provide and maintain traffic safety, control measures and temporary diversions during construction including water spraying thrice a week to avoid dust pollution as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. G-12.	mth	**18.00**
1.6	Supply and provide rental Four Wheel Drive Double cap Pickup Vehicle with full option including fuel, driver' wages, major & minor maintenances etc for the Engineer for supervision works as specified	mth	**18.00**
1.7	Provide and installation of project information board of size 1.80 mx1.2 m along with iron posts including excavation, concreting, backfilling etc all complete as per DoR Standard Specification for Road and Bridge Works (SSRBW) July 2001,Section-108	No.	**3.00**
1.8	Provision and maintenance of labour camps payable monthly in equal installments as per DoR Standard Specification for Road and Bridge Works (SSRBW) July 2001,Section-109 (3)	mth	**18.00**
1.9	Establish, maintain and operate laboratory at the site with equipments furnishing required for testing specified quality of the materials as per DoR-SSRBW, Section-511	mth	**18.00**
1.10	Environmental Mitigation Works as per EMP and as Instructed by the Engineer(DOR Section 109)	P.S.	**1.00**
1.11	Social Compliance and safeguards as per Resettlement Action Plan and GESI and as instructed by the Engineer(DOR Section 109)	P.S.	**1.00**
2	**Site Clearance**		
2.1	Clearing and Grubbing including cutting of all types of plants as per DoLIDAR-Technical Specifications for Labour Based Construction of Agricultural and Rural Roads (Tech. Spec. for LBCWARR) Clause No.: 1-1.5(a), 1-1.5(b) & 1-1.6	Sqm	**48,421.20**

S No.	Description	Unit	Total
3	**Earthwork**		
3.1	Excavation in roadway and drain in all types of soil and rock materials including removal and satisfactory disposal of all materials at approved environmentally safe tipping area as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 2-1	Cum	**257,382.93**
3.2	Excavation in foundation in structure in all types of soil materials including removal and satisfactory disposal of all materials at approved environmentally safe tipping area as per DoLIdar-Tech. Spec, for LBCWARR Clause No. 2-5	Cum	**6,698.98**
3.3	Construction of embankments, shoulders and other miscellaneous filling and backfilling in structure with approved materials as per design and drawing as per DoLIDAR-Tech. Spec. for LBCWARR Clause No.2-5	Cum	**17,091.15**
3.4	Transportation of material beyond the initial lead within 1 km distance with safe disposal sites as instructed by the engineer.	Cum	**120,171.54**
4	**Structural/Side Drain/Cross Drainage Works**		
4.1	Supply & place un-coursed random rubble stone masonry works in MM 5 cement sand mortar in the line & level all complete stone masonry work including full compensation for all labour, materials and other incidentals required to complete the work as per the specifications and drawings. It includes full compensation for using specially dressed stones on the face of wall with batter and provisions for weep hole as necessary as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 8	Cum	**11,305.47**
4.2	Supply machine made fabrication of gabion boxes of different sizes with hexagonal mesh size of 100 mm x 120 mm including rolling, cutting and weaving (mesh wire 3.0 mm, selvedge wire 3.9 mm, binding wire 2.4 mm, all heavy zinc coated wires),assembling, placing in position, packing and filling of gabion create with rubble stone and tying by 2.4 mm binding wires all complete as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 17-1.4, 17-5 & 17-6	Cum	**10,159.42**
4.3	Supplying and providing of Reinforced Soil wall Structure with Teramesh System (TMS) Facing: fixing Flexible Geogrids (eg. Paralink) as primary reinforcement for composite soil reinforcement system, made of polyester core with polyethylene coating including secondary reinforcement of Terramesh system (TMS) as per specification Clause 2402 with Zinc +PVC coated including laying of Geo textile, drainage gallery filling with boulder all complete as per Specification	Sqm	**240.00**
4.4	Provide and place Geo-textile all complete as per drawing and specifications as per (DOR-SSRBW Section No.: 2404,3110)	Sqm	**7,074.00**
4.5	Supply & place P.C.C. works M 10/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	Cum	**382.31**
4.6	Supply & place P.C.C. works M 15/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	Cum	**5.25**
4.7	Supply & place P.C.C. works M 20/20 as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 11	Cum	**45.00**
4.8	Supply & place P.C.C. works M 25/20 as per DOR-SSRBW, July 2001,Section 2000	Cum	**57.69**
4.9	Supply and place formwork for concrete works with all complete as per DOLIDAR Item 39-9-a	Sqm	**279.11**

S No.	Description	Unit	Total
4.10	Supply & place TMT high tensile strength steel reinforcement of specified grade (Fe 500) for RCC works including bending, centering & binding in position as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 10	T	**9.32**
4.11	Supply, Laying, fitting and fixing of hume pipe class NP3. It includes all operations required to complete the work and the jointing of pipes with 1:2 cement sand mortar as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 15-5 and 15-6		
4.11.1	450 mm diameter pipe for irrigation purpose	rm	**112.50**
4.11.2	600 mm diameter pipe as per DOLIDAR Item no 47-15-5,15-6-b	rm	**255.00**
4.11.3	900 mm diameter pipe as per DOLIDAR Item no 47-15-5,15-6-b	rm	**202.50**
4.12	Supply & place100 mm Dia. HDPE Pipe for weep hole as per Nepal Standard & directed by Engineer	rm	**406.00**
4.13	Supply & place Heavy Duty Steel pipe (Dia 50 mm) for railing as per Nepal Standard & directed by the Engineer	**rm**	**29.60**
4.14	Backfilling works with approved soil materials with compaction as per DoLIDAR-Tech. Spec. for LBCWARR Clause No-2.5.4	Cum	**6,159.77**
4.15	Supply and Place graded filter in backfilling for structures and cross drainage works	cum	**487.91**
5	**Pavement Works**		
5.1	Preparation of subgrade for rehabilitation works as per DoR-SSRBW (Standard Specification for Road & Bridge Works, 2001) SECTION No. 1003	Sqm	**93,924.82**
5.2	Providing, laying, spreading, watering, leveling and compaction of natural sand gravel sub base grading as specified and according to the designed camber all complete as per DoR-SSRBW SECTION No. 1201	Cum	**12,265.59**
5.3	Providing, laying, spreading, watering, leveling and compaction of capping layer of approved materials according to the designed camber all complete as per DoR-SSRBW, Section 1004	Cum	**1,506.59**
5.4	Supplying and preparing 20 cm thick stone pitching work on the prepared granular bedding with stone available at site	Cum	**446.80**
5.5	Providing, laying, spreading, watering, leveling and compaction of 12 cm thick natural sand gravel sub base grading for cobble pavement as specified and according to the designed camber all complete as per DoR-SSRBW SECTION No. 1201	Cum	**2,860.29**
5.6	Supplying and preparation of 5 cm thick granular material and sand with mixing red soil and spreading in layer, watering, compacting and all complete.	Sqm	**23,835.72**
5.7	Breaking and supplying of rock for cobble manually and chisel dressing it in the 8 cm sizes with all complete	Cum	**1,728.14**
5.8	Supplying and construction of 8 cm thick coble pavement (Breaked Coble) on the prepared granular material bedding with spreading the spall/ Granular material and compacting with Steel Roller with all complete	Cum	**1,728.14**

S No.	Description	Unit	Total
6	**Road Furniture/Traffic Sign Board**		
6.1	Supplying and placing standard RCC kilometer post (place at each km) all complete including painting, and writing etc. all complete as per specification and drawings (DOR-SSRBW SECTION No. 1501)	nos	**4.00**
6.2	Supplying and placing standard RCC kilometer post (place at 5km interval) all complete including painting, and writing etc. all complete as per specification and drawings (DOR-SSRBW SECTION No. 1501)	nos	**12.00**
6.3	Supplying and fixing in place R.C.C. delineator and guard post including excavation, painting, and erection etc. all complete as final drawing (DOR-SSRBW SECTION No. 1504)	nos	**1,760.00**
6.4	Supplying and erecting traffic sign in place including 50 mm dia steel tube, 2mm thick steel plate, cement concrete, painting, writing and supporting steel angle nut and bolt etc complete as per DoR-SSRBW SECTION No. 1501)		
6.4.1	60 cm dia circular, 60 cm equilateral triangle and 60 x 45 cm rectangular shaped sign (Single post)	nos	**100.00**
6.4.2	1.2m x 0.75 m size bigger traffic sign with back support and two or more post	nos	**61.00**
7	**Bio Engineering Works**		
7.1	Slope trimming work DoLIDAR : 4 Spec. Clause No.: 2-1.3.2,2-1.8 and 2-1.95	Sqm	**7,750.00**
7.2	Construction of Rip-rap drain with the stone pitching work of 20 cm thick and 1.2 m wide as per DoLIDAR-Tech. Spec. for LBCWARR Clause No. 8	rm	**500.00**
7.3	Dry stone check/toe walls for segmentation and support of slopes DoLIDAR Tech. Spec. clause No. 8	Cum	**291.20**
7.4	Brush layering work: including preparation of terraces of 30 - 40 cm wide and laying live cuttings of selected Species along the terrace @ 5 cm c/c with 2/3 of cuttings in to terrace and leaving one bud and up to 1/3 of the cuttings sticking beyond the terrace edge (Cutting can be of assuro, simali etc of 45 - 60 m length) DoLIDAR Spec. Clause no.70-6.7 b	rm	**1,200.00**
7.5	Planting rooted grass slips on slopes < 45° including preparation of slips on site. Operation includes digging planting holes to a maximum of 5 cm depth with metal or hardwood peg, depending on nature of soil. The planting drills should be spaced 10 cm apart as per Bio engineering information of DOR	Sqm	**7,750.00**
7.6	Planting containerized tree and shrub seedlings, including pitting, transplanting, composting and placing tree guards, on toe of embankment slopes in plain areas, not less than 8 m from the road centre line. Pit size 30 cm diameter×30 cm depth. Compost volume ¼ of the volume of pit, mixed with original soil as per Bio engineering information of DOR	nos	**310.00**

Annex 7: Curve Data

Annex 8: District Rate