

## CHAPTER A-11 ROAD IMPROVEMENT PLAN

Following the Road Network Development Master Plan, road improvement plans for the different road categories are identified considering the present conditions of the existing roads and the required class and level of road proposed in the master plan.

### 11.1 Basic Policy of Road Improvement Plan

As the result of road inventory survey, it has been revealed that road network length is sufficient but road design level and quality of pavement and bridges is quite poor. The Study team established the following design policy for the improvement of road.

#### (1) Design Policy for Road Improvement

Road Classification	Policy of Road Design
1-Digit National Roads	To improve the road level to be all weather condition with sufficient capacity and standard for international corridor
2-Digit National Roads	To improve the road to be highway class function under all weather condition by asphalt concrete pavement or DBST
Provincial Roads & Rural Roads	To maintain the road function level to be trafficable in accordance with traffic demand by strengthening the road maintenance system

#### (2) Design Policy for Rehabilitation for Existing Bridge

Road Classification	Policy of Bridge Design
Bridges in 1-Digit Roads	To improve all temporary bridges remained in the completed section and bridges with low standard (less 7m width and 20 ton loads) to be a permanent bridge in accordance with the standard of 1-Digit road
Bridges in 2-Digit Roads	(1) Bridges in 2-Digit road connecting provincial capital or international border: To improve all temporary bridges or dangerous bridges to be a permanent bridge with appropriate standard of road classification (2) Bridges in a road except the above; To utilize existing bridges as it is as much as possible except the bridge in dangerous condition, wooden bridge or causeway
Bridges in Provincial Roads & Rural Roads	To maintain the road to be trafficable in accordance with traffic demand by strengthening the road maintenance system

## 11.2 Definition of Improvement Works

### 11.2.1 Road Network and Road Condition Problems

In Section 4.6, the road network and road condition problems were identified and summarized in **Table 11.2.1** as follows:

**Table 11.2.1 Problems on Existing Road**

Road Condition Problems	Road Network Problems
<ul style="list-style-type: none"> <li>● Poor pavement condition</li> <li>● Insufficient road width</li> <li>● Insufficient level for international route</li> <li>● Insufficient geometric design</li> <li>● Insufficient road slope protection against flood</li> <li>● Temporary and narrow bridges</li> <li>● Bridges in poor condition</li> <li>● Insufficient culvert capacity</li> </ul>	<ul style="list-style-type: none"> <li>● Insufficient bridge links crossing major rivers</li> <li>● Missing road links</li> <li>● Low paved road ratio</li> <li>● Vulnerability to flood</li> <li>● Traffic congestion in major cities/areas</li> </ul>

As mentioned in Chapter 4, only 19.3% of the total national and provincial roads are paved with mostly DBST (Double Bituminous Surface Treatment) while the rest at 80.7% remain unpaved. Majority of the paved roads belong to 1-Digit roads at 75.2% while the 2-Digit and 3-Digit (provincial) roads have shares of 19.9% and 1.6% of the paved roads, respectively (see **Figure 11.2.1**). However, the completion of on-going 1-Digit road projects will elevate the paved road status of 1-Digit national highway to 100%.

Moreover, while 1-Digit roads will have at least 10m wide carriageway (road width), 63.6% of the 2-Digit roads and 83.4% of the 3-Digit roads have carriageway width of less than 6.5m. Such widths are less than that required by the Cambodian Road Design Standard, which will be discussed in the next section.

### 11.2.2 Traffic Congestion and Traffic Demand

At present, it observed that traffic congestion is building up in some built-up areas or cities in Cambodia, especially around Phnom Penh and Kandal area. Bottlenecks in 1-Digit and 2-Digit roads are observed in commercial areas or market places due to roadside friction. A narrow bridge in Siem Reap reduces the service level in NR.6, as seen in **Figure 11.2.2**.

Traffic demand for the road network is projected until year 2020 based on the development objectives and patterns. As presented in **Figure 11.2.2**, it is seen that by year 2020 some

sections of the 1-Digit national roads will have traffic demand of more than 20,000 pcu per day while the rest of the 1-Digit roads will have traffic demands less than 20,000 pcu.

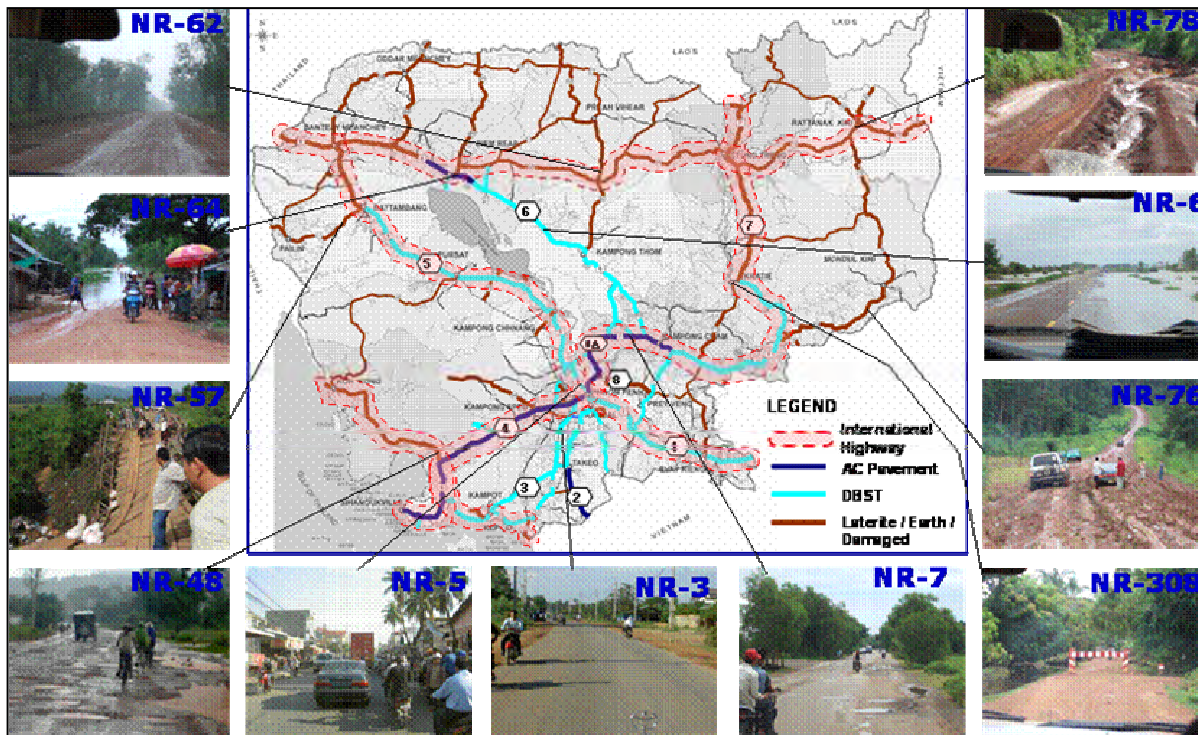


Figure 11.2.1 Existing Road Pavement Type and Condition

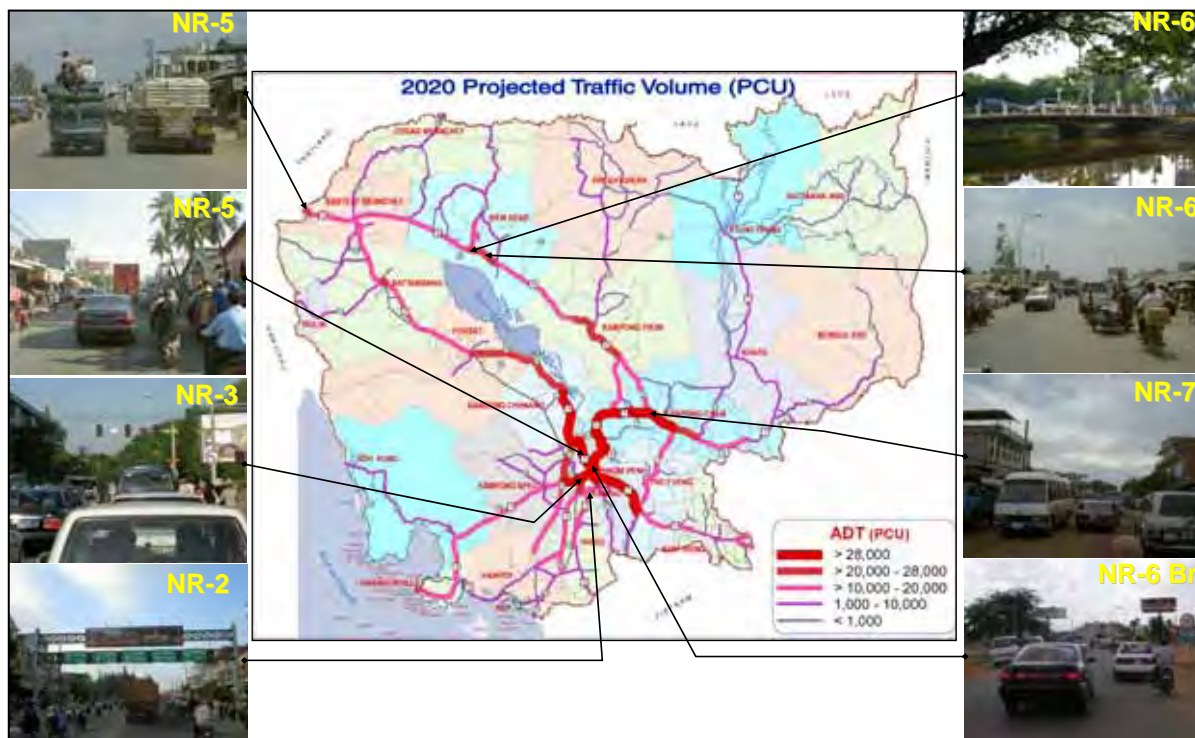


Figure 11.2.2 Conditions of Some Road Sections and Projected Traffic in Year 2020

### 11.2.3 Identification of Improvement Measures

The types of improvement works for the proposed road network are identified based on the existing road condition and the need to maintain the required service level of each road category.

**Table 11.2.2** presents the improvement works identification based on the present road condition and problems.

**Table 11.2.2 Improvement Works Identification**

PRESENT CONDITON / PROBLEMS		PROPOSED IMPROVEMENT MEASURES
<b>1. Insufficient Road Traffic Capacity</b> <ul style="list-style-type: none"> <li>• Traffic Congestion</li> <li>• Future Traffic Demand</li> </ul>	➔	<ul style="list-style-type: none"> <li>• <b>Road Capacity Improvement</b> <ul style="list-style-type: none"> <li>• New Road/Bypass</li> <li>• Widening (Additional Lanes)</li> </ul> </li> </ul>
<b>2. Missing Links on Road Network</b> <ul style="list-style-type: none"> <li>• Missing Road Links</li> <li>• Lack of Bridge Connection</li> </ul>	➔	<ul style="list-style-type: none"> <li>• <b>Road Network Improvement</b> <ul style="list-style-type: none"> <li>• Road Link Completion</li> <li>• New Bridge Construction</li> </ul> </li> </ul>
<b>3. Road Condition Below Required Standard</b> <ul style="list-style-type: none"> <li>• International/Asian Highway</li> <li>• Cambodian Road Design Standard</li> </ul>	➔	<ul style="list-style-type: none"> <li>• <b>Road Upgrading to Required Standard</b> <ul style="list-style-type: none"> <li>• Cross-section Improvement</li> <li>• Geometric Improvement</li> <li>• Pavement Structure Improvement (New Pavement/Replacement)</li> </ul> </li> </ul>
<b>4. Road and Bridge in Poor Service Condition</b> <ul style="list-style-type: none"> <li>• Pavement Damage/Deterioration</li> <li>• Poor Drainage Condition</li> <li>• Embankment Slope Damaged</li> <li>• Temporary Bridge</li> <li>• Bridge Heavily Damaged</li> </ul>	➔	<ul style="list-style-type: none"> <li>• <b>Road and Bridge Rehabilitation</b> <ul style="list-style-type: none"> <li>• Pavement Rehabilitation</li> <li>• Drainage Rehabilitation</li> <li>• Slope Protection</li> <li>• Bridge Rehabilitation</li> <li>• Urgent Bridge Rehabilitation Program</li> </ul> </li> </ul>
<b>5. Road Maintenance Problem</b>	➔	<ul style="list-style-type: none"> <li>• <b>Road Maintenance Works</b> <ul style="list-style-type: none"> <li>• Minor Repairs</li> <li>• Markings/Cleaning/Painting</li> </ul> </li> </ul>

The proposed improvement measures identified in **Table 11.2.2** above are basically grouped into:

(a) New Construction

- New Bypass Road Construction – when bypass roads are required to be constructed, the scope of works includes new road development on new road alignment including right-of-way acquisition.
- New Road Construction – construction of new roads on identified missing links to complete the road connection.
- New Bridge Construction – involves construction of new bridges where required to complete the road network passing through obstructions or bodies of water. This may include construction of new bridge to replace existing bridge.

(b) Upgrading of Existing Roads

- Upgrading to International Highway Standard – the scope of work includes road upgrading to that required by the Asian Highway Standard including road structure (improving road cross-sections to satisfy minimum traffic lanes and shoulder requirements, pavement structure/type improvement, safety facilities, traffic signals, guide signs, etc.) and geometric (horizontal and vertical) requirements. The road alignment basically follows the existing road alignment with minor modification, if necessary.
- Upgrading to Cambodian Road Design Standard – upgrading to the local design standard is similar to the above scope considering the requirements for each road category and road function. Similarly, the road alignment basically follows the existing road alignment.

(c) Road and Bridge Widening

- Road Widening – involves construction of additional traffic lanes to increase existing road capacity. The master plan identifies road sections to be widened based on traffic demand, however, on built-up areas where road widening may not be possible, consideration for alternative road alignment will have to be looked into.
- Bridge widening – involves bridge carriageway widening to satisfy design cross-sectional requirement or provision of additional lane for narrow bridges with one lane.

(d) Road and Bridge Rehabilitation

- When road condition, including pavement, drainage, slope protection, etc. requires major repair, such road section shall be improved and rehabilitated. However, the master plan assumes that since most of the damaged road sections are due for road upgrading, such road rehabilitation shall be carried-out as part of road maintenance if it is needed before road upgrading is carried-out.
- Bridge rehabilitation involves major repairs on permanent bridges which has extensive damage but does not require replacement. Temporary bridges are not included in bridge rehabilitation.

(e) Road Maintenance Works

- This involves road maintenance works and minor intervention to maintain the service quality of the road.

Refer to Section 11.3 for the typical types of improvement measures for the national and provincial roads.

### 11.3 Design Standards and Typical Cross-Sections

In this master plan, the design standard and cross-section requirements are based on the functional classification of the road to be improved. Such functional characteristics of the different road categories are discussed in Chapter A-4 which classifies Cambodian roads into four class levels and road category as to International/Urban Expressway, Highway/Arterial, Provincial/Collector and District/Local roads. However, since Cambodia is part of the Greater Mekong Sub-region, some 1-Digit national roads and 2-Digit national roads are identified as part of the Asian Highway and Regional Highway, respectively.

#### 11.3.1 Design Standard

The design standard proposed for the different improvement measures for each road based on road categories and functions for each road is presented in **Table 11.3.1**. It is recommended to apply the Asian Highway Standard (AHS) for roads classified as International Highway and the Cambodian Road Design Standard (CRDS) for roads classified as Highway (arterial and minor arterial), Provincial/Collector and District/Local. Details of the design requirements for both standards are discussed in Chapter A-4.

#### 11.3.2 Standard Road Sections

Road cross-sections are developed for the different road functions and categories for this master plan based on the AHS and the CRDS requirements. As shown in **Figure 11.3.1**, there are five typical sections:

- Type A : covers 4-Lane roads classified as International and Highway/Arterial roads. This section has 3.5m wide paved traffic lanes and 3.0m wide paved shoulders. Asian highway and new bypass/ring road requiring 4-lanes and 1-Digit roads to be widened to 4-lanes belong to this class. Recommended pavement is asphalt concrete.
- Type B : covers 2-Lane roads classified as International, Highway/Arterial, and Highway/Minor Arterial roads. Similar to Type A, this section has 3.5m wide paved traffic lanes and 3.0m wide paved shoulders. Asian/regional highway, new bypass roads and 1-Digit roads are included in this class. Recommended pavement is asphalt concrete.
- Type C : covers 2-Lane provincial/collector roads with asphalt concrete (C-1) and DBST (C-2) pavement. Both the 3.0m wide traffic lanes and 2.5m wide shoulders are paved. 2-Digit roads and 3-Digit roads functioning as provincial roads are included in this class.
- Type D : covers 2-Lane provincial/collector roads with low traffic volume and district/local roads. This has 2.75m traffic lanes with DBST surface

structure and unpaved shoulder 2.0m wide. 3-Digit provincial roads with low traffic volume and 4-Digit/rural roads are included in this class.

- Type E : covers district/local roads with very low traffic volume and chance of two-way flow is low. The 5.0m traffic lane is paved with DBST while the 1.5m wide shoulders are unpaved. 3&4-Digit roads functioning as district/local roads and rural roads belong to this class.

**Table 11.3.1 Proposed Design Standard**

Road Category / Classification	International Highway*	Highway / Arterial	Highway / Minor Arterial	Provincial / Collector	District / Local
<b>General</b>					
Road Class/Number Digit	AH/1-Digit	1-Digit	2-Digit	2/3-Digit	Rural
Number of Lanes	4***	2 - 4	2	2	2
Design Standard	Asian Highway / CRDS** (R5)	CRDS (R5)	CRDS (R5/R4)	CRDS (R4/R3)	CRDS (R2/R1)
Design Speed (km/hr)	80 -110	60 - 100	60 - 90	50 - 70	20 - 60
<b>Cross-section</b>					
Cross-Section Type	A & B	A & B	B	C	D & E
Right-of-Way (m)	60	60	50	40	30
Vehicle Lane (m)	3.50	3.50	3.25 - 3.50	3.00	2.50 - 2.75
Shoulder (m)	3.00	3.00	3.00	2.50	1.50 - 2.00
<b>Traffic Volume</b>					
Design Traffic Volume (ADT in pcu)	>10,000	>10,000	3,000-10,000	1,000-3,000	150-1,000 /<150
<b>Pavement Structure</b>					
Surface Type	Asphalt Concrete	Asphalt Concrete	Asphalt Concrete	Asphalt Concrete or DBST	DBST or Laterite

\*AHS – Asian Highway Standard

\*\*CRDS – Cambodian Road Design Standard

\*\*\*Although the AHS for International Highway requires 4 lanes, this is partially applied to the proposed road improvement under this class considering future traffic demand and financial requirements until 2020. Widening to 4 lanes of remaining sections shall be done when traffic demand volume requires.

Asphalt concrete (AC) pavement is proposed for important roads of highway class or when the expected traffic volume (ADT) is 3,000pcu or more.

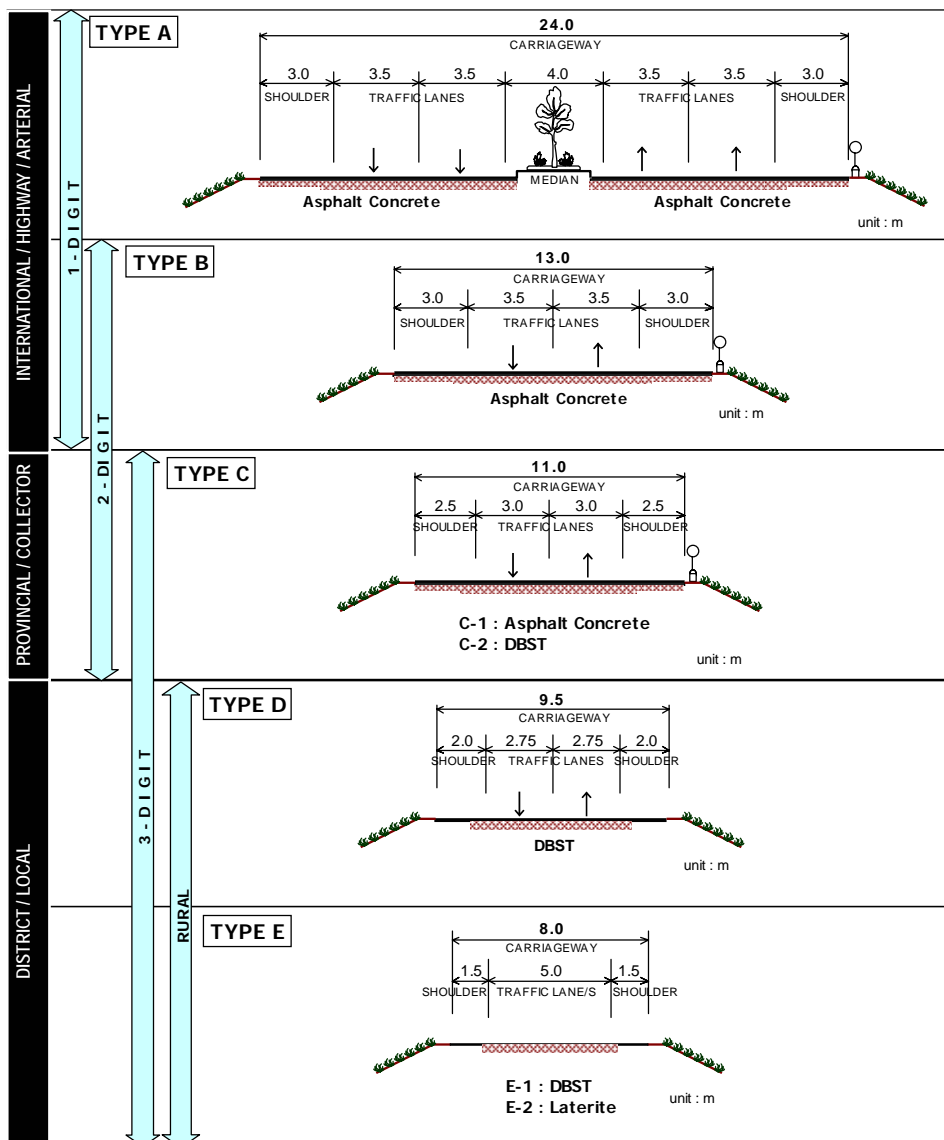


Figure 11.3.1 Typical Road Cross-sections

## 11.4 Improvement Measures

### 11.4.1 Selection of Improvement Measures

The type of improvement measures applied to each road section in the proposed road network was identified based on the road function/category, the existing road structure and condition and the present and future traffic demands. The criteria for the selection of improvement work are presented in **Table 11.4.1**. From the proposed road network master plan, the road function is identified and categorized according to the Cambodian Road Design Standard (CRDS). At present, the 1-Digit roads function as either international highway or major arterial while most of the 2-Digit roads function as highway (minor arterial), the rest function as provincial or collector roads. Moreover, most of the 3-Digit roads function as provincial or collector roads and some with very low traffic volume can be considered as district or local roads. As illustrated, the



selection of required improvement works for each road depends on the existing condition and the requirements of the master plan.

It was observed that most of the existing roads fall below the CRDS requirements especially the road cross-section elements (such as traffic lane width, shoulder width, etc.), pavement structure, geometric elements, safety facilities, etc. It is recommended to upgrade such road sections to comply with the requirements of the CRDS and the Asian Highway Standard for International Highway routes.

The definition of the different improvement measures are discussed earlier in Section 11.1.

**Table 11.4.1 Criteria for Improvement Work Selection**

ROAD FUNCTION/ CATEGORY	CRITERIA	IMPROVEMENT WORKS
<ul style="list-style-type: none"> <li>● International Highway</li> <li>● Highway/Arterial</li> <li>● Highway/Minor Arterial</li> <li>● Provincial/Collector</li> <li>● District/Local</li> </ul>	<ul style="list-style-type: none"> <li>● Road structure below standard required by road function (Cross-section, pavement structure, geometric level, etc.)</li> <li>● Road in poor service condition</li> <li>● Road not all-weather condition</li> <li>● Traffic level approaching unstable flow and/or capacity congestion</li> <li>● Future traffic demand is more than existing capacity</li> <li>● Large share of through traffic volume</li> <li>● Missing road link</li> <li>● Lacking bridge structure to complete road network</li> <li>● Road requires maintenance</li> </ul>	<ul style="list-style-type: none"> <li>● Road Upgrading (to required functional level, including rehabilitation)</li> <li>● Road Widening (additional lanes)</li> <li>● New Road or Bypass Construction</li> <li>● New Bridge Construction</li> <li>● Road Maintenance</li> </ul>

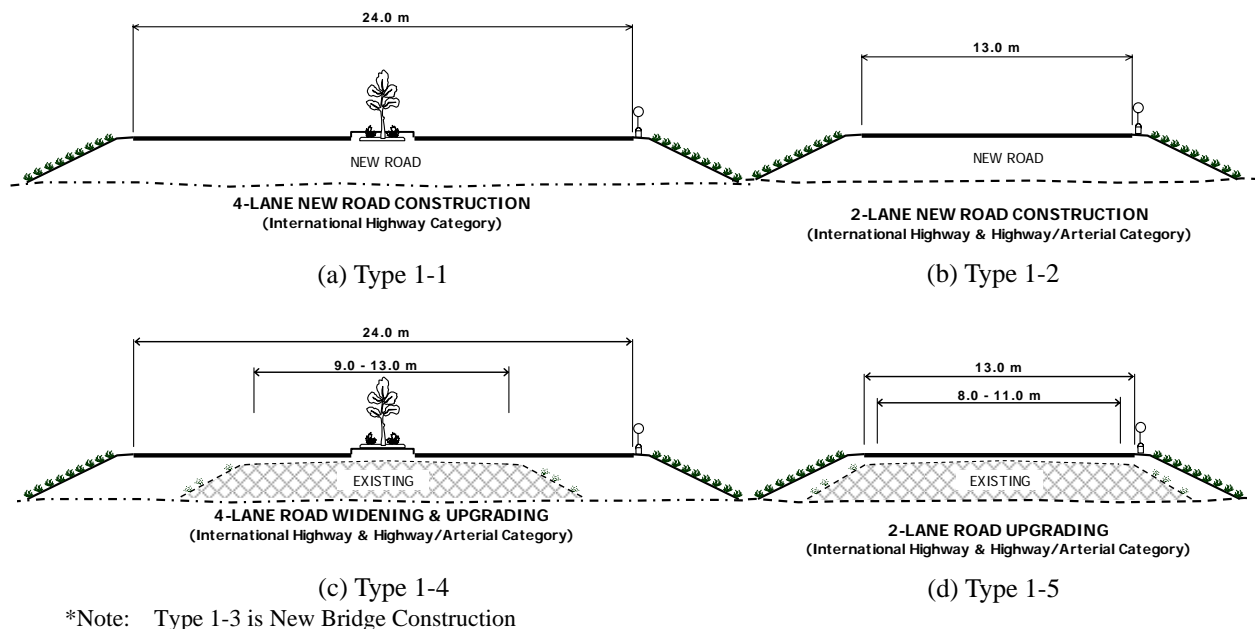
### 11.4.2 Improvement Plans for 1-Digit Roads

The types of improvement measures identified for 1-Digit roads are illustrated in **Figure 11.4.1** consisting of new construction (4 lanes and 2 lanes), road widening to 4-lanes and road upgrading to international standard and Cambodian highway standard. These improvement measures follow the typical road section for each road category described in Section 11.2.

**Table 11.4.2** summarizes the scope of improvement measures for each road section with new construction involving three bypasses and three bridges. Existing roads are either widened or upgraded. The corresponding length of road sections for the different improvement groups are shown in **Figure 11.4.2**.

The four new bypasses are proposed to improve future traffic flow – (1) Phnom Penh Ring Road, (2) Siem Reap Bypass, (3) Battambang Bypass, and (4) Kampong Chhnang Bypass. Moreover, additional three bridges are also included in the network crossing the three major rivers – Mekong river (NR.1 crossing), Tonle Sap and Bassac rivers (Phnom Penh Ring Road crossings).

On sections where future traffic demands are expected, road widening to 4-lanes is proposed both for international and national highway standards. Upgrading for international and national highways is also proposed for 2-lane sections. It is recommended, in the long term, to use Asphalt Concrete as the road surfacing.



**Figure 11.4.1** Types of Improvement Measures for 1-Digit Roads

**Table 11.4.2 1-Digit Roads Improvement Plans**

Road Number	Road Class*	Length (km)	Improvement Measures			
			Type	Scope	No. of Lanes	Pavement
<b>Road Widening and Upgrading</b>						
NR.1	IH	166.0	1-4, 1-5	Road Widening & Upgrading	4L=60.0 km 2L=106.0 km	AC
NR.2	H/A	120.0	1-5	Road Upgrading	2	AC
NR.3	IH & H/A	202.0	1-5	Road Upgrading	2	AC
NR.4	IH	214.0	1-4	Road Widening	4L=122.0 km	AC
NR.5	IH	406.0	1-4, 1-5	Road Widening & Upgrading	4L=95.0 km 2L=311.0 km	AC
NR.6	IH/ & H/A	416.0	1-4, 1-5	Road Widening & Upgrading	4L=75.0 km 2L=341.0 km	AC
NR.7	IH	464.0	1-4, 1-5	Road Widening & Upgrading	4L=61.0 km 2L=403.0 km	AC
NR.8	H/A	64.0	1-5	Road Upgrading	2	AC
<b>New Construction</b>						
2 <sup>nd</sup> Mekong Bridge	IH	2.0	1-3	New Bridge Construction	2	AC
Phnom Penh Ring Road	IH	50.0	1-1	New Road Construction	4	AC
2 Ring Road Bridges	IH	2.7	1-3	New Bridge Construction	2	AC
Siem Reap Bypass	H/A	30.0	1-2	New Road Construction	2	AC
Battambang Bypass	IH	30.0	1-2	New Road Construction	2	AC
Kampong Chhnang Bypass	IH	20.0	1-2	New Road Construction	2	AC

\*IH – International Highway

H/A – Highway/Arterial

Figure 11.4.3 shows the existing and master plan target pavements of the different road sections.

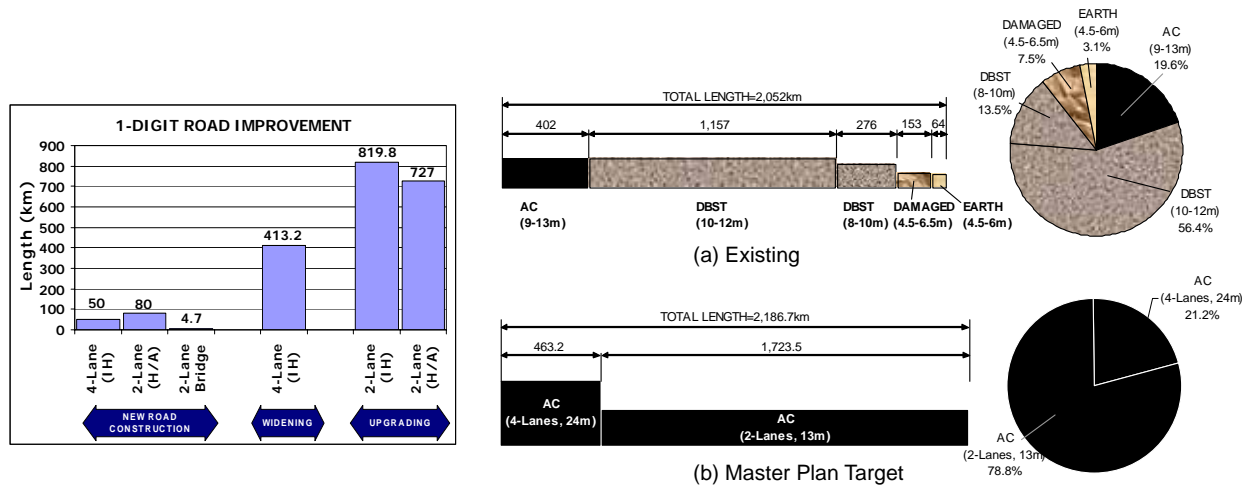


Figure 11.4.2 1-Digit Road Improvement Measures

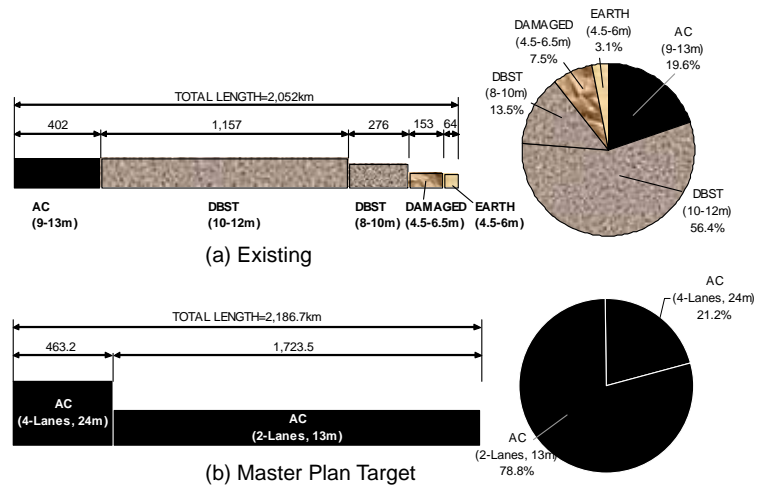


Figure 11.4.3 1-Digit Road Pavement Structure

The road network development master plan target by year 2020 for the 1-Digit road is shown in Figure 11.4.4 below with recommended cross-section types.

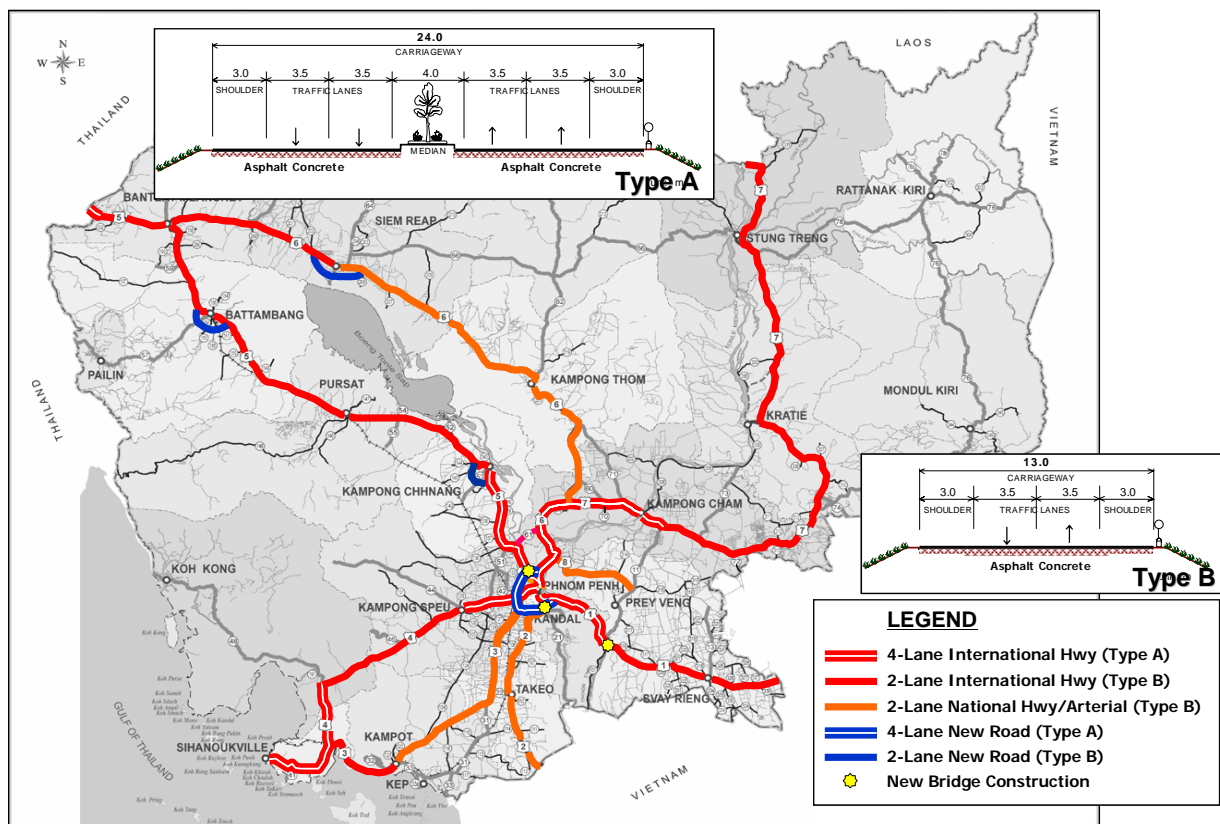
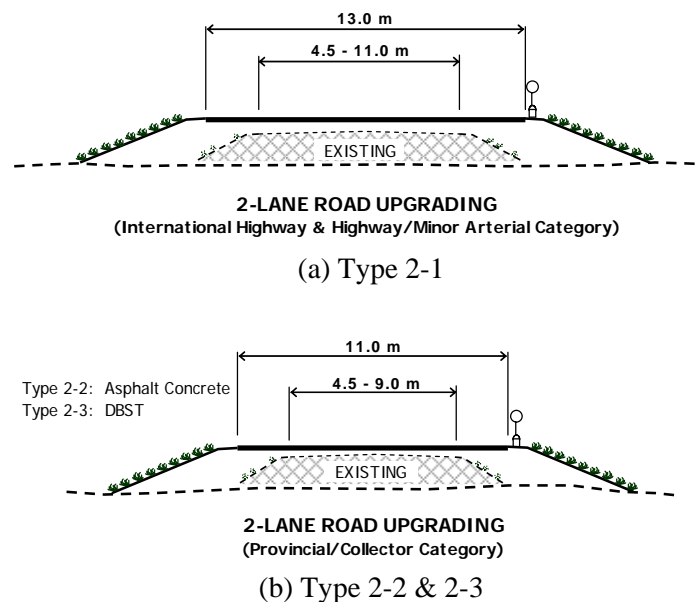


Figure 11.4.4 1-Digit Road Development Master Plan with Typical Road Cross-Sections

### 11.4.3 Improvement Plans for 2-Digit Roads

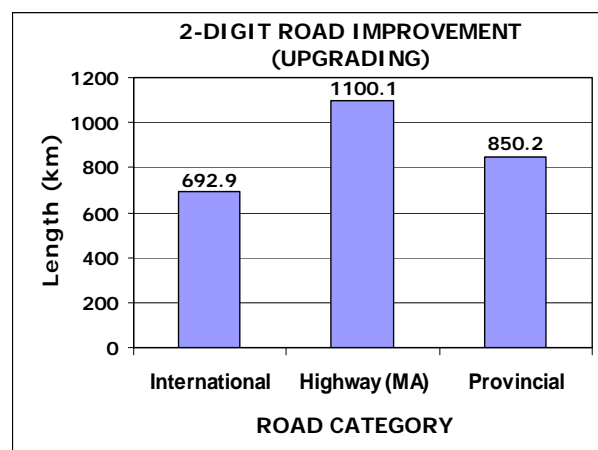
Most of the 2-Digit roads fall below the Cambodian Road Design Standard and those designated as international highway will have to be upgraded to Asian Highway Standard. Therefore, the improvement measures for the 2-Digit roads cover mostly upgrading works to the desired road functional category.

**Figure 11.4.5** illustrates the typical improvement measures for the 2-Digit roads with corresponding types based on the required standard cross-section described in Section 11.2. **Table 11.4.3** summarizes the different improvement measures for the 2-Digit roads based on the road functional category as to either highway/minor arterial or provincial/collector roads. Note that some of the 2-Digit roads are classified as provincial roads due to function and the traffic demand volume until 2020. Such 2-Digit provincial roads can be upgraded to highway/minor arterial category when traffic condition and demand requires.



**Figure 11.4.5 Typical Improvement Measures for 2-Digit Roads**

The distribution of 2-Digit road upgrading into international highway, national minor arterial highway and provincial road is presented in **Figure 11.4.6**. Of the total 2,643.2 km of 2-Digit roads, the international highway upgrading will cover 26% while the minor arterial highway upgrading will cover 42% and the rest at 32% will be provincial roads. It is recommended that asphalt concrete be used as pavement structure for international highway and



**Figure 11.4.6 2-Digit Road Improvement Measure**

minor arterial highway. On the other hand, DBST is recommended for roads designated as provincial or collector roads. See **Figure 11.4.7** for the existing and master plan target pavement structures.

**Table 11.4.3 2-Digit Roads Improvement Plans**

Road Number	Road Class*	Length (km)	Improvement Measures				
			Type	Scope	Section Type	No. of Lanes	Pavement
NR.11	H/MA	90.4	2-1	Road Upgrading	B	2	AC
NR.13	P/C	44.6	2-3	Road Upgrading	C-2	2	DBST
NR.21	H/MA	65.6	2-1	Road Upgrading	B	2	AC
NR.21A	P/C	20.1	2-3	Road Upgrading	C-2	2	DBST
NR.22	H/MA	9.6	2-1	Road Upgrading	B	2	AC
NR.31	H/MA	54.8	2-1	Road Upgrading	B	2	AC
NR.32	P/C	33.3	2-3	Road Upgrading	C-2	2	DBST
NR.33	IH	52.3	2-1	Road Upgrading	B	2	AC
NR.33A	P/C	19.7	2-3	Road Upgrading	C-2	2	DBST
NR.41	P/C	9.3	2-3	Road Upgrading	C-2	2	DBST
NR.42	P/C	24.3	2-3	Road Upgrading	C-2	2	DBST
NR.44	P/C	84.8	2-3	Road Upgrading	C-2	2	DBST
NR.46	P/C	27.0	2-3	Road Upgrading	C-2	2	DBST
NR.48	IH	161.3	2-1	Road Upgrading	B	2	AC
NR. 51	H/MA	44.9	2-1	Road Upgrading	B	2	AC
NR. 52	P/C	8.0	2-3	Road Upgrading	C-2	2	DBST
NR. 53	P/C	27.3	2-3	Road Upgrading	C-2	2	DBST
NR. 54	P/C	4.9	2-3	Road Upgrading	C-2	2	DBST
NR. 55	P/C	22.3	2-3	Road Upgrading	C-2	2	DBST
NR. 56	H/MA	113.6	2-1	Road Upgrading	B	2	AC
NR. 57	H/MA	103.3	2-1	Road Upgrading	B	2	AC
NR 59	P/C	16.3	2-3	Road Upgrading	C-2	2	DBST
NR. 60	H/MA	19.9	2-1	Road Upgrading	B	2	AC
NR. 61	H/MA	15.9	2-1	Road Upgrading	B	2	AC
NR. 62-1	H/MA	128.4	2-1	Road Upgrading	B	2	AC
NR 62-2	P/C	114.3	2-3	Road Upgrading	C-2	2	DBST
NR. 63	P/C	14.3	2-3	Road Upgrading	C-2	2	DBST
NR. 64	H/MA	134.0	2-1	Road Upgrading	B	2	AC
NR. 65	P/C	21.5	2-3	Road Upgrading	C-2	2	DBST
NR. 66-1	IH	139.9	2-1	Road Upgrading	B	2	AC
NR. 66-2	IH	145.4	2-1	Road Upgrading	B	2	AC
NR. 68	H/MA	117.7	2-1	Road Upgrading	B	2	AC
NR 70	P/C	13.5	2-3	Road Upgrading	C-2	2	DBST
NR. 71	H/MA	57.8	2-1	Road Upgrading	B	2	AC
NR. 72	H/MA	13.5	2-1	Road Upgrading	B	2	AC
NR. 73	P/C	57.4	2-3	Road Upgrading	C-2	2	DBST
NR. 74	P/C	17.9	2-3	Road Upgrading	C-2	2	DBST
NR. 76-1	H/MA	130.7	2-1	Road Upgrading	B	2	AC
NR. 76-2	P/C	193.5	2-3	Road Upgrading	C-2	2	DBST
NR. 78	IH	194	2-1	Road Upgrading	B	2	AC
NR 78A	P/C	36.9	2-3	Road Upgrading	C-2	2	DBST
NR. 78B	P/C	39	2-3	Road Upgrading	C-2	2	DBST

\*IH – International Highway, H/MA – Highway/Minor Arterial, P/C – Provincial/Collector

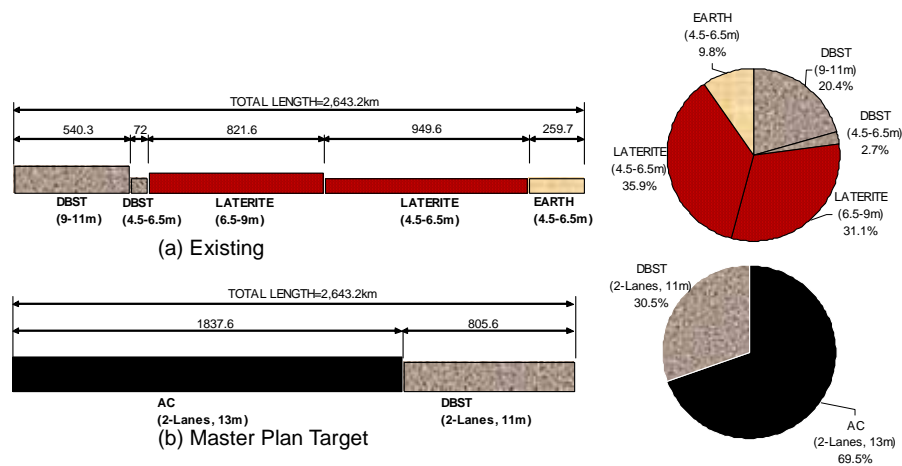


Figure 11.4.7 2-Digit Road Pavement Structure

The road network development master plan target by year 2020 for the 2 and 3-Digit roads is shown in Figure 11.4.8 below with recommended cross-section types.

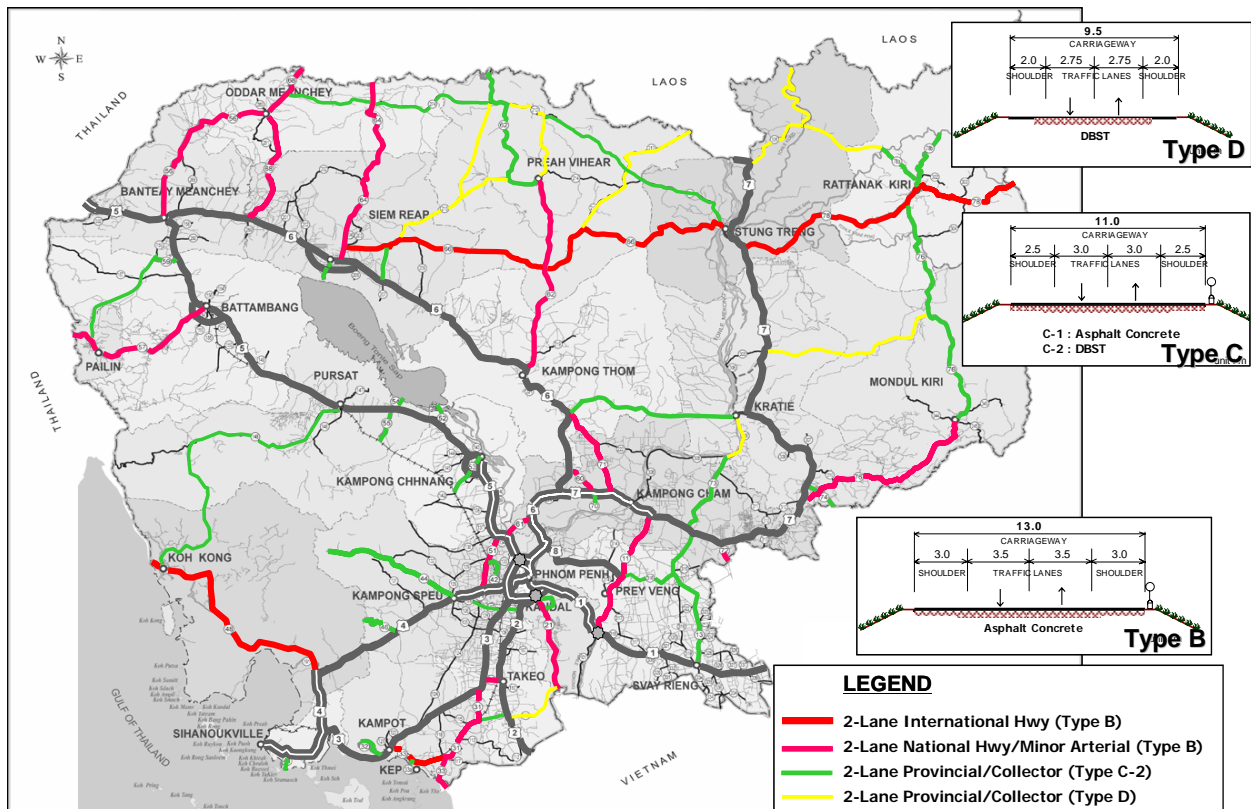
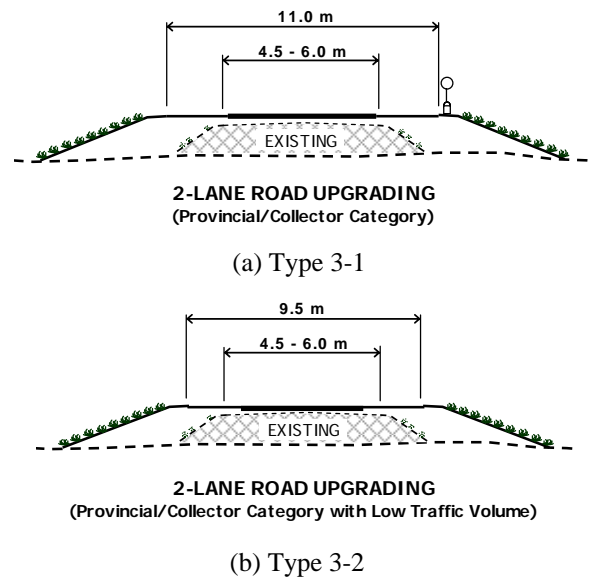


Figure 11.4.8 2 and 3-Digit Road Improvement Master Plan with Typical Road Cross-Sections

#### 11.4.4 Provincial Roads and Maintenance

The road network development formulated in the master plan covers some of the provincial roads necessary to be improved until 2020. Although much of the road network will have to be developed beyond this time frame, **Table 11.4.4** presents those provincial roads which are proposed to be improved until 2020 in support of developmental objectives and completion of the road network. The types of improvement measures for the provincial roads are presented on **Figure 11.4.9** corresponding to the road section category as discussed in Section 11.2.



**Figure 11.4.9 Typical Improvement Measures for 3-Digit Roads**

The road development master plan for some provincial roads to be improved is shown in **Figure 11.4.8** together with 2-Digit roads. The improvement measures cover basically upgrading of these roads to the functional standard required for provincial or collector roads category. The pavement structure recommended for these roads should be at least DBST. In some areas where traffic demand volume are low, narrow road section (Type 3-2) is proposed to minimize civil works cost.



**Table 11.4.4 Provincial Roads Improvement Plans**

Road Number	Road Class*	Length (km)	Improvement Measures				
			Type	Scope	Section Type	No. of Lanes	Pavement
PR.104	P/C	9.6	3-1	Road Upgrading	C-2	2	DBST
PR.111 to NR.21	P/C	41.0	3-2	Road Upgrading	D	2	DBST
PR.114	P/C	16.4	3-1	Road Upgrading	C-2	2	DBST
PR.127	P/C	15.0	3-1	Road Upgrading	C-2	2	DBST
PR.148	P/C	114.0	3-1	Road Upgrading	C-2	2	DBST
PR.148A	P/C	120.0	3-1	Road Upgrading	C-2	2	DBST
PR.210	P/C	91.7	3-2	Road Upgrading	D	2	DBST
PR.210A	P/C	70.0	3-2	Road Upgrading	D	2	DBST
PR.212	P/C	77.0	3-2	Road Upgrading	D	2	DBST
PR.213	P/C	112.4	3-2	Road Upgrading	D	2	DBST
PR.274	P/C	132.0	3-1	Road Upgrading	C-2	2	DBST
PR.301	P/C	47.4	3-2	Road Upgrading	D	2	DBST
PR.301-1	P/C	59.0	3-2	Road Upgrading	D	2	DBST
PR.301-2	P/C	59.0	3-2	Road Upgrading	D	2	DBST
PR.305	P/C	120.0	3-2	Road Upgrading	D	2	DBST
PR.308	P/C	34.6	3-1	Road Upgrading	C-2	2	DBST
PR.316	P/C	35.0	3-1	Road Upgrading	C-2	2	DBST
NR.13 to NR.7	P/C	61.4	3-1	Road Upgrading	C-2	2	DBST
PR.2076/2081/2082	P/C	101.0	3-1	Road Upgrading	C-2	2	DBST
Stung Treng – Cham Khsan	P/C	135.0	3-1	Road Upgrading	C-2	2	DBST
Kampong Thom - Kratie	P/C	102.0	3-1	Road Upgrading	C-2	2	DBST

\* P/C – Provincial/Collector

On the other hand, routine maintenance is proposed for other provincial road sections since traffic demand volume does not yet warrant additional investments in these roads. However, budget for maintenance of these roads to trafficable levels are allocated.

Similarly, routine maintenance works are proposed for rural roads. **Table 11.4.5** presents allocations for road maintenance at different road class.

**Table 11.4.5 Road Maintenance**

Road Reference	Road Class*	Length (km)	Maintenance		
			Scope	No. of Lanes	Pavement
1 - DIGIT	IH, H/A	2,052	Routine Maintenance	2 – 4	AC/DBST
2 - DIGIT	H/MA ,P/C	2,643	Routine Maintenance	2	AC/DBST
PROVINCIAL	P/C	6,615	Routine Maintenance	2	DBST/Laterite
RURAL	RURAL	18,154	Routine Maintenance	1 – 2	Laterite/Earth

\*IH – International Highway

AC – Asphalt Concrete

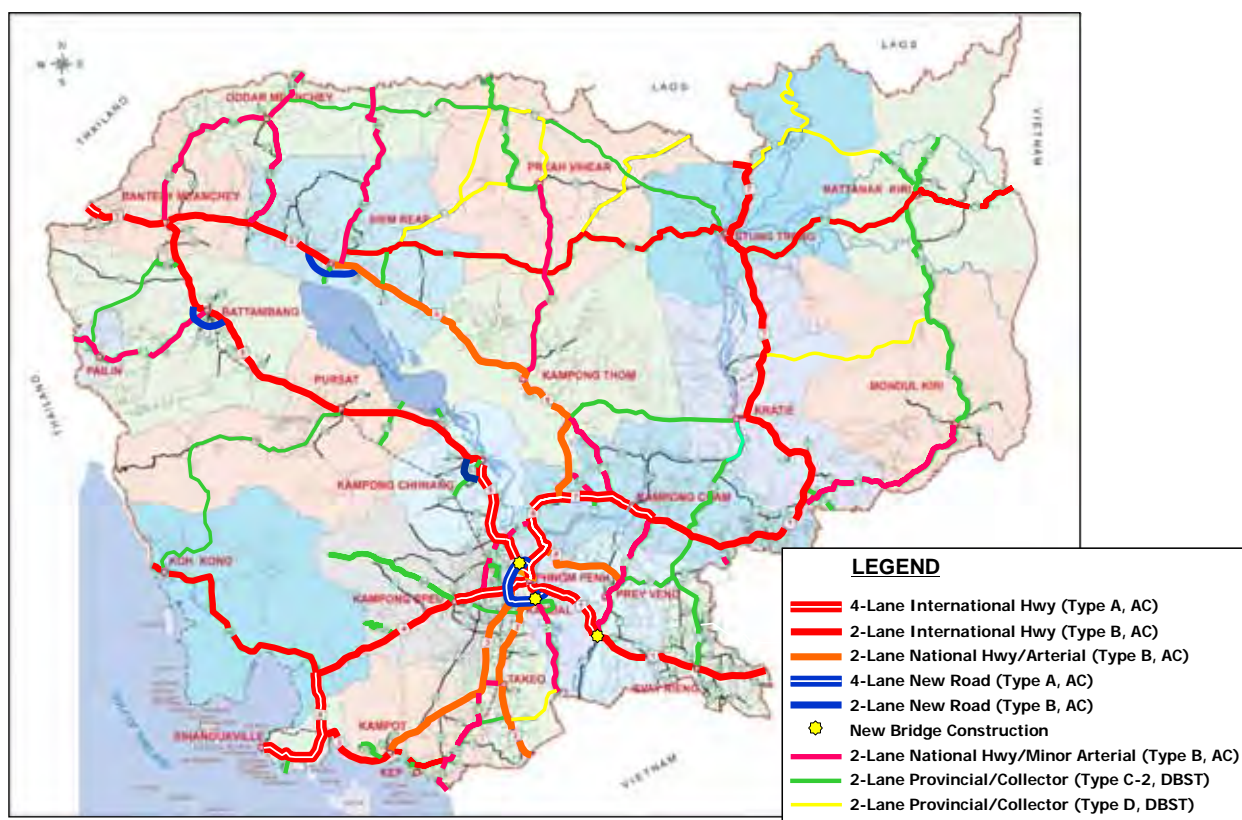
H/A – Highway/Arterial

DBST – Double Bituminous Surface Treatment

H/MA – Highway/Minor Arterial

P/C – Provincial/Collector

The total road network development master plan target by year 2020 is presented in **Figure 11.4.10** below showing the improvement measures by road functional category.



**Figure 11.4.10 Improvement Plans for the Road Development Master Plan**

## 11.5 Cost Estimate of Improvement Works

In order to determine the financial requirements of the master plan, the civil works cost of the different road sections are estimated based on the necessary road improvement and the corresponding improvement measure type.

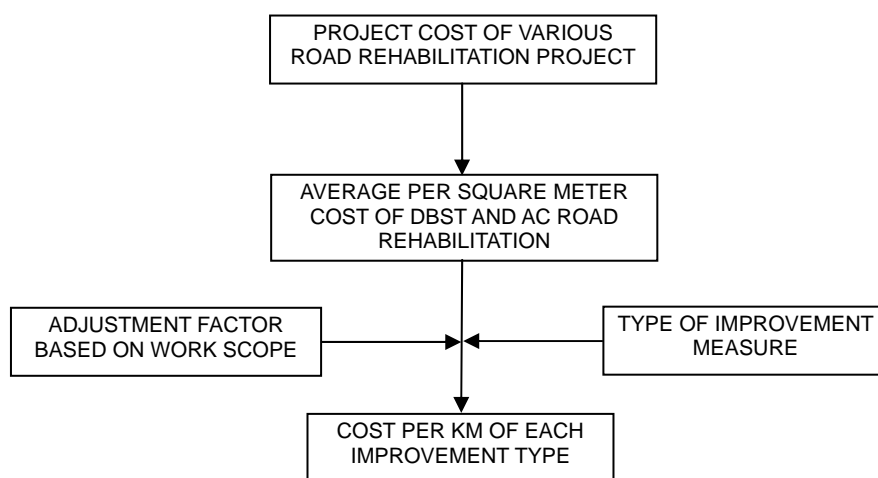
### 11.5.1 Assumptions

For budgetary purposes, the project costs of the different road sections in the master plan were derived based on the project costs of the different on-going and completed road rehabilitation projects given in **Table 11.5.1**.

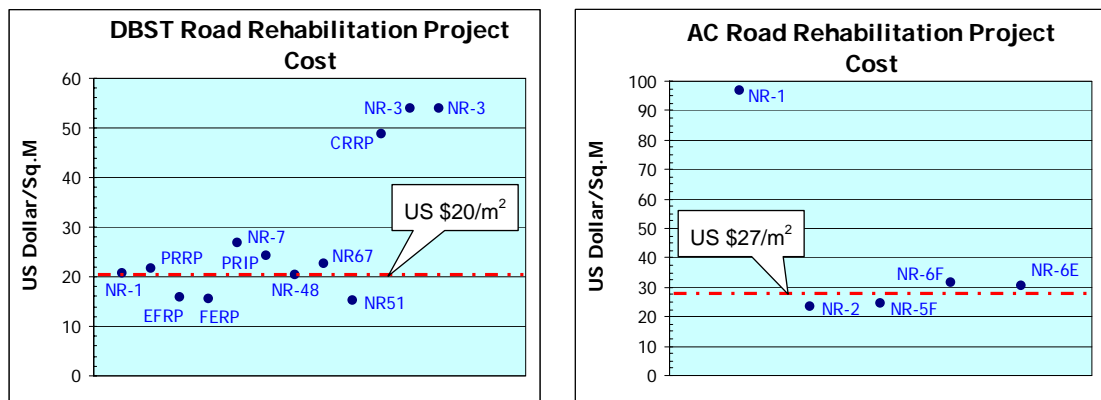
**Table 11.5.1 Major Road Rehabilitation Projects in Cambodia**

Project Name	Donor	Length (km)	Pavement Type	Carriage -way Width (m)	Project Cost (US \$ million)	Unit Cost (\$/m <sup>2</sup> )
Asian Highway Improvement (NR1)	ADB	105.0	DBST	10.5	22.9	20.8
Improvement of NR1	Japan	56.0	AC	12.0	65.0	96.7
Primary Road Restoration Project	ADB	407.0	DBST	10.0	88.2	21.7
Emergency Flood Rehabilitation Project	ADB	368.0	DBST	7.0	41.0	15.9
Cambodia Road Rehabilitation Project	WB	93.9	DBST	10.0	45.6	48.6
Flood Emergency Rehabilitation Project	WB	113.0	DBST	7.0	12.2	15.4
Rehabilitation of NR.2 (Takeo_VN Border)	Japan	51.6	AC	10.0	12.0	23.3
NR.3 Kampot-Trapang Ropaou Road Rehabilitation	Korea	32.5	DBST	10.0	17.5	53.8
NR.3 Veal Renh-Trapang Ropaou Rod Rehabilitation	WB	21.5	DBST	10.0	11.6	54.0
Rehbilitation of NR.7 (Kratie-Stung Treng-Lao)	China	187.0	DBST	10.0	50.0	26.7
Provincial and Rural Infrastructure Project	WB	105.4	DBST	6.5	16.6	24.2
Rehabilitation of NR.48	Thailand	152.2	DBST	7.0	21.7	20.4
Rehabilitation of NR.67 (Siem Reap-Anloung Veng-Sagnam)	Thailand	123.7	DBST	10.0	27.8	22.5
NR.51 Road Rehabilitation Project	WB	38.0	DBST	10.0	5.8	15.26
GMS Canbodia Road Improvement, NR.5 (Sisophon-Poipet)	ADB	47.2	AC	10.0	11.6	24.6
GMS Canbodia Road Improvement, NR.6 (Siem Reap-Kralanh)	ADB	48.4	AC	10.0	15.2	31.4
GMS Canbodia Road Improvement, NR.6 (Kralanh-Sisophon)	ADB	49.8	AC	10.0	15.1	30.3

The unit costs (cost per kilometer of road length) of the different improvement types by road category were determined following the procedure illustrated in **Figure 11.5.1**. As seen in the figure, the per square meter cost of different rehabilitation projects were first calculated and the average taken to become the base cost of DBST and AC roads (see **Figure 11.5.2**). The base cost is applied to the road section of the corresponding improvement measure type and by adjusting to the scope of improvement work, the per kilometer cost of each corresponding improvement type is derived. The adjustment factor will take into account the function of the road, the type of pavement structure, scope of work – as to new construction or road rehabilitation and the anticipated traffic volume and characteristics.



**Figure 11.5.1** Determination of Road Improvement Cost per Km



**Figure 11.5.2** Cost Per Square Meter of Different Rehabilitation Projects

### 11.5.2 Unit Cost Applied in the Master Plan

The unit costs (per km) of the road type used in the master plan for the different road improvement measure types are presented in **Table 11.5.2** below.

**Table 11.5.2 Unit Cost of Road Improvement Measures**

Road Classification	Type of Improvement Measure	Road Section Type	No. of Lanes	Carriageway Width (m)	Pavement Type	Unit Cost (US\$/km)
1-Digit National Road Including New Road	1 – 1	A	4	24	AC	2,000,000
	1 – 2	B	2	13	AC	760,000
	1 – 3	B	2	13	AC	35,000,000
	1 – 4	A	4	24	AC	660,000
	1 – 5	B	2	13	AC	340,000
2-Digit National Road	2 – 1	B	2	13	AC	290,000
	2 – 2	C-1	2	11	AC	240,000
	2 – 3	C-2	2	11	DBST	190,000
Provincial Road	3 – 1	C-2	2	11	DBST	150,000
	3 – 2	D	2	9.5	DBST	110,000

\*The Unit Cost includes earthwork, pavement, drainage, slope protection and minor bridges.

### 11.5.3 Cost Estimate of Improvement Measures

The cost estimates of civil works for the different road sections in the master plan are presented in **Table 11.5.3** to **11.5.5** for the 1-Digit national, 2-Digit national and provincial roads, respectively.

Moreover, the maintenance cost for the different road classification is presented in **Table 11.5.6**.

A summary of civil works and maintenance cost is presented in **Table 11.5.7**.

The civil works costs of the different road projects are distributed into short, medium and long-term projects depending on the results of prioritization as presented in the implementation program of Chapter MP-A-14. See Appendix for MP-A-11 for the details of the costs.

**Table 11.5.3 Civil Works Cost of 1-Digit National Roads**

\*Unit in US\$ million

Road Section	Location	Length (km)	Type	Road Category	No. Lane	Pavement	Unit Cost	Amount
<b>NR 1</b>	<b>Phnom Penh -Vietnam Border</b>	<b>166.0</b>						<b>171.0</b>
1-1	Phnom Penh -Neak Leuong	60.0	1-4	International Highway	4	AC	-	** 103.0
1-2	Neak Leuong Ferry	(2)	1-3	International Highway	2	AC	35.00	70.0
1-3	Neak Leuong -Bavet (Vietnam Border)	106.0	1-5	International Highway	2	AC	0.34	36.0
<b>NR 2</b>	<b>Takhmao -Phnom Den (VN Border)</b>	<b>120.0</b>						<b>35.0</b>
2-1	Takhmao -Takeo	68.0	1-5	Highway/ Arterial	2	AC	0.34	23.0
2-2	Takeo -Phnom Den (VN Border)	52.0	1-5	Highway/ Arterial	2	AC	-	* 12.0
<b>NR 3</b>	<b>Phnom Penh -Veal Rinh</b>	<b>202.0</b>						<b>67.5</b>
3-1	Phnom Penh -Kampot	148.0	1-5	Highway/ Arterial	2	AC	0.34	50.0
3-2	Kampot-Veal Rinh	54.0	1-5	International Highway	2	AC		* 17.5
<b>NR 4</b>	<b>Phnom Penh -Sihanoukville</b>	<b>214.0</b>						<b>81.0</b>
4-1	Phnom Penh – Kampong Speu	36.0	1-4	International Highway	4	AC	0.66	24.0
4-2	Kampong Speu – NR.48	92.0	-	International Highway				
4-3	NR.48 -Sihanoukville	86.0	1-4	International Highway	4	AC	0.66	57.0
<b>NR 5</b>	<b>Phnom Penh -Poi Pet</b>	<b>406.0</b>						<b>162.6</b>
5-1	Phnom Penh -Odongk	37.0	1-4	International Highway	4	AC	0.66	24.0
5-2	Odongk -Kompong Chhnang	53.0	1-4	International Highway	4	AC	0.66	35.0
5-3	Kompong Chhnang -Battambang	205.0	1-5	International Highway	2	AC	0.34	70.0
5-4	Battambang -Sisophon	64.0	1-5	International Highway	2	AC	0.34	22.0
5-5	Sisophon -Poi Pet	47.0	1-5	International Highway	2	AC	-	* 11.6
<b>NR .6</b>	<b>Phnom Penh -Sisophon</b>	<b>416.0</b>						<b>162.4</b>
6-1	Phnom Penh -KM20	20.0	1-4	Highway/ Arterial	4	AC	0.66	13.0
6-2	KM20 -Skun	55.0	1-4	Highway/ Arterial	4	AC	0.66	36.0
6-3	Skun -Siem Reap	243.0	1-5	Highway/ Arterial	2	AC	0.34	83.0
6-4	Siem Reap -Sisophon	98.0	1-5	International Highway	2	AC	-	* 30.4
<b>NR 7</b>	<b>Skun -Doung Krolor (Laos Border)</b>	<b>464.0</b>						<b>161.0</b>
7-1	Skun -NR.11	61.0	1-4	International Highway	4	AC	0.66	40.0
7-2	NR.11 -Kratie	210.0	1-5	International Highway	2	AC	0.34	71.0
7-3	Kratie -Stoeung Treng	137.0	1-5	International Highway	2	AC	-	* 50.0
7-4	Stoeung Treng -Laos border	56.0	1-5	International Highway	2	AC	-	
<b>NR 8</b>	<b>Preak Tameak -NR13</b>	<b>64.0</b>	<b>1-5</b>	<b>Highway/ Arterial</b>	<b>2</b>	<b>AC</b>	<b>0.34</b>	<b>22.0</b>
	Sub-total	<b>2,052.0</b>						<b>900..5</b>
New Construc- tion	Phnom Penh Ring Road	50.0	1-1	International Highway	4	AC	2.00	100.0
	2nd Chruoy Changvar Bridgecrossing Tonle Sap	1.5	1-3	International Highway	2	AC	35.00	53.0
	2nd Monivong Bridgecrossing Bassac	1.2	1-3	International Highway	2	AC	35.00	42.0
	Kampong Chhnang Bypass	20.0	1-2	International Highway	2	AC	0.76	15.0
	Battambang Bypass	30.0	1-2	International Highway	2	AC	0.76	23.0
	Siem Reap Bypass	30.0	1-2	Highway / Arterial	2	AC	0.76	23.0
	Sub-total	<b>132.7</b>						<b>256.0</b>
Total Civil Works Cost (1-Digit)								<b>1,156.5</b>

\*Cost indicates contract amount of on-going project

\*\*Includes on-going project contract amount and cost of widening to 4-lanes

**Table 11.5.4 Civil Works Cost of 2-Digit National Roads**

\*Unit in US\$ million

Road Section	Location	Length (km)	Type	Road Category	No. Lane	Pave ment	Unit Cost per km	Amount
NR 11	Neak Leoung-Thnal Toteoung	90.4	2-1	Highway/ Minor Arterial	2	AC	0.29	26.0
NR 13	Svay Rieng - Traok	44.6	2-3	Provincial / Collector	2	DBS	0.19	8.0
NR 21	Takhmao - Chrev Thom	65.6	2-1	Highway/ Minor Arterial	2	AC	0.29	19.0
NR 21A	Takhmao - Wat Chhoung Leab	20.1	2-3	Provincial / Collector	2	DBS	0.19	4.0
NR 22	Ou Chambok - Ang Tasom	9.6	2-1	Highway/ Minor Arterial	2	AC	0.29	3.0
NR 31	Thnal Bek Koas - Kampong Trach	54.8	2-1	Highway/ Minor Arterial	2	AC	0.29	16.0
NR 32	Road to Bokor - Bokor ton	33.3	2-3	Provincial / Collector	2	DBS	0.19	6.0
NR 33-1	Kampot - Kampong Trach	35.3	2-1	International Highway	2	AC	0.29	10.0
NR 33-2	Kampong Trach - Lork	17.0	2-1	International Highway	2	AC	0.29	5.0
NR 33A	See Sor (Keb) - Krong Keb	19.7	2-3	Provincial / Collector	2	DBS	0.19	4.0
NR 41	Korng Keng - Ream	9.3	2-3	Provincial / Collector	2	DBS	0.19	2.0
NR 42	Bek Chan - Bat Doeng	24.3	2-3	Provincial / Collector	2	DBS	0.19	5.0
NR 44	Chba Morn - Khtes Village	84.8	2-3	Provincial / Collector	2	DBS	0.19	16.0
NR 46	Treng Tro Yeung - Kirirom Mount - Thai Border	27.0	2-3	Provincial / Collector	2	DBS	0.19	5.0
NR 48	Chamker Loung - Thai Border	161.3	2-1	International Highway	2	AC	-	* 29.7
NR 51	Veang Chass - Wat Ang Metrev	44.9	2-1	Highway/ Minor Arterial	2	AC	0.29	13.0
NR 52	Ponlev - Chhnang Trou	8.0	2-3	Provincial / Collector	2	DBS	0.19	2.0
NR 53	Kampong Chhnang - Teuk Phos	27.3	2-3	Provincial / Collector	2	DBS	0.19	5.0
NR 54	Krakor - Tonle Sap	4.9	2-3	Provincial / Collector	2	DBS	0.19	1.0
NR 55	Anlong Thnaot - Kam Reng	22.3	2-3	Provincial / Collector	2	DBS	0.19	4.0
NR 56	Banteav Mean - Oddar Mean Chev	113.6	2-1	Highway/ Minor Arterial	2	AC	0.29	33.0
NR 57	Battambang - Ou Prum - Thai Border	103.3	2-1	Highway/ Minor Arterial	2	AC	0.29	45.0
NR 59	Thma Kom - Khoum Lvea	16.3	2-3	Provincial / Collector	2	DBS	0.19	3.0
NR 60	Sambor Chev - Prey Toteng	19.9	2-1	Highway / Minor Arterial	2	AC	0.29	6.0
NR 61	Prek Kdam - Thnal Keik	15.9	2-1	Highway/ Minor Arterial	2	AC	0.29	5.0
NR 62-1	Thnal Baek - Tbeng Meanchey	128.4	2-1	Highway/ Minor Arterial	2	AC	0.29	37.0
NR 62-2	Tbeng Meanchey - Prasat Peah Viar	114.3	2-3	Provincial / Collector	2	DBS	0.19	22.0
NR 63	Siem Reap - Chong Khnaes	14.3	2-3	Provincial / Collector	2	DBS	0.19	3.0
NR 64-1	Svay Thom (NR6) - 18km	18.0	2-1	Highway/ Minor Arterial	2	AC	-	* 2.2
NR 64-2	18km - Dang Rek	116.0	2-1	Highway/ Minor Arterial	2	AC	-	* 25.6
NR 65	Dam Deck (NR67) - Trapeang Prey	21.5	2-3	Provincial / Collector	2	DBS	0.19	4.0
NR 66-1	Trach Chrum(NR67) - Phnom Deak	139.9	2-1	International Highway	2	AC	0.29	41.0
NR 66-2	Phnom Deak - Thalabarivat	145.4	2-1	International Highway	2	AC	0.29	42.0
NR 68	Kralanh - Osmach (T-B)	117.7	2-1	Highway/ Minor Arterial	2	AC	0.29	34.0
NR 70	Prey Toteung - Peam Chikong	13.5	2-3	Provincial / Collector	2	DBS	0.19	3.0
NR 71	Treung (NR7) - Kompong Thmar (NR6)	57.8	2-1	Highway/ Minor Arterial	2	AC	0.29	17.0
NR 72	Kreak Tboung (NR7) - Smach	13.5	2-1	Highway/ Minor Arterial	2	AC	0.29	4.0
NR 73	Pratheat - Chhloung	57.4	2-3	Provincial / Collector	2	DBS	0.19	11.0
NR 74	Snuol - Khum Thnu (Vietnam B)	17.9	2-3	Provincial / Collector	2	DBS	0.19	3.0
NR 76-1	Srei Char (NR7) - Mondlikiri	130.7	2-1	Highway/ Minor Arterial	2	AC	0.29	38.0
NR 76-2	Mondorikiri - Ta Ang (NR78)	193.5	2-3	Provincial / Collector	2	DBS	0.19	37.0
NR 78-1	Ou Pong Moan - Bang Lung	124.0	2-1	International Highway	2	AC	0.29	36.0
NR 78-2	Bang Lung - Vietnam B	70.0	2-1	International Highway	2	AC	-	* 26.0
NR 78A	Rattanak Kiri - Veun Sai	36.9	2-3	Provincial / Collector	2	DBS	0.19	7.0
NR 78B	Thrang Svay - Ta Veng	39.0	2-3	Provincial / Collector	2	DBS	0.19	7.0
Total Road Length		<b>2,643.2</b>	Total Civil Works Cost (2-Digit)					<b>675.5</b>

\*Cost indicates contract amount of on-going project

**Table 11.5.5 Civil Works Cost of Provincial Roads**

\*Unit in US\$ million

Location	Length (km)	Type	Road Category	No. Lane	Pavement	Unit Cost per km	Amount
PR 104	9.6	3-1	Provincial / Collector	2	DBST	0.15	1.4
PR 111 + Connection to NR.21	41.0	3-2	Provincial / Collector	2	DBST	0.11	5.0
PR 114	16.4	3-1	Provincial / Collector	2	DBST	0.15	2.0
PR 127	15.0	3-1	Provincial / Collector	2	DBST	0.15	2.0
PR 2082+2081+2076 (NR 59)	101.0	3-1	Provincial / Collector	2	DBST	0.15	15.0
PR 210	91.7	3-2	Provincial / Collector	2	DBST	0.11	10.0
PR 210A	70.0	3-2	Provincial / Collector	2	DBST	0.11	8.0
PR 212	77.0	3-2	Provincial / Collector	2	DBST	0.11	8.0
PR 213	112.4	3-2	Provincial / Collector	2	DBST	0.11	12.0
PR 274	132.0	3-1	Provincial / Collector	2	DBST	0.15	20.0
PR 301	47.4	3-2	Provincial / Collector	2	DBST	0.11	5.0
PR 301-1	59.0	3-2	Provincial / Collector	2	DBST	0.11	6.0
PR 301-2	59.0	3-2	Provincial / Collector	2	DBST	0.11	6.0
PR 305	120.0	3-2	Provincial / Collector	2	DBST	0.11	13.0
PR 308	34.6	3-1	Provincial / Collector	2	DBST	0.15	5.0
PR 316	35.0	3-1	Provincial / Collector	2	DBST	0.15	5.0
PR 148	114.0	3-1	Provincial / Collector	2	DBST	0.15	17.0
PR 148A	120.0	3-1	Provincial / Collector	2	DBST	0.15	18.0
Road connecting NR13 to NR 7	61.4	3-1	Provincial / Collector	2	DBST	0.15	9.0
Stung Treng-Cham Khsan	135.0	3-1	Provincial / Collector	2	DBST	0.15	20.0
Kampong Thom-Kratie	102.0	3-1	Provincial / Collector	2	DBST	0.15	15.0
<b>Total Road Length</b>	<b>1,553.5</b>					<b>Total of Improvement Cost</b>	<b>202.4</b>



**Table 11.5.6 Routine Maintenance Cost**

Road Classification	Total Road Length (km)	Maintenance Cost per Year (US\$ million)	Implementation Cost (US\$ million)			
			Short-Term (2006-2010)	Short-Term (2011-2015)	Short-Term (2016-2020)	Total
1-Digit National Road	2,052.0	6.12	30.6	30.6	30.6	91.8
2-Digit National Road	2,643.2	5.81	23.9	34.1	29.1	87.1
Provincial Road	6,615.0	18.66	54.9	97.0	128.0	279.9
Rural Road	18,154.0	1.45	3.6	7.2	10.9	21.7
Total Maintenance Cost			<b>113.0</b>	<b>168.9</b>	<b>198.6</b>	<b>480.5</b>

**Table 11.5.7 Summary of Civil Works and Maintenance Cost**

\*Unit in US\$ million

Road Classification		Total Road Length (km)	Civil Works Improvement Cost	Maintenance Cost	Total Cost
1-Digit National Road	Existing	2,052	901	92	993
	New	133	256	-	256
2-Digit National Road		2,643	676	87	763
Provincial Road		6,615	202	280	482
Rural Road		18,948	-	22	22
Total		30,391	2,035	481	2,516

**APPENDIX FOR CHAPTER MP-A-11 COST SUMMARY FOR CIVIL WORKS**

**Appendix for MP-A-11 (1) Derivation of Improvement Measures Civil Works Unit Costs**

Road Classification	Type of Improvement Measures	New Construction/ Upgrading/ Maintenance	Type of Cross Section	Lane No.	Carriageway Wdth (m)	Pavement Width (m)	Pavement Type	*U/C (\$/km) Standardized (@10m wide)	Adjustment Factor			U/C (\$/km) Adjusted
									**Pavement Width Factor	New Construction/ Upgrading New Const.: 1.5 - 2.0 Upgrading: 1.0	***Road Structure Factor	
IMPROVEMENT 1 Digit Road including New Road	TYPE 1-1	New Construction of Road	TYPE A	4	24.0	21.0	AC	270,000	2.05	2.0	1.80	2,000,000
	TYPE 1-2		TYPE B	2	13.0	13.0	AC	270,000	1.15	1.5	1.60	760,000
	TYPE 1-3	New Construction of Bridge	TYPE B	2	13.0	13.0	AC	35,000,000	NA	NA	NA	35,000,000
	TYPE 1-4	Upgrading	TYPE A	4	24.0	21.0	AC	270,000	2.05	1.0	1.20	660,000
	TYPE 1-5		TYPE B	2	13.0	13.0	AC	270,000	1.15	1.0	1.10	340,000
2 Digit Road	TYPE 2-1	Upgrading	TYPE B	2	13.0	13.0	AC	270,000	1.05	1.0	1.02	290,000
	TYPE 2-2		TYPE C-1	2	11.0	11.0	AC	270,000	0.90	1.0	1.00	240,000
	TYPE 2-3		TYPE C-2	2	11.0	11.0	DBST	200,000	0.95	1.0	1.00	190,000
3 Digit Road	TYPE 3-1	Upgrading	TYPE C-2	2	11.0	11.0	DBST	200,000	0.90	1.0	0.85	150,000
	TYPE 3-2		TYPE D	2	9.5	7.5	DBST	200,000	0.75	1.0	0.75	110,000

\*This Unit Cost includes Earthwork, Pavement (DBST), Drainage, Slope Protection and Minor Bridges and was calculated based on the past projects with standardization of pavement width to 10m.

\*\*Pavement width factor considers the width of sealed traffic lanes and shoulders. The basis of original cost is 7m traffic lanes with 3m shoulders. Cost of improvement is adjusted based on the traffic lanes and shoulder width plus the anticipated traffic due to road function.

\*\*\*Other factors include additional costs for road structure/facilities due to function, road strengthening against disaster (slope protection), etc.

Appendix for MP-A-11 (2) Civil Works Costs of Improvement Measures for 1-Digit Roads

1 Digit Road Section	Location	Existing Road				Improvement Measures							Remarks	
		Length (km)	Traffic Lanes	Carriageway (m)	Type of Pavement	Traffic Volume (PCU)	Type of Improvement Measures	Road Category	Lane Nos.	Pavement	Typical Cross Section	Future Traffic Volume (PCU)		Amount (Million US\$)
<b>NR 1</b>	<b>Phnom Penh - Vietnam Border</b>	<b>166.0</b>											<b>209.0</b>	
1-1	Phnom Penh - Neak Leuong	60.0	2x 3.0	8.0-10.0	DBST	12,150	TYPE 1-4	International Highway	4Lanes	AC	Type A	41,090	** 103.0	On-going Project is 2-lane road which will be widened to 4-lane AC in the long-term
1-2	Neak Leuong Ferry	(2)	-	-	-	5,240	TYPE 1-3	International Highway	2 Lanes	AC	Type B	28,570	70.0	Under Study by Japan
1-3	Neak Leuong - Bavet (Vietnam Border)	106.0	2x 3.75	11.5	DBST	2,930	TYPE 1-5	International Highway	2Lanes	AC	Type B	12,410	36.0	
<b>NR 2</b>	<b>Takhmao - Phnom Den (VN Border)</b>	<b>120.0</b>												<b>35.0</b>
2-1	Takhmao - Takeo	68.0	2 x 3.0	8.0-10.0	DBST	7,690	TYPE 1-5	Highway/ Arterial	2 Lanes	AC	Type B	15,190	23.0	
2-2	Takeo - Phnom Den (VN Border)	52.0	2 x 3.50	10.0-11.0	AC	980	TYPE 1-5	Highway/ Arterial	2 Lanes	AC	Type B	4,490	* 12.0	On-going Project. Road structure to be upgraded based on traffic demand (AC)
<b>NR 3</b>	<b>Phnom Penh - Veal Rin</b>	<b>202.0</b>												<b>67.5</b>
3-1	Phnom Penh - Kampot	148.0	2 x 3.0	8.0-10.0	DBST	4,820	TYPE 1-5	Highway/ Arterial	2 Lanes	AC	Type B	13,890	50.0	
3-2	Kampot- Veal Rin	54.0	2 x 3.50	10.0-11.0	DBST	2,050	TYPE 1-5	International Highway	2 Lanes	AC	Type B	7,210	* 17.5	(32.5 Km) On-going Project. Road structure to be upgraded based on traffic demand (DBST)
<b>NR 4</b>	<b>Phnom Penh - Sihanoukville</b>	<b>214.0</b>												<b>81.0</b>
4-1	Phnom Penh - Kampong Speu	36.0	2 x 3.50	10.0-13.0	AC	4,730	TYPE 1-4	International Highway	4 Lanes	AC	Type A	18,170	24.0	BOT Road
4-2	Kampong Speu - NR-48	92.0	3 x 3.50	10.0-13.1	AC	4,730			2 Lanes	AC				
4-3	NR.48 - Sihanoukville	86.0	2 x 3.50	10.0-13.0	AC	4,730	TYPE 1-4	International Highway	4 Lanes	AC	Type A		57.0	BOT Road
<b>NR 5</b>	<b>Phnom Penh - Poi Pet</b>	<b>406.0</b>												<b>162.6</b>
5-1	Phnom Penh - Odongk	37.0	2 x 3.50	11.0-12.0	DBST	15,720	TYPE 1-4	International Highway	4 Lanes	AC	Type A	34,410	24.0	
5-2	Odongk - Kompong Chhnang	53.0	2 x 3.50	11.0-12.0	DBST	9,230	TYPE 1-4	International Highway	4 Lanes	AC	Type A	37,850	35.0	
5-3	Kompong Chhnang - Battambang	205.0	2 x 3.50	10.0-12.0	DBST	5,130	TYPE 1-5	International Highway	2 Lanes	AC	Type B	22,000	70.0	
5-4	Battambang - Sisophon	64.0	2 x 3.0	10.0-11.0	DBST	5,840	TYPE 1-5	International Highway	2 Lanes	AC	Type B	16,510	22.0	
5-5	Sisophon - Poi Pet	47.0	2X3.0	6.5-9.0	Damaged	6,490	TYPE 1-5	International Highway	2-4 Lanes	AC	Type B	17,460	* 11.6	On-going Project. Road structure to be upgraded based on traffic demand (AC)
<b>NR 6</b>	<b>Phnom Penh - Sisophon</b>	<b>416.0</b>												<b>162.4</b>
6-1	Phnom Penh - KM20	20.0	2 x 3.50	9.0-10.0	AC	20,850	TYPE 1-4	Highway/ Arterial	4 Lanes	AC	Type A	50,880	13.0	
6-2	KM20 - Skun	55.0	2 x 3.50	9.0-11.0	AC	8,350	TYPE 1-4	Highway/ Arterial	4 Lanes	AC	Type A	35,210	36.0	
6-3	Skun - Siem Reap	243.0	2 x 3.50	10.0-11.0	DBST	2,760	TYPE 1-5	Highway/ Arterial	2 Lanes	AC	Type B	20,650	83.0	
6-4	Siem Reap - Sisophon	98.0	2 x 2.75	6.5-9.0	Damaged	3,620	TYPE 1-5	International Highway	2 Lanes	AC	Type B	16,050	* 30.4	On-going Project. Road structure to be upgraded based on traffic demand (AC)
<b>NR 7</b>	<b>Skun - Doung Krolor (Laos Border)</b>	<b>464.0</b>												<b>161.0</b>
7-1	Skun - NR-11	61.0	2 x 3.50	9.0-10.0	AC	8,140	TYPE 1-4	International Highway	4 Lanes	AC	Type A	33,270	40.0	
7-2	NR-11 - Kratie	210.0	2 x 3.50	11.0-12.0	DBST	2,320	TYPE 1-5	International Highway	2 Lanes	AC	Type B	8,950	71.0	
7-3	Kratie - Stoeung Treng	137.0	2 x 3.50	11.0	DBST	460	TYPE 1-5	International Highway	2 Lanes	AC	Type B	1,530	50.0	On-going Project. Road structure to be upgraded based on traffic demand (DBST)
7-4	Stoeung Treng - Laos border	56.0	2 x 3.50	11	DBST	710	TYPE 1-5	International Highway	2 Lanes	AC	Type B	2,570		
<b>NR 8</b>	<b>Preak Tameak - NR13</b>	<b>64.0</b>	<b>1</b>	<b>4.5-6.5</b>	<b>Earth</b>		<b>TYPE 1-5</b>	<b>Highway/ Arterial</b>	<b>2 Lanes</b>	<b>AC</b>	<b>Type B</b>			<b>22.0</b>
<b>Total of 1 Digit Road (Existing)</b>		<b>2,052.0</b>												<b>900.5</b>
New Construction	Phnom Penh Ring Road	50.0	-	-	-		TYPE 1-1	International Highway	4 Lanes	AC	Type A			100.0
	2nd Chruoy Changvar Bridge crossing Tonle Sap	1.5	-	-	-		TYPE 1-3	International Highway	2 Lanes	AC	Type B			53.0
	2nd Monivong Bridge crossing Bassac	1.2	-	-	-		TYPE 1-3	International Highway	2 Lanes	AC	Type B			42.0
	Battambang Bypass	30.0	-	-	-		TYPE 1-2	Highway / Arterial	2 Lanes	AC	Type B			23.0
	Siem Reap Bypass	30.0	-	-	-		TYPE 1-2	Highway / Arterial	2 Lanes	AC	Type B			23.0
	Kampong Chhnang Bypass	20.0	-	-	-		TYPE 1-2	Highway / Arterial	2 Lanes	AC	Type B			15.0
<b>Total of Bypass (New)</b>		<b>133.0</b>												<b>256.0</b>
<b>Total of Improvement cost</b>		<b>2,185.0</b>												<b>1,156.5</b>
<b>Total of Maintenance cost</b>		<b>2,052.0</b>												<b>91.8</b>
<b>TOTAL COST FOR 1 DIGIT ROAD</b>														<b>1,248.3</b>

\* Contract Amount of On-going Project

Appendix for MP-A-11 (3) Civil Works Costs of Improvement Measures for 2-Digit Roads

2 Digit Road Section	Location	Existing Road				Improvement Measures							Remarks	
		Length (km)	Traffic Lanes	Carriageway (m)	Type of Pavement	Traffic Volume (PCU)	Type of Improvement Measures	Road Category	Lane Nos.	Pavement	Typical Cross Section	Future Traffic Volume (PCU)		Amount (Million US\$)
NR 11	Neak Leoung-Thnal Toteoung	90.4	2 x 3.50	9.0	DBST	2,020	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	17,430	26.0	
NR 13	Svay Rieng - Trach	44.6	2 X 3.00	4.5-6.5	Laterite	50	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	170	8.0	
NR 21	Takhmao - Chrey Thom	65.6	2 X 3.00	10.0	DBST	600	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	4,400	19.0	
NR 21A	Takhmao - Wat Chhoung Leab	20.1	2 x 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		4.0	
NR 22	Ou Chambok - Ang Tasom	9.6	2 X 3.00	4.5-6.5	DBST	70	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	14,710	3.0	
NR 31	Thnal Bek Koas - Kampong Trach	54.8	2 X 3.00	10.0	DBST	620	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	2,680	16.0	
NR 32	Road to Bokor - Bokor top	33.3	2 X 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		6.0	
NR 33-1	Kampot - Kampong Trach	35.3	2 X 3.00	10.0	DBST	610	TYPE 2-1	International Highway	2 Lanes	AC	Type B	2,090	10.0	
NR 33-2	Kampong Trach - Lork	17.0	3 X 3.00	10.0	Laterite	610	TYPE 2-1	International Highway	2 Lanes	AC	Type B	2,090	5.0	(17.0 Km) Committed Project
NR 33A	See Sor (Keb) - Krong Keb	19.7	2 X 3.00	4.5-6.5	DBST		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		4.0	
NR 41	Kong Keng - Ream	9.3	2 X 3.00	4.5-6.5	DBST		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		2.0	
NR 42	Bek Chan - Bat Doeng	24.3	2 X 3.00	6.5-9.0	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	14,340	5.0	
NR 44	Chba Morn - Khies Village	84.8	2 X 3.00	4.5-9.0	Laterite	400	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	2,140	16.0	
NR 46	Treng Tro Yeung - Kirirom Mount - Thai Border	27.0	2 X 3.00	6.5-9.0	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		5.0	
NR 48	Chamker Loung - Thai Border	161.3	2 X 3.50	10.0-11.0	DBST	1,020	TYPE 2-1	International Highway	2 Lanes	AC	Type B	3,260	* 29.7	On-going Project. Road structure to be upgraded based on traffic demand (DBST)
NR 51	Veang Chass - Wat Ang Metrey	44.9	2 X 3.50	10.0-11.0	DBST	1,600	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	19,550	13.0	
NR 52	Ponley - Chhnang Trou	8.0	2 X 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		2.0	
NR 53	Kampong Chhnang - Teuk Phos	27.3	2 X 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	470	5.0	
NR 54	Krakor - Tonle Sap	4.9	2 X 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		1.0	
NR 55	Anlong Thnaot - Kam Reng	22.3	2 X 3.00	4.5-6.5	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		4.0	
NR 56	Banteay Mean - Oddar Mean Chey	113.6	2 X 3.00	6.5-9.0	Laterite	260	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	1,240	33.0	Committed Project
NR 57	Battambang - Ou Prum - Thai Border	103.3	2 X 3.00	6.5-9.0	Laterite	1,120	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	3,710	45.0	
NR 59	Thma Kom - Khoum Lvea	16.3	2 X 3.00	6.5-9.0	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	510	3.0	
NR 60	Sambor Chey - Prey Toteng	19.9	2 X 3.00	4.5-6.5	DBST	540	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	3,460	6.0	
NR 61	Prek Kdam - Thnal Keik	15.9	2 X 3.00	9.0-10.0	DBST	3,890	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	17,800	5.0	
NR 62-1	Thnal Baek - Tbeng Meanchey	128.4	1 X 3.00	4.5-6.5	Laterite	270	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	2,420	37.0	On-going Project. Road structure to be upgraded based on traffic demand (DBST)
NR 62-2	Tbeng Meanchey - Prasat Peah Viar	114.3	1 X 3.00	4.5-6.5	Earth	160	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	1,010	22.0	
NR 63	Siem Reap - Chong Khnaes	14.3	2 X 3.00	6.5-9.0	DBST		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		3.0	
NR 64-1	Svay Thom (NR6) - 18km	18.0	2 X 3.00	6.5-9.0	Laterite	540	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	5,130	* 2.2	(18.0Km) On-going Project. Road structure to be upgraded based on traffic demand (DBST).
NR 64-2	18km - Dang Rek	116.0	2 X 3.00	6.5-9.0	Laterite	540	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	5,130	* 25.6	Committed Project
NR 65	Dam Deck (NR67) - Trapeang Prey	21.5	2 X 3.00	6.5-9.0	Laterite	510	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	1,740	4.0	On-going Project. Road structure to be upgraded based on traffic demand (DBST)
NR 66-1	Trach Chrum(NR67) - Phnom Deak	139.9	2 X 3.00	<4.5	Laterite	510	TYPE 2-1	International Highway	2 Lanes	AC	Type B	1,740	41.0	
NR 66-2	Phnom Deak - Thalabarivat	145.4	2 X 3.00	<4.5	Earth	120	TYPE 2-1	International Highway	2 Lanes	AC	Type B	460	42.0	
NR 68	Kralanh - Osmach (T-B)	117.7	2 X 3.00	6.5-9.0	Laterite	580	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	3,120	34.0	Committed Project
NR 70	Prey Toteung - Peam Chikong	13.5	2 X 3.00	4.5-6.5	DBST	680	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	2,650	3.0	
NR 71	Treung (NR7) - Kompong Thmar (NR6)	57.8	2 X 3.00	6.5-9.0	DBST	720	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	13,790	17.0	(15.5 Km) On-going Project. Road structure to be upgraded based on traffic demand (DBST).
NR 72	Kreak Tboung (NR7) - Smach	13.5	2 X 3.00	6.5-9.0	Laterite	1,260	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	6,030	4.0	Committed Project
NR 73	Pratheat - Chhloung	57.4	2 X 3.00	4.5-6.5	Laterite	310	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	2,480	11.0	
NR 74	Snuol - Khum Thnu (Vietnam B)	17.9	2 X 3.00	6.5-9.0	Laterite	910	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	940	3.0	
NR 76-1	Srei Char (NR7) - Mondlikiri	130.7	2 X 3.00	6.5-9.0	Laterite	500	TYPE 2-1	Highway / Minor Arterial	2 Lanes	AC	Type B	2,590	38.0	
NR 76-2	Mondrikiri - Ta Ang (NR78)	193.5	2 X 3.00	4.5-6.5	Laterite	10	TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2	260	37.0	
NR 78-1	Ou Pong Moan - Bang Lung	124.0	2 X 3.00	4.5-6.5	Laterite	290	TYPE 2-1	International Highway	2 Lanes	AC	Type B	810	36.0	
NR 78-2	Bang Lung - Vietnam B	70.0	2 X 3.00	4.5-6.5	Laterite	290	TYPE 2-1	International Highway	2 Lanes	AC	Type B	810	* 26.0	(70.0 Km) Committed Project.
NR 78A	Rattanak Kiri - Veun Sai	36.9	2 X 3.00	4.5-6.6	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		7.0	
NR 78B	Thrang Svay - Ta Veng	39.0	2 X 3.00	4.5-6.7	Laterite		TYPE 2-3	Provincial / Collector	2 Lanes	DBST	Type C-2		7.0	
<b>Total of Improvement cost</b>		<b>2,643.2</b>										<b>675.5</b>	<b>675.5</b>	
<b>Total of Maintenance cost</b>		<b>2,643.2</b>										<b>87.1</b>	<b>87.1</b>	
<b>TOTAL COST FOR 2 DIGIT ROAD</b>												<b>762.6</b>	<b>762.6</b>	

\* Contract Amount of On-going Project

**Appendix for MP-A-11 (4) Civil Works Costs of Improvement Measures for 3&4-Digit Provincial Roads**

3 Digit Road and Name of Province	Existing Road				Improvement Measures						Remarks
	Length (km)	Traffic Lanes	Carriageway (m)	Type of Pavement	Type of Improvement Measures	Road Category	Lane Nos.	Pavement	Typical Cross Section	Amount (Million US\$)	
PR 104	9.6	2 x 3.0	4.5-6.5	DBST	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	1.4	
PR 111+Connection to NR-21	41.0			Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	5.0	
PR 114	16.4	2 x 3.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	2.0	
PR 127	15.0	2 x 3.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	2.0	
PR 2082+2081+2076 (NR 59)	101.0	2 x 2.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	15.0	NR-59 Extension
Stung Treng-Cham Khsan	135.0			Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	20.0	
Kampong Thom-Kratie	102.0			Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	15.0	
PR 210	91.7	5.0	4.5-6.5	Laterite	TYPE 3-2	Provincial / Collector	2	DBST	Type D	10.0	
PR 210A	70.0	-	<4.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	8.0	
PR 212	77.0	3.0	4.5-6.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	8.0	
PR 213	112.4	3.0	4.5-6.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	12.0	
PR 274	132.0	2 x 3.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	20.0	
PR 301	47.4	3.0	4.5-6.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	5.0	
PR 301-1	59.0	2.0	<4.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	6.0	
PR 301-2	59.0	2.0	<4.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	6.0	
PR 305	120.0	2.0	<4.5	Earth	TYPE 3-2	Provincial / Collector	2	DBST	Type D	13.0	
PR 308	34.6	2.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	5.0	
PR 316	35.0	2 x 2.0	4.5-6.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	5.0	
PR 148	114.0	2 x 2.0	4.5-6.5	Laterite	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	17.0	
PR 148A	120.0	-	<4.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	18.0	
Road connecting NR13 to NR 7	61.4	-	<4.5	Earth	TYPE 3-1	Provincial / Collector	2	DBST	Type C-2	9.0	
<b>Total of Improvement cost</b>	<b>1,553.5</b>									<b>202.4</b>	<b>202.4</b>
Banteay Meanchey	443.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	18.7	
Siem Reap	535.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	22.6	
Kandal	306.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	12.9	
Kep	18.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	0.8	
Koh Kong	5.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	0.2	
Kompong Chhnang	167.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	7.1	
Kompong Speu	355.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	15.0	
Kompong Thom	413.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	17.5	
Kompot	354.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	15.0	
Kratie	149.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	6.3	
Mondulkiri	103.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	4.4	
Kompong Cham	749.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	31.7	
Odor Meanchey	199.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	8.4	
Pailin	18.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	0.8	
Battambang	410.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	17.3	
Peach Vihear	344.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	14.6	
Prey Veng	464.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	19.6	
Pursat	517.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	21.9	
Rattanakiri	172.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	7.3	
Stung Treng	112.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	4.7	
Svay Rieng	478.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	20.2	
Takeo	300.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	12.7	
Sihanoukville	0.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	0.0	
Phnom Penh	4.0	NA	NA	NA		Provincial / Collector	NA	NA	NA	0.2	
<b>Total of Maintenance cost</b>	<b>6,615.0</b>									<b>279.9</b>	<b>279.9</b>
<b>TOTAL COST FOR 3 DIGIT ROAD</b>										<b>482.3</b>	<b>482.3</b>

Rural Road	Existing Road				Improvement Measures						Remarks
	Length (km)	Carriageway Width (m)	Road Width (m)	Type of Pavement	Type of Improvement Measures	Road Category	Lane Nos.	Pavement	Typical Cross Section	Amount (Million US\$)	
<b>Total of Maintenance cost</b>	<b>18,948.0</b>	NA	NA	NA	NA	NA	NA	NA	NA	<b>21.7</b>	<b>21.7</b>
<b>TOTAL COST FOR RURAL ROAD</b>											<b>21.7</b>

## CHAPTER A-12 PROJECT EVALUATION

### 12.1 Prioritization Methodology

The road network plan was formulated in Chapter A-10 and the proposed improvement measures including cost estimates, were formulated in Chapter A-11. With reference to the identified road improvement projects and the estimated improvement costs, the priority of the projects will be determined based on the project evaluation in this chapter.

#### 12.1.1 Project Evaluation Procedure

The procedure for the project evaluation is illustrated in **Figure 12.1.1**.

The road improvement project list was prepared in Chapter A-10 and the improvement costs were estimated in Chapter A-11. This project list and cost estimation is adopted in this Chapter.

In the project evaluation, the road projects are classified into three (3) types followed by the road network plan:

- 1-Digit National Roads
- 2-Digit National Roads
- Provincial Roads

The evaluation criteria and factors for 1-Digit and 2-Digit National Roads are set up as follows;

- Social & economic criteria

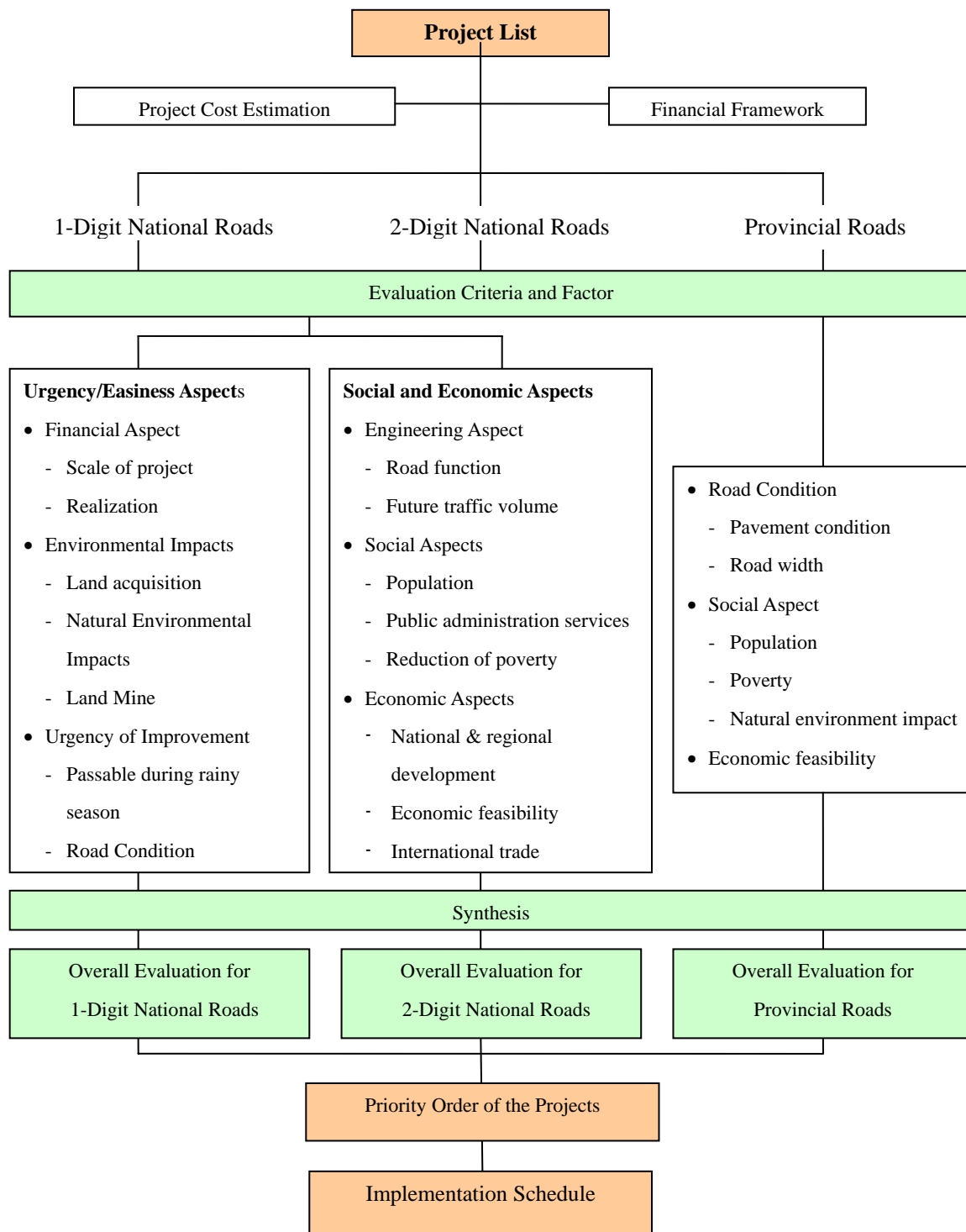
These criteria indicate the degree of the project influence in terms of engineering, social, and economic impacts.

- Urgency & easiness aspect

This indicates how urgent the project is or how easily the project can be implemented from the aspect of financial availability, environmental acceptability and urgency of the project.

An overall evaluation of the road projects is carried out to prioritize the projects using weighted scores from the above-mentioned criteria and factors.

However, the evaluation criteria and factors for the provincial roads are only from a social and economic aspect.

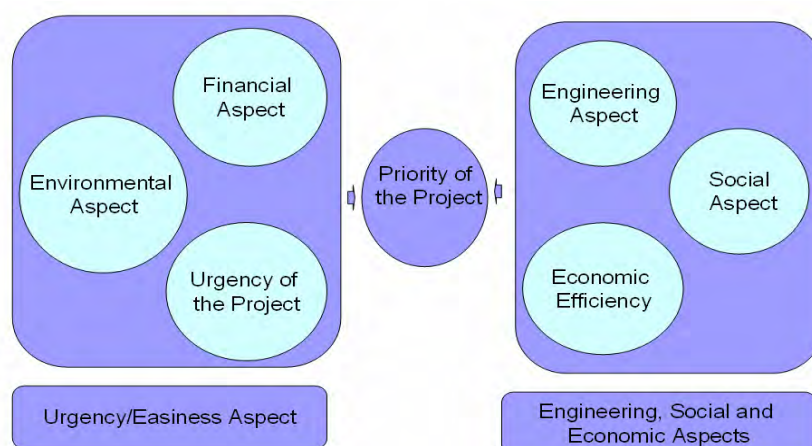


**Figure 12.1.1 Evaluation Procedure for the Project**

## 12.1.2 Evaluation Criteria and Factors

### (1) Selection of Evaluation Criteria and Factors

In order to evaluate the road projects, the following criteria and factors were selected, as shown in **Figures 12.1.2**, **Table 12.1.1** and **Table 12.1.2**, due to their significant influence on road improvements.



**Figure 12.1.2 Prioritization Criteria and Factors**

**Table 12.1.1 Prioritization Factors and Indicators under Social and Economic Criteria**

Factor	Engineering Aspect	Social Aspect	Economic Aspect
1-Digit NR	Max. 10	Max. 30	Max. 60
2-Digit NR	Max. 10	Max. 40	Max. 50
PR	Max. 20	Max. 60	Max. 20
<b>Indicator</b>	<ul style="list-style-type: none"> <li>■ Road Function</li> <li>■ Traffic Volume</li> </ul>	<ul style="list-style-type: none"> <li>■ Influenced Population by Project Road</li> <li>■ Public Administrative Service</li> <li>■ Poverty Reduction</li> </ul>	<ul style="list-style-type: none"> <li>■ National &amp; Regional Development Aspect                             <ul style="list-style-type: none"> <li>- Growth Pole Development</li> <li>- Tourism Development</li> <li>- Industrial Development</li> <li>- Agricultural Development</li> <li>- Logistic Industry Development</li> </ul> </li> <li>■ Economic Indicator                             <ul style="list-style-type: none"> <li>- EIRR</li> <li>- B/C Ratio</li> <li>- NPV</li> </ul> </li> <li>■ International Trade</li> </ul>



**Table 12.1.2 Prioritization Factors and Indicators under Urgency / Easiness Criteria**

Factor	Financial Aspect	Negative Impacts for Project Implementation	Urgency for Project Implementation
1-Digit NR	Max. 50	Max. 20	Max. 30
2-Digit NR	Max. 50	Max. 20	Max. 30
<b>Indicator</b>	<ul style="list-style-type: none"> <li>■ Scale of the Project</li> <li>■ Realization of the Project</li> </ul>	<ul style="list-style-type: none"> <li>■ Difficulty of Land Acquisition</li> <li>■ Natural Environmental Impact</li> <li>■ UXO and Landmine</li> </ul>	<ul style="list-style-type: none"> <li>■ Passable during rainy season</li> <li>■ Urgent improvement from present road condition</li> </ul>

**(2) Ranking and Scoring Method**

The project scores were determined from the scores for the criteria and factors using the following equations:

$$SC_i = SC_i^1 + SC_i^2 + SC_i^3 + SC_i^4 + \dots + SC_i^f + \dots = \sum_{i=1}^n SC_i^f$$

Where :

SC<sub>i</sub> : Total score on road i

SC<sub>i</sub><sup>f</sup> : Scores of factor f of the project road i

The total sums of the scores for each project were categorized into three groups, those are “1<sup>st</sup> Priority”, “2<sup>nd</sup> Priority” or “3<sup>rd</sup> Priority” based on the following ranking.

**Table 12.1.3 Ranking of Scores for the Project Roads**

			Easiness of Project Implementation		
			Easy	Moderate	Difficult
			Rate>80	80>Rate>50	Rate<50
Engineering, Economic and Social Impacts	Large	Rate>80	<b>1<sup>st</sup> Priority</b>	<b>2<sup>nd</sup> Priority</b>	<b>3<sup>rd</sup> Priority</b>
	Moderate	50<Rate<80	<b>2<sup>nd</sup> Priority</b>	<b>2<sup>nd</sup> Priority</b>	<b>3<sup>rd</sup> Priority</b>
	Small	Rate<50	<b>3<sup>rd</sup> Priority</b>	<b>3<sup>rd</sup> Priority</b>	<b>3<sup>rd</sup> Priority</b>

## 12.2 Measurement of the Factors

### 12.2.1 Social and Economic Aspects

#### (1) Function and Role of the Project Roads

The function and role of the projects was defined in Chapter A-11. According to these definitions, the functional classifications were determined as per **Table 12.2.1**. Each project was classified as shown in **Table 12.2.1**.

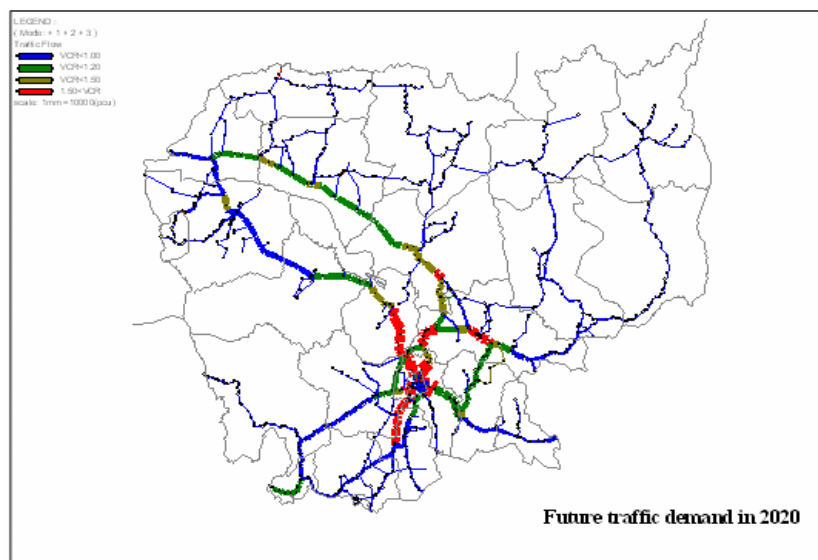
**Table 12.2.1 Function and Role of the Project Roads**

	Name of Road
1-Digit National Roads	
- International highway (Asian Highway & GMR Roads)	NR.1, NR.4, NR.5, NR.7
- National backbone road	NR.6
- Secondary national road	NR.2, NR.3, NR.8
2-Digit National Roads	
- Secondary national backbone road	NR.11, NR.21, NR.22, NR.31, NR.33, NR.42, NR.48, NR.51, NR.56, NR.57, NR.60, NR.61, NR.64, NR.66, NR.71, NR.72, NR.74, NR.76, NR.78
- Provincial backbone road	Other 2-Digit Roads

Source: JICA Study Team

#### (2) Magnitude of Traffic Demand

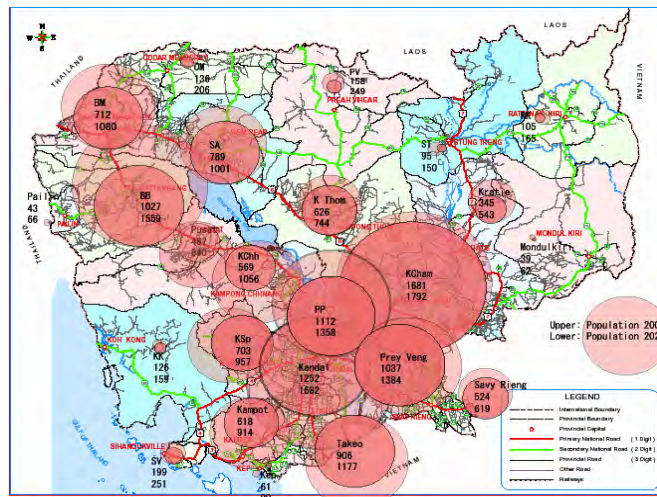
A higher priority is given to project roads that have a higher volume of traffic. Based on the traffic demand forecast (as per Chapter A-8), the traffic demands on the project roads in 2010 and 2020 were estimated as shown in **Figure 12.2.1**.



**Figure 12.2.1 Results of Traffic Assignment in 2020**

**(3) Beneficiaries of the Project Roads**

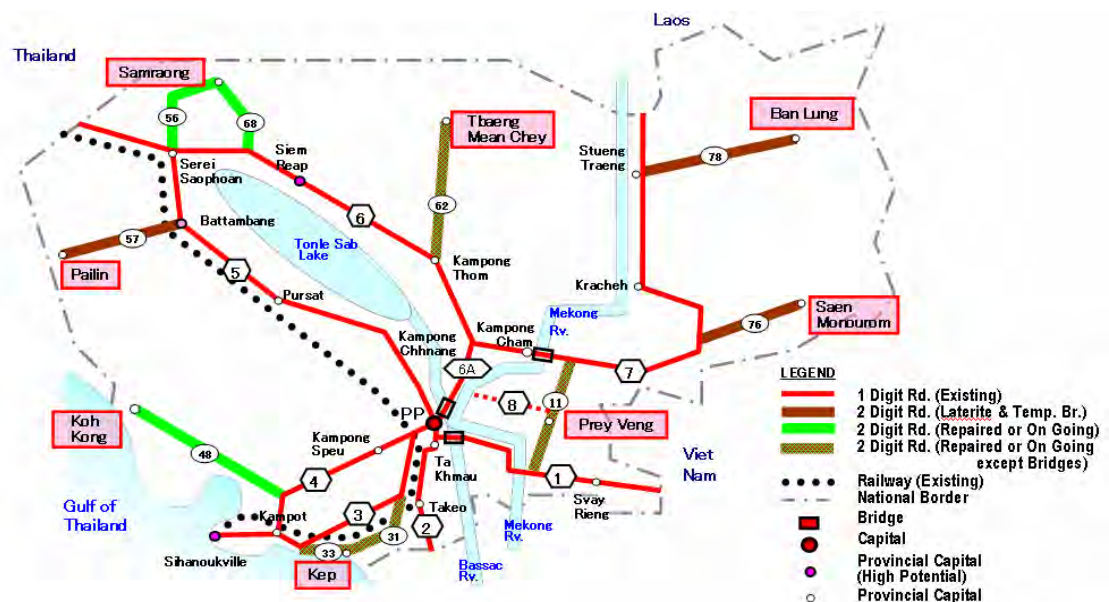
The improvement of the project roads will bring benefits to the people in the vicinity of the roads. In order to identify the number of people that will benefit from the road improvements, the population in the influenced area was estimated at a district level, as shown in **Figure 12.2.2**.



**Figure 12.2.2 Population Distribution**

**(4) Public Administrative Services**

The road improvements will improve the accessibility of the public administration centers where the population receives administrative services, health services, and other public services. The public administration centers can be defined as the provincial capitals, as shown in **Figure 12.2.3**.



**Figure 12.2.3 Location of Public Administration Centers**

## (5) Poverty Level

Poverty reduction is one of the important goals in Cambodia. The road improvements will bring benefits in terms of reducing the poverty of the people along the project roads.

There are many methods for defining the poverty level. These include:

- Energy intake
- Head Count Index (HCI)
- Poverty Gap Index (PGI)
- Poverty Severity Index (PSI)

In Cambodia, the poverty level by district and province was studied under the “National Poverty Reduction Strategy” compiled in 2002 by the Council for Social Development. This study was based on a sample survey undertaken in a number of communes. However, the study results differed from empirical knowledge. Therefore, in this study, ‘poverty’ is defined using the following three (3) factors:

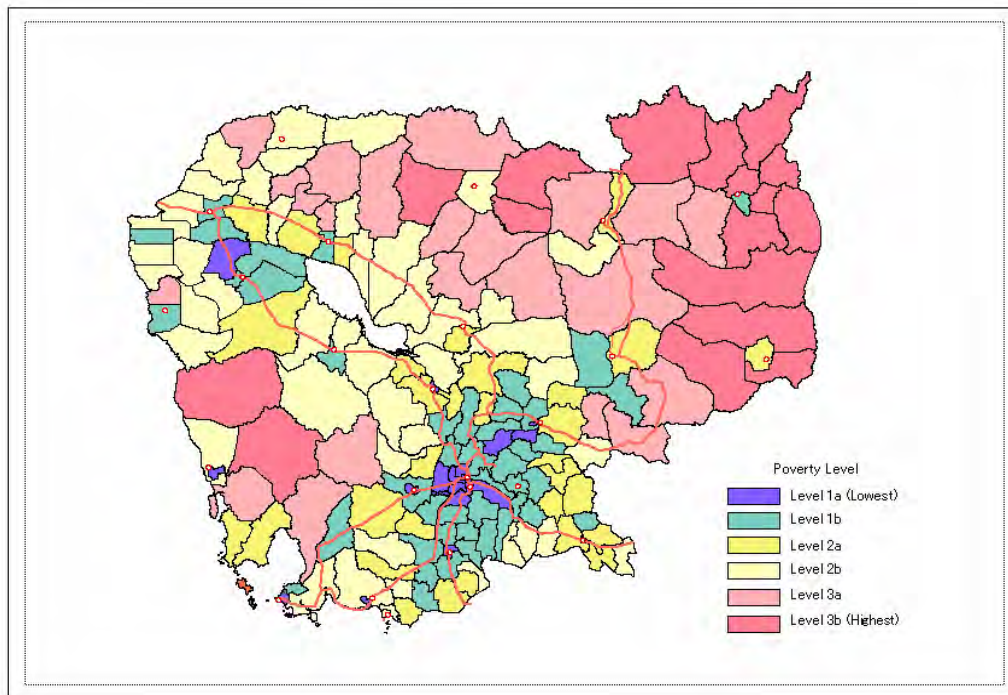
- Ratio of illiterate population to total adult population;
- Ratio of thatched roof households to total households; and
- Ratio of non-TV households to total households.

Based on the above mentioned definitions, the poverty level was estimated by province and district and is presented in **Table 12.2.2** and **Figure 12.2.4**, respectively.

**Table 12.2.2 Poverty Level by Province, 2003**

No	Province	Adult Population	Illiteracy	Illiteracy Ratio	Illiteracy Level	No of Family	Thatcher Roof Family	Thatcher Roof Ratio	Thatcher Roof Level	TV Holding Family	TV Holding Ratio	TV Holding Level	Poverty Level Category
1	Banteay Meanchey	410,163	63,171	0.154	2	130,362	57,059	0.438	4	34,397	0.264	4	3
2	Battambang	584,809	75,363	0.129	2	179,574	74,828	0.417	4	60,608	0.338	3	3
3	Kampong Cham	1,120,973	217,812	0.194	2	355,800	120,029	0.337	3	128,535	0.361	3	2
4	Kampong Chhnang	271,284	42,346	0.156	2	88,675	39,546	0.446	4	30,334	0.342	3	3
5	Kampong Speu	423,327	86,728	0.205	3	129,333	50,388	0.390	3	48,574	0.376	3	3
6	Kampong Thom	389,732	98,607	0.253	3	120,693	55,845	0.463	4	21,196	0.176	5	4
7	Kampot	360,796	67,219	0.186	2	111,759	39,366	0.352	3	28,437	0.254	4	3
8	Kandal	766,636	99,514	0.130	2	226,460	48,569	0.214	2	127,990	0.565	1	2
9	Koh Kong	78,134	22,414	0.287	3	24,867	8,900	0.358	3	7,048	0.283	4	3
10	Kracheh	178,332	39,098	0.219	3	55,770	25,336	0.454	4	14,131	0.253	4	4
11	Mondul Kiri	24,556	13,288	0.541	6	9,455	5,254	0.556	5	693	0.073	6	6
12	Phnom Penh	749,308	34,764	0.046	1	186,642	9,466	0.051	1	149,997	0.804	1	1
13	Preah Vihear	80,411	30,832	0.383	4	27,548	15,315	0.556	5	1,219	0.044	6	5
14	Prey Veng	696,719	126,769	0.182	2	221,990	86,911	0.392	3	81,669	0.368	3	2
15	Pursat	237,156	38,309	0.162	2	73,280	38,186	0.521	5	21,357	0.291	4	4
16	Ratanak Kiri	67,512	41,808	0.619	6	23,435	12,915	0.551	5	2,758	0.118	5	5
17	Siem Reap	469,649	124,176	0.264	3	139,035	67,721	0.487	4	46,452	0.334	3	3
18	Krong Preah Sihanouk	106,767	18,580	0.174	2	31,212	6,961	0.223	2	11,947	0.383	3	2
19	Stung Treng	46,816	19,027	0.406	5	14,960	7,309	0.489	4	430	0.029	6	5
20	Svay Rieng	350,597	51,662	0.147	2	109,264	46,011	0.421	4	28,983	0.265	4	3
21	Takeo	556,771	81,147	0.146	2	167,750	44,216	0.264	2	62,617	0.373	3	2
22	Otdar Meanchey	80,177	24,560	0.306	4	26,752	16,031	0.599	5	4,402	0.165	5	5
23	Krong Kep	20,565	2,652	0.129	2	6,768	3,083	0.456	4	320	0.047	6	4
24	Krong Pailin	28,651	6,478	0.226	3	10,450	5,060	0.484	4	2,447	0.234	4	4
	Total	8,099,841	1,426,324	0.176	-	2,471,834	884,305	0.358	-	916,541	0.371	-	

Source: 1) Original data from SEILA 2003  
2) Level and Classification are made by the JICA Study Team



**Figure 12.2.4 Poverty Level by Districts, 2003**

#### **(6) National and Regional Development**

In this study, it is assumed that the road improvements will significantly contribute towards national and regional development. Based on such an objective, the development strategies were prepared as follows:

- Support for multi growth-pole development
- Support for tourism development
- Support for industrial development
- Support for agricultural development
- Support for commodity distribution industry development
- Support for CLV (Cambodia, Laos and Vietnam) development

**Table 12.2.3** shows the roads that will contribute towards the national and regional development.

**Table 12.2.3 Roads Contributing towards the National and Regional Development**

	Name of Roads
a) Support for multi growth pole development	NR.1, NR.4, NR.5, NR.6, NR.7 Phnom Penh Ring Road, Battambang Bypass, Siem Reap Bypass
b) Support for tourism development	NR.4, NR.6, NR.7 NR.48, NR.62, NR.63, NR.64, NR.65, NR.66, NR.76, NR.78, NR.78A, NR.78B PR.210, PR.212, PR.213, PR.274, PR.301 Phnom Penh Ring Road, Siem Reap Bypass
c) Support for industrial development	NR.1, NR.4 NR.48, NR.51, PR.104, PR.127, PR.128
d) Support for agricultural development	NR.44, NR.48, NR.57, NR.59, NR.64, NR.65, NR.68, NR.71, NR.73, NR.78, NR.78A, NR.78B PR.274, PR.301
e) Support for commodity distribution industry development	NR.4, NR.7 NR.31, NR.33, NR.42, NR.51, NR.52, NR.53, NR.54, NR.55, NR.63, NR.70 PR.114
f) Support for CLV development	NR.76, NR.78, NR.78A PR.301, PR.305

### (7) Economic Feasibility

The economic feasibility will be discussed in Chapter 12.3.

### (8) Promotion of International Trade

The road improvements will promote international trade due to the cheaper traffic costs. It was observed that the border trade with Vietnam and Thailand became more active when political stability was achieved in Cambodia. Once the proposed road improvements have been carried out, it is expected that international trade will become more active and will be on a wider scale. These impacts are expected to be achieved by the following road improvements.

**Table 12.2.4 Roads Contributing to the Promotion of International Trade**

	Name of Roads
a) Contribute to the Promotion of International Trade	NR.1, NR.2, NR.4, NR.5, NR.7 NR.21, NR.33, NR.48, NR.57, NR.62, NR.64, NR.68, NR.72, NR.74, NR.78

## 12.2.2 Urgency and Easiness Aspects

### (1) Scale of the Project

Small scale projects are relatively easy to implement, while larger scale projects are difficult to implement from a project financing point of view. Therefore, in this study, the road projects were classified into four (4) categories:

**Table 12.2.5 Scale of the Project**

	Description
Small Scale Project	Project cost < US \$ 10,000
Medium Small Scale Project	US \$ 10,000 <Project cost < US \$ 30,000
Medium Large Scale Project	US \$ 30,000 <Project cost < US \$ 50,000
Large Scale Project	US \$ 50,000 <Project cost

### (2) Project Financing Status

In Cambodia, the projects financed by international agencies and donors are easy to implement while those not financed are difficult to implement. Therefore, in this study, the road projects were classified into four (4) categories:

**Table 12.2.6 Project Financing Status**

	Name of Roads
On-going Projects	NR.1-1, NR.2-2, NR.5. NR.7 NR.33, NR.48, NR.62, NR.56, NR.68
Committed Project	NR.78, NR.64
Proposal Submitted	NR.67, PR.301
Feasibility Study conducted	NR.57

### (3) Land Acquisition

One of the major problems in the implementation of the projects is whether or not the right-of-way (ROW) can be acquired. In this study, the areas along the project roads can be classified into four (4) categories:

**Table 12.2.7 Land Acquisition Situation**

Area	Land Acquisition
Urbanized Area	Difficult
Sub-urban Area	Comparatively easy
Rural and Isolated Area	Easy

#### (4) Natural Environment

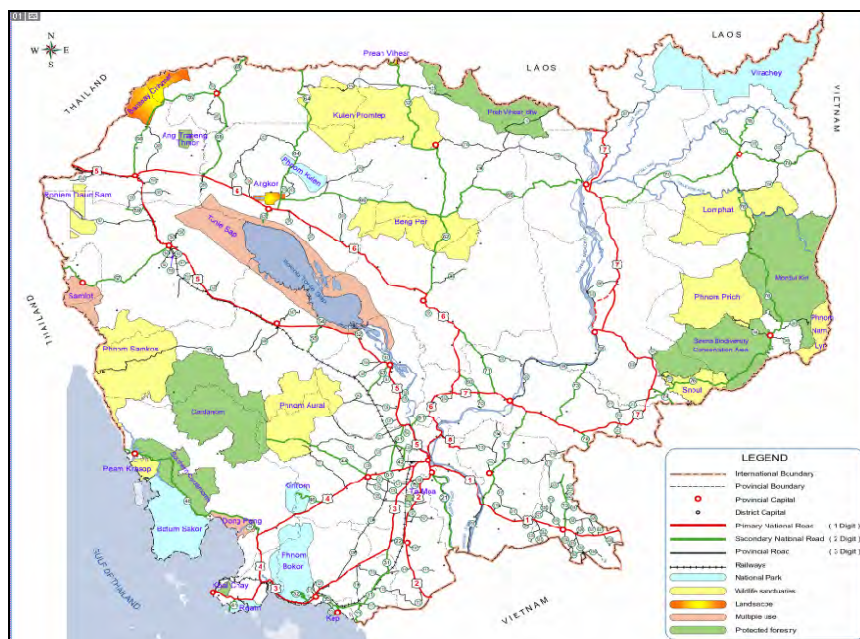
Environmental effects are one of the major external effects of road development. According to the IEE conducted in Chapter A-15, the natural environmental impacts are the most significant of the various environmental impacts.

As shown in **Figure 12.2.5**, the following areas are protected:

- National parks
- Wildlife sanctuaries
- Landscape protection areas
- Multiple use areas
- Protected forest areas

The road projects were classified into three (3) categories based on whether the roads pass through these protected areas:

- No affect on any protected natural environmental area
- Partially affects a protected area
- Fully affects a protected area



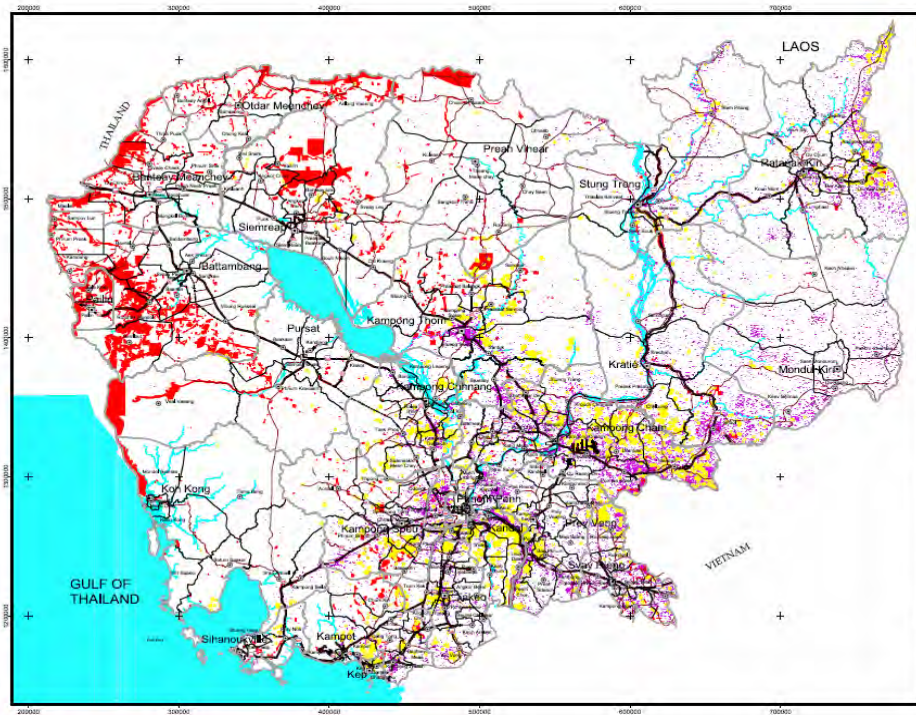
**Figure 12.2.5** Natural Environmental Protection Areas



## (5) UXO and Land Mines

One of the major problems in the implementation of the projects is whether UXO and land mines exist along the project roads. **Figure 12.2.6** shows the UXO and land mine contamination map. Based on this map, the road projects were classified into three (3) categories in this Study:

- Large area contaminated by UXO and land mines
- Medium area contaminated by UXO and land mines
- Small area contaminated by UXO and land mines



**Figure 12.2.6 UXO and Land Mine Contamination**

## (6) Passability During the Rainy Season/Urgency of Road Conditions

The passability of the roads during the rainy season is a very important factor for the people. The passability can be defined by the following road conditions:

- All weather asphalt concrete roads
- DBST roads
- Literate/Earth/Damaged roads

### 12.2.3 Scoring of the Factors

#### (1) Scoring Each Factor

The scoring of each factor for 1-Digit, 2-Digit and 3-Digit roads is given in **Table 12.2.8** to **Table 12.2.10**, respectively.

**Table 12.2.8 Criteria and Score for Prioritization of Road Projects - Social & Economic Aspects  
(1 & 2-Digit Roads)**

Factors	1-Digit Roads Score	2-Digit Roads Score
<b>1. Engineering Aspects</b>	<b>10</b>	<b>10</b>
1.1 Road function in the road network	5	5
1.2 Magnitude of traffic volume	5	5
<b>2. Social &amp; Environmental Factors</b>	<b>30</b>	<b>40</b>
2.1 Beneficiary population along project roads	10	10
2.2 Public administration services	10	10
2.3 Reduction in poverty level	10	20
<b>3. Economic Factors</b>	<b>60</b>	<b>50</b>
3.1 National & Regional Development	30	20
3.1.1 Acceleration of economic growth in growth pole	10	-
3.1.2 Promotion of manufacturing development	5	5
3.1.3 Promotion of tourism development	5	5
3.1.4 Promotion of agriculture development	5	5
3.1.5 Promotion of the logistics industry	5	5
3.2 Economic Viability	20	20
3.3 Promotion of international trade	10	10
<b>Total</b>	<b>100</b>	<b>100</b>

**Table 12.2.9 Criteria and Score for Prioritization of Road Projects - Urgency & Easiness Aspects  
(1 & 2-Digit Roads)**

Factors	1 & 2-Digit Roads Score
<b>1. Financial Aspects</b>	<b>50</b>
1.1 Scale of the project road	20
1.2 Realization of the project road	30
<b>2. Environmental Factors</b>	<b>20</b>
2.1 Land acquisition	10
2.2 Natural environmental impact	5
2.3 UXO and land mines	5
<b>3. Urgency of the Project Road</b>	<b>30</b>
3.1 Passability during the rainy season	20
3.2 Road condition	10
<b>Total</b>	<b>100</b>

**Table 12.2.10 Criteria and Score for Prioritization of Road Projects  
(Provincial Roads)**

Factors	Provincial Roads Score
<b>1. Engineering Aspects</b>	<b>20</b>
1.1 Pavement condition	10
1.2 Road width	10
<b>2. Social Aspects</b>	<b>60</b>
2.1 Influenced population size	30
2.2 Poverty	20
2.3 Natural Environment	10
<b>3. Economic Feasibility</b>	<b>20</b>
<b>Total</b>	<b>100</b>

(2) Score for Each Indicator

A score for each indicator was applied on the following basis:

**Table 12.2.11 Criteria and Score for Prioritization of Road Projects**

**A. Social & Economic Aspects**

Factor	Indicator	Score
<b>1. Engineering Aspects</b>		
<b>1.1 Road Function</b>	1. Primary arterial road	5
	2. Arterial road	3
	3. Secondary arterial road	1
<b>1.2 Magnitude of Traffic Volume</b>	1. ADT > 10,000 PCU/Km	5
	3. 10,000 > ADT > 3,000 PCU/Km	3
	4. 3,000 > ADT > 1,000 PCU/Km	2
	5. 1,000 > ADT	1
<b>2. Social Factors</b>		
<b>2.1 Population in influenced area</b>	1. Population > 300,000	10 (20)
	2. 300,000 > Population > 100,000	6 (12)
	3. 100,000 > Population	2 (4)
<b>2.2 Public Administrative Services</b>	1. Provincial capital	10
	2. Not a designated administrative center	0
<b>2.3 Poverty Level</b>	1. Poverty index is very high	10
	2. Poverty index is average	6
	3. Poverty index is very low	2
<b>3. Economic Factors</b>		
<b>3.1 National &amp; Regional Development</b>		
<b>3.1.1 Acceleration of economic growth in growth pole</b>	1. PP / Kandal, Sihanoukville, Siem Reap Battambang, Kampong Cham	10 (0)
	2. Other	0
<b>3.1.2 Promotion of manufacturing development</b>	1. Designated manufacturing development area	5
	2. Not a designated area	0
<b>3.1.3 Promotion of tourism development</b>	1. Designated tourism development area	5
	2. Not a designated area	0
<b>3.1.4 Promotion of agriculture development</b>	1. Designated agriculture development area	5
	2. Not a designated area	0
<b>3.1.5 Promotion of logistical development</b>	1. Designated logical development area	5
	2. Not a designated area	0
<b>3.2 Economic Viability</b>	1. EIRR > 12 %	20
	2. 12 % > EIRR > 08 %	12
	3. 8 % > EIRR	4
<b>3.2 Promotion of international trade</b>	1. Designated ASEAN highway route / Greater Mekong Development	10
	2. Border trade route	6
	3. No relation	2

( ) means score for 2-Digit roads

**Table 12.2.12 Criteria and Score for Prioritization of Road Projects**

**B. Urgency & Easiness Aspects**

Factor	Indicator	Score
<b>1. Financial Aspects</b>		
<b>1.1 Scale of the project</b>	1. 10,000 > Project Cost	20
	2. 10,000 < Population < 30,000	15
	3. 30,000 < Population < 50,000	10
	4. Population > 50,000	5
<b>1.2 Realization of the Project</b>	1. On-going	30
	2. Committed to implement	20
	2. Under study	15
	3. Need to improve	10
4. Already improved	5	
<b>2. Negative Impacts of Project Implementation</b>		
<b>2.1 Difficulty of land acquisition</b>	1. Not urbanized area, already acquired land	10
	2. Urbanized area, partially acquired land	6
	3. Highly urbanized area difficult to acquire land	2
<b>2.2 Natural environmental impacts</b>	1. No effect on any natural environmental area	5
	2. Partial effect	3
	3. Full effect	1
<b>2.3 Unexploded Bombs and Land Mines</b>	1. Few unexploded bombs and land mines in area	5
	2. Moderate number of unexploded bombs and land mines in area	3
	3. Many unexploded bombs and land mines in area	1
<b>3. Urgency of Improvement</b>		
<b>3.1 Passable during rainy season and traffic congestion</b>	1. Impassable during rainy season / Heavy traffic congestion	20
	2. Difficulty of passage during rainy season / Moderate traffic congestion	10
	3. Passable during rainy season / no traffic congestion	5
<b>3.2 Urgency from Road Conditions perspective</b>	1. Very Poor	5
	2. Poor	3
	3. Fair	1
	4. Good	0

## 12.3 Preliminary Economic Analysis of the Project

### 12.3.1 Assumptions for Economic Analysis

In order to carry out the economic analysis, the following assumptions were made.

- 1) The implementation schedule was assumed as follows:
  - 2007: Detailed design
  - 2008 -2010: Construction of each project
  - 2011: Open to public
- 2) Evaluation period: 25 years after opening to public
- 3) A discount rate of 12% was assumed, taking into account the opportunity rate for capital in Cambodia.

- 4) In order to evaluate the road projects from an economic view point, the following economic indicators were estimated:
  - Economic internal rate of return (EIRR)
  - Benefit-cost ratio (B/C Ratio)
  - Net Present Value (NPV)
- 5) The following benefits were estimated
  - Savings in terms of vehicle operating costs (VOC)
  - Savings in terms of travel time costs (TTC)
- 6) The benefits were calculated on the basis of the normal traffic but not the divertible or generated traffic. This is because the purpose of this analysis is to carry out a comparison between the project roads.
- 7) The annualized factor of the daily benefits was assumed to be 340 days per year taking into consideration the weekly variation in the volume of traffic on the roads.

### 12.3.2 Estimated Benefits

Of the various benefits derived from the road network development in Cambodia, the most significant and tangible benefits will be:

- a) Savings in the vehicle operating costs (SVOC)
  - Distance related running costs
  - Time related running costs
- b) Savings in the travel time costs (STTC)

In the benefit calculation, the vehicle operating costs and travel time costs were calculated for both the dry and rainy seasons due to significant difference in costs between the seasons.

#### (1) Unit Vehicle Operating Costs and Time Costs

The unit VOC's were principally determined by modifying and updating the unit VOC's estimated in 'The Feasibility Study on the National Road No 1 (Phnom Penh – Neak Loung section)' based on the inflation rate between 2002 and 2005. **Table 12.3.1** shows a summary of the VOC's by vehicle type.

**Table 12.3.1 Unit Vehicle Operating Costs by Vehicle Type**

(unit: US\$)

Type	Item	Motor Cycle	Car	Pick-up	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
Distance related VOC	Fuel cost	145.3	2,543.5	3,052.1	3,270.2	11,973.8	3,877.2	14,710.6	14,710.6
	Lubricant cost	8.0	19.9	29.9	39.8	348.3	123.8	359.4	359.4
	Tire cost	6.9	63.1	75.7	97.8	1006.1	174.7	706.4	2060.2
	Maintenance cost	6.7	136.4	131.5	296.6	623.5	199.6	306.1	579.6
	Depreciation cost	0.4	8.5	9.8	18.3	38.5	10.3	16.3	30.8
	S-total	167.3	2,771.3	3,299.0	3,722.7	13,990.2	4,385.6	16,098.8	17,740.7
	Overhead cost	0.0	0.0	329.9	372.3	1,399.0	438.6	1,609.9	1,774.1
	Total	167.3	2,771.3	3,628.9	4,095.0	15,389.2	4,824.2	17,708.7	19,514.7
Time related VOC	Crew cost	75.0	275.0	412.5	1,344.0	2,170.0	1,488.0	2,542.0	2,542.0
	Maintenance cost	2.3	5.1	5.1	18.1	21.9	18.1	21.9	25.6
	Insurance cost	20.0	493.1	475.4	296.6	623.5	199.6	368.8	698.4
	Depreciation cost	0.2	4.6	5.3	9.9	20.7	5.5	8.8	16.6
	S-total	97.6	777.7	898.2	1,668.6	2,836.1	1,711.2	2,941.4	3,282.5
	Overhead cost	0.0	0.0	89.8	166.9	283.6	171.1	294.1	328.3
	Total	97.6	777.7	988.0	1,835.4	3,119.8	1,882.3	3,235.6	3,610.8
Total		264.9	3,549.0	4,616.9	5,930.4	18,509.0	6,706.5	20,944.3	23,125.5
VOC /1000 km		26.5	142.0	153.9	197.7	264.4	167.7	243.5	268.9

The passenger travel time costs were based on the function of wage rates and trip purpose. **Table 12.3.2** shows the estimated unit time

**Table 12.3.2 Time Value of Passengers by Vehicle Type**

(Unit: US\$ / Hr)

	2005	2010	2015	2020
Motorcycle	0.321	0.388	0.491	0.648
LV	2.394	2.897	3.663	4.836
Bus	3.166	3.831	4.844	6.395

Based on the VOC's determined above, the unit VOC's were estimated for the cases of with and without the improvements by pavement type and season, as shown in **Table 12.3.3**. The travel speeds were also estimated for both cases, as shown in **Table 12.3.4**.

**Table 12.3.3 Unit Vehicle Operating Costs by Pavement Type and Season**

(Unit: US\$ / Km)

Surface Type	Asphalt	DBST	Literate Road		Earth Road	
	Concrete (AC)		Dry	Rainy	Dry	Rainy
W/O Improvement	164.6	171.1	177.6	185.0	185.0	202.0
Notes	IRI=5	IRI=6	IRI= 7	IRI=8	IRI=8	IRI=10
Surface Type	Asphalt Concrete (AC)			DBST		
W/ Improvement	151.6			155.1		
Notes	IRI=2.5			IRI=3.5		

**Table 12.3.4 Travel Speed by Pavement Type and Season**

(Unit: US\$ / Km)

W/O Improvement			W/ Improvement	
Existing Road Pavement	Travel Speed		Proposed Road Pavement	Travel Speed
Asphalt Concrete (AC)	40		AC	60
DBST	30		AC	60
Laterite Road	Dry Season	25	DBST	50
	Rainy Season	15	DBST	50
Earth Road	Dry Season	20	DBST	50
	Rainy Season	10	DBST	50

## (2) Benefits of Estimation

The savings, in terms of vehicle operating costs and travel time costs, were estimated from the vehicle kilometers and hours using the following equations:

$$SVOC_i = T_i w_o \times L_i \times (UVC_{woDry} \times \text{Dry Mth}/12 + UVC_{woRain} \times \text{Rainy Mth}/12) - T_i w \times L_i \times UVC_{wAll}$$

Where:

- SVOC<sub>i</sub> : Savings in vehicle operating costs on road i
- T<sub>i w<sub>o</sub></sub> : Traffic volume on road i without improvements
- T<sub>i w</sub> : Traffic volume on road i with improvements
- L<sub>i</sub> : Length of road i
- UVC<sub>woDry</sub> : Unit vehicle operating cost without improvements in dry season

- UVCwoRain : Unit vehicle operating cost without improvements in rainy season  
DM : Dry months per year, RM: Rainy months per year  
UVC w All : Unit vehicle operating cost with improvements under all weather conditions

$$STTC_i = (T_i \text{ wo } x Li / (S \text{ wo } \text{ Dry } x \text{ Dry Mth}/12 + S \text{ wo } \text{ Rain } x \text{ Rainy Mth}/12)) x TV - T_i \text{ w } x Li / S \text{ w All} \\ x TV$$

Where:

- STTC<sub>i</sub> : Savings in travel time cost on road i  
T<sub>i</sub> wo : Traffic volume on road i without improvements  
T<sub>i</sub> w : Traffic volume on road i with improvements  
Li : Length of road i  
S wo Dry : Travel speed without improvements in dry season  
S wo Rain : Travel speed without improvements in rainy season  
DM : Dry months per year,  
RM : Rainy months per year  
S w All : Travel speed with improvements under all weather condition  
TV : Time Value

### 12.3.2 Estimation of Economic Cost

#### (1) Economic Cost

The project costs, which were calculated in the previous section, were expressed as financial costs. It is therefore necessary to convert the financial costs into economic costs. In this study, the economic costs were estimated by deducting VAT, government taxes, import duties, and the shadow prices of unskilled labor from the financial costs.

#### (2) Maintenance Cost

The maintenance costs, which consist of routine maintenance and periodic maintenance costs, are assumed to be 1% of the construction/improvement costs. The maintenance cost were converted into economic costs by deducting VAT, government taxes, import duties, and the shadow prices of unskilled labor from the financial costs.

### 12.3.3 Preliminary Economic Analysis

#### (1) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimates, an economic analysis was carried out for the project roads. **Tables 12.3.5, 12.3.6 and 12.3.7** show the benefit – cost analysis for the 1-Digit national roads, 2-Digit national roads and provincial roads, respectively.

**Table 12.3.8** summarizes the projects with high and low economic feasibility.



**Table 12.3.5 Economic Analysis for 1-Digit Roads**

National Road	Location	Length	No of Lane	Cost (US\$'000)	Maintenance Cost (US\$ '000)	Benefit in 2010 (US\$'000)	Benefit in 2020 (US\$'000)	EIRR	B/C Ratio	NPV (US \$ Million)
<b>NR. 1</b>	<b>Phnom Penh - Vietnam Border</b>	<b>166.0</b>								
1-1	Phnom Penh - Neak Luong	60.0	4	103,000	1,030	11,291	23,887	14.5	1.26	23.2
1-2	Neak Luong Ferry	1.7	2	70,000	700	3,252	9,998	9.4	0.75	-15.2
1-3	Neak Luong - Vietnam Border	106.0	2	36,000	360	11,291	23,887	19.0	1.86	26.9
<b>NR. 2</b>	<b>Phnom Penh - Dun Loap</b>	<b>120.0</b>	2	35,000						
2-1	Thakmao-Takeo	68.0	2	23,000	230	6,446	20,320	32.6	4.63	72.7
2-2	Takeo - Dun Loap	52.0	2	12,000	120	2,159	6,373	22.0	2.26	13.1
<b>NR. 3</b>	<b>Phnom Penh - Veal Lean</b>	<b>202.0</b>	2	67,500	675	11,112	21,834	19.1	1.77	45.5
<b>NR. 4</b>	<b>Phnom Penh - Sihanoukville</b>	<b>214.0</b>	2	81,000						
4-1	PhnomPenh - Kampong Speu	36.0	4	24,000	240	4,623	11,602	24.0	2.60	33.1
4-2	Kampong Speu - NR.48	92.0	2	0	0	0	0	-	-	-
4-3	NR.48 - Sihanoukville	86.0	4	57,000	570	4,775	11,019	12.5	1.05	2.4
<b>NR. 5</b>	<b>Phnom Penh - Thai Border (Poipet)</b>	<b>406.0</b>								
5-1	Phnom Penh - Penh Odongk	37.0	4	24,000	240	6,398	12,471	26.8	2.85	38.7
5-2	Penh Odongk - Kampong Chhang	53.0	2	35,000	350	8,086	18,951	26.1	2.90	58.0
5-3	Kampong Chhang - Buttambang	205.0	2	70,000	700	27,770	62,885	28.2	3.24	136.6
5-4	Battambang - Poipet	111.0	2	33,600	336	14,959	26,885	28.1	2.99	58.1
<b>NR. 6</b>	<b>Phnom Penh - Sisophone</b>	<b>416.0</b>								
6-1	Phnom Penh - KM20	20.0	2	13,000	130	3,295	5,893	25.0	2.53	17.3
6-2	KM20 - Skun	55.0	2	36,000	360	8,434	20,504	20.0	1.98	30.6
6-3	Skun - Siem Reap	243.0	2	83,000	830	19,715	69,302	26.4	3.37	171.3
6-4	Siem Reap - Sisophone	98.0	2	30,400	304	13,577	31,010	38.6	5.34	114.9
<b>NR. 7</b>	<b>Skun - Laos Border</b>	<b>464.0</b>								
7-1	Skun - NR.11	61.0	2	40,000	400	7,019	16,565	34.2	4.44	59.8
7-2	NR.11 - Kratie	210.0	2	71,000	710	9,963	24,190	18.9	1.82	50.7
7-3	Kratie - Laos Border	193.0	2	50,000	500	1,641	4,181	4.5	0.42	-26.8
<b>NR. 8</b>	<b>Ktoch Saeuch -NR.13</b>	<b>64.0</b>	1	20,000	200	7,019	16,565	11.4	0.94	-1.0
New	Phnom Penh Ring Road	50.0	4	97,000	970	31,251	32,287	24.2	2.11	94.0
	2nd Japan Bridge crossing Tonlesan River	1.5	2	53,000	530	5,565	11,178	903.3	836.51	0.8
	2nd Monibong Bridge crossing Bassac River	1.2	2	42,000	420	4,360	8,823	716.6	663.90	0.6
	Battambang Bypass	30.0	2	39,000	390	4,671	8,166	599.4	551.04	0.5
	Siem Reap Bypass	30.0	2	39,000	390	4,380	8,058	612.4	564.56	0.5
	Kampong Chhang Bypass	20.0	2	15,000	150	1,422	3,038	255.9	237.81	0.2

**Table 12.3.6 Economic Analysis for 2-Digit Roads**

2-Digit National Road	Road No. Connected	Length	No of Lane	Cost	Benefit in 2010	Benefit in 2020	EIRR	B/C Ratio	NPV
NR. 11	NR. 1	90	2	26,000	4,972	13,548	24.5	2.92	41,021
NR. 13		45	2	8,000	1,517	1,652	15.5	1.37	2,426
NR. 21	NR. 2	66	2	19,000	834	2,482	8.6	0.73	-4,228
NR. 22		10	2	3,000	178	1,215	18.9	2.35	3,318
NR. 31	NR. 3	55	2	16,000	418	1,406	5.6	0.49	-6,724
NR. 32		33	2	6,000	83	345	3.0	0.32	-3,349
NR.33-1		35	2	10,000	374	893	5.4	0.51	-4,045
NR. 33-2		17	2	5,000	260	430	4.9	0.52	-1,985
NR. 41	NR. 4	9	2	2,000	44	320	5.6	0.49	-6,724
NR. 42		24	2	5,000	283	1,147	13.7	1.27	1,121
NR. 44		85	2	16,000	515	448	4.9	0.52	-1,985
NR. 46		27	2	5,000	120	225	-0.2	0.26	-3,021
NR. 48		161	2	29,700	1,691	4,523	10.0	0.86	-3,522
NR. 51	NR. 5	45	2	13,000	2,571	7,548	25.7	3.24	23,906
NR. 52		8	2	2,000	28	80	-0.2	0.22	-1,274
NR. 53		27	2	5,000	215	610	8.8	0.70	-1,240
NR. 54		5	2	1,000	21	79	5.0	0.44	-461
NR. 55		22	2	4,000	95	360	5.9	0.50	-1,646
NR. 56		114	2	33,000	562	2,543	5.1	0.43	-15,443
NR. 57		103	2	45,000	2,121	6,942	10.1	0.86	-5,273
NR. 59		16	2	3,000	64	159	1.5	0.30	-1,723
NR. 60		NR. 6	20	2	6,000	392	593	6.1	0.60
NR. 61	16		2	5,000	762	2,434	22.7	2.71	7,003
NR. 62	128		2	37,000	271	1,849	3.1	0.29	-21,561
NR. 63	14		2	3,000	96	357	8.0	0.66	-838
NR. 64	134		2	27,800	878	5,910	13.2	1.23	5,263
NR. 65	22		2	4,000	147	321	4.5	0.46	-1,772
NR. 66A	140		2	41,000	956	2,087	1.0	0.29	-23,818
NR. 66B	145		2	42,000	193	285	0.0	0.04	-32,205
NR. 68	118		2	34,000	820	3,154	6.2	0.51	-13,538
NR. 70	NR. 7		14	2	3,000	138	307	6.5	0.59
NR. 71		58	2	17,000	661	6,853	18.9	2.53	21,377
NR. 72		14	2	4,000	252	699	11.2	0.98	-67
NR. 73		57	2	11,000	696	1,222	7.2	0.66	-3,078
NR. 74		18	2	3,000	78	144	0.3	0.28	-1,765
NR. 76-1		131	2	38,000	1,502	3,495	5.6	0.52	-14,855
NR. 76-2		194	2	37,000	751	1,918	1.4	0.29	-21,483
NR. 78-1		124	2	36,000	381	815	-4.9	0.13	-25,693
NR. 78-2		70	2	26,000	87	155	-10.9	0.04	-19,420

**Table 12.3.7 Economic Analysis for Provincial Roads**

Provincial Road	Length	No of Lane	Cost	Benefit in 2010	Benefit in 2020	EIRR	B/C Ratio	NPV
<b>PR. 104</b>	10	2	1,400	74	210	9.8	0.84	-0.2
<b>PR111+ Con. To NR 21</b>	41	2	5,000	105	267	1.6	0.30	-2.9
<b>PR. 114</b>	16	2	2,000	79	305	10.0	0.84	0.3
<b>PR. 127</b>	15	2	2,000	113	436	13.2	1.21	0.3
<b>PR 2082+2081+2076</b>	101	2	15,000	863	3,172	10.0	0.84	-0.3
<b>Srung Treng - Cham Khsan</b>	135	2	20,000	862	1,760	5.2	0.51	-8.1
<b>Kampong Thom - Kratie</b>	102	2	15,000	521	1,108	3.8	0.43	-7.1
<b>PR. 210</b>	162	2	18,000	1,012	2,350	8.6	0.74	-3.8
<b>PR. 212</b>	77	2	10,000	95	366	-6.3	0.08	-7.5
<b>PR. 213</b>	112	2	8,000	38	146	1.3	0.25	-4.9
<b>PR. 274</b>	132	2	12,000	95	366	4.1	0.38	-6.1
<b>NR. 301</b>	165	2	17,000	68	263	-5.8	0.09	-12.8
<b>NR. 305</b>	120	2	13,000	68	263	0.9	0.24	-8.1
<b>NR 308</b>	35	2	13,000	689	3,428	-0.1	0.31	-2.3
<b>NR 316</b>	35	2	5,000	150	239	2.6	0.27	-3.0
<b>NR 148</b>	234	2	35,000	689	3,428	6.9	0.55	-12.9
<b>Road connecting NR 13 to NR 7</b>	61	2	4,000	150	193	7.2	0.64	-1.2

**Table 12.3.8 Project Roads with High and Low Economic Feasibility**

	High Economic Feasibility	Low Economic Feasibility
Name of Project Roads	· NR.11 (Neak Leoung - Thnal Toteoung)	· NR.78-1 (Ou Pong Moan - Bang Lung)
	· NR.13 (Svay Rieng - Traok)	· NR.78-2 (Bang Lung – Vietnam Boarder)
	· NR.22 (Ou Chambok – Ang Tasom)	· NR.78A (Rattanak Kiri – Veun Sai)
	· NR.51 (Veang Chass – Wet Ang Metrey)	· NR.78B (Thrang Svay – Ta Veng)
	· NR.61 (Prek Kdam - Thnal Keik)	· NR.76-2 (Mondori Kiri – Ta Ang)
	· NR.71 (Treung – Peam Chikong )	· NR.66-2 (Phnom Deak - Thalabarivat )
		· NR.52 (Ponley - Chhnang Trou)
		· NR.66-1 (Trach Chrum – Phnom Deak)
		· NR.59 (Thma Kom - Khoum Lvea)
		· NR.46 (Treg Tre Yeung - Thai Boarder)
	· NR.74 (Snuol - Khum Thnu (Vietnam B))	

## 12.4 Overall Evaluation of the Project Roads

### 12.4.1 Results of the Overall Evaluation

Based on the input data prepared in the previous section, each project road was evaluated using the scoring methodology for the social, economic and urgency/easiness categories. The results of the overall evaluation for the 1-Digit, 2-Digit and provincial roads are shown in **Tables 12.4.1, 12.4.2** and **12.4.3**, respectively.

### 12.4.2 Road Network Plan based on the Project Evaluation

**Figure 12.4.1** shows the road network plan based on the project evaluation. **Table 12.4.4** shows the prioritization of the project roads.

MP-A-12-24

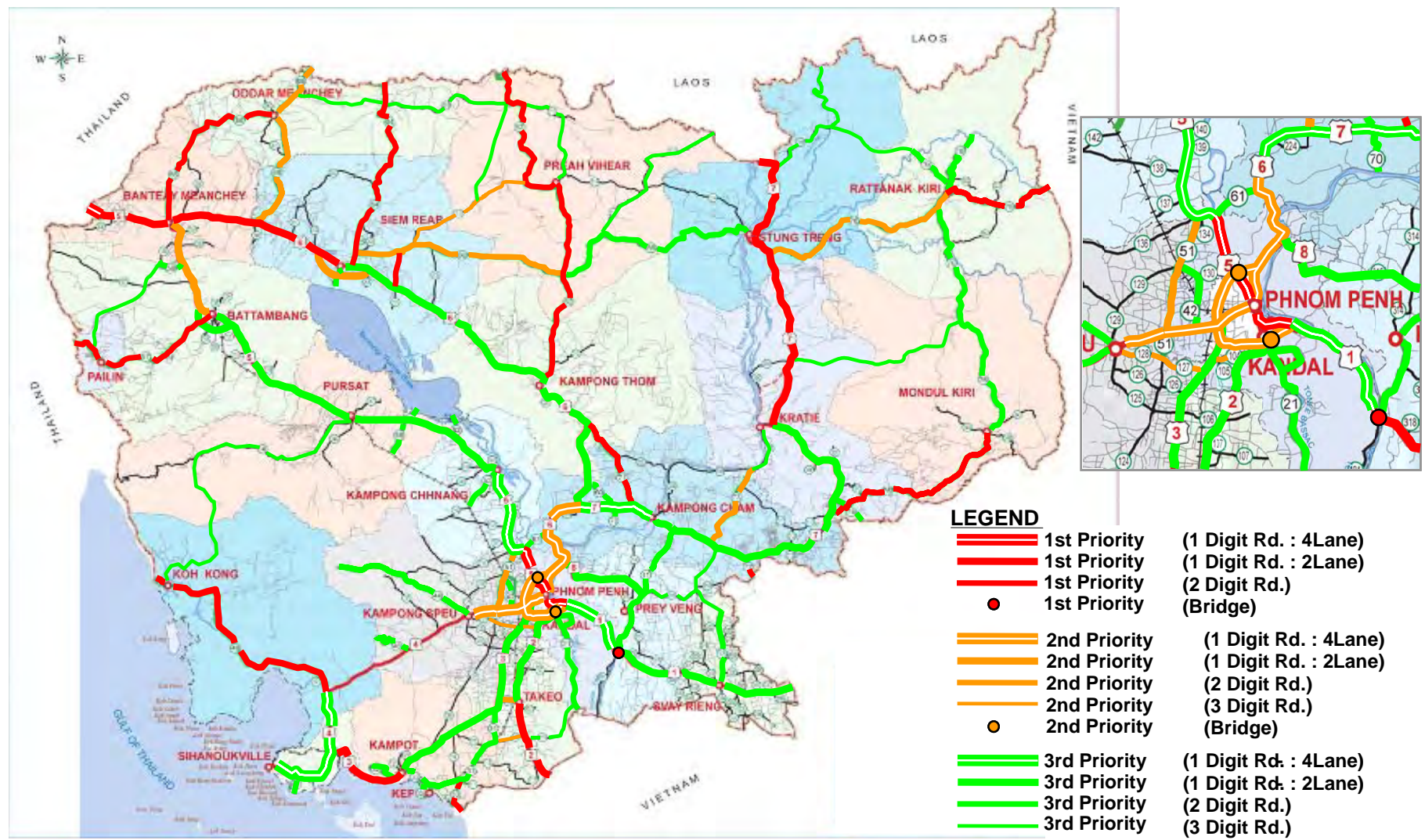


Figure 12.4.1 Road Network Plan based on the Project Evaluation

**Table 12.4.1 Evaluation of the Projects (1-Digit Roads)**

National Road	Location	Length (km)	Lane Nos	Construction Cost	A. Urgency/Easiness Aspect					B. Engineering, Social and Economic Aspect					Present Situation	Overall Evaluation			Recommended Projects to be done by the year 2020
					A.1	A.2	A.3	A	A	B.1	B.2	B.3	B	B		1st Priority	2nd Priority	3rd Priority	
					Financial Aspect	Negative Impacts	Urgency of Improvement	Total	Ranking	Engineering Aspect	Social Aspect	Economic Aspect	Total	Ranking					
					Max. 50	Max. 20	Max. 30	Max 100		Max. 10	Max 30	Max. 60	Max 100						
<b>NR. No.1</b>	<b>Phnom Penh - Vietnam Border</b>	<b>166.0</b>		209,000															
1-1	Phnom Penh -Neak Luong	60.0	4	103,000	35	20	30	85	A	10	22	55	87	A	On-Going & Widening	☉			On-going project & Widening to 4-lane
1-2	Second Mekong River Bridge on Route 1	(2.0)	2	70,000	20	20	30	70	B	10	22	55	87	A	Under studying	☉			Under Study by Japan
1-3	Neak Leuong -Vietnam Border	104.6	2	36,000	15	20	7	42	C	10	24	50	84	A	Completed by DBST			△	Overlay to Asphalt concrete by 2020
<b>NR. No.2</b>	<b>Phnom Penh - Phnom Den</b>	<b>120.0</b>	2	35,000															
2-1	Thakmao-Takeo	63.0	2	23,000	20	20	7	47	C	8	22	40	70	B	Completed by DBST			△	Overlay to Asphalt concrete by 2020
2-2	Takeo-Phnom Den	57.0	2	12,000	45	15	20	80	A	6	18	45	69	B	On-going	☉			Rehabilitation under going
<b>NR. No.3</b>	<b>Phnom Penh -Veal Lean</b>	<b>202.0</b>	2	67,500															
3-1	Phnom Penh - Kampot	148.0	2	50,000	10	20	7	37	C	6	16	30	52	C	Completed by DBST			△	Overlay to Asphalt concrete by 2020
3-2	Kampot - Veal Rinh	54.0	2	17,500	45	20	7	72	B	6	24	50	80	A	On-Going	☉			
<b>NR. No.4</b>	<b>Phnom Penh -Sihanoukville</b>	<b>213.0</b>	4	81,000															
4-1	PhnomPenh- Kampong Speu	35.0	4	24,000	25	20	30	75	B	10	24	50	84	A	Widening	☉			Widening to 4 lanes
4-2	Kampong Speu-NR 48	92.0	2	0	0	0	0	-	0	0	0	0	-						
4-3	NR 48- Sihanoukville	86.0	4	57,000	10	20	12	42	C	10	24	50	84	A	Widening		○		Widening to 4 lanes
<b>NR. No.5</b>	<b>Phnom Penh -Thai Border(Poipet)</b>	<b>359.0</b>		162,600															
5-1	Phnom Penh -Penh Odongk	37.0	4	24,000	25	12	30	67	B	10	22	55	87	A	Widening	☉			Widening to 4 lanes
5-2	Penh Odongk -Kampong Chhnang	53.0	4	35,000	15	20	12	47	C	10	26	45	81	A	Completed by DBST			△	Widening to 4 lanes
5-3	Kampong Chhnang- Buttambang	205.0	2	70,000	10	20	7	37	C	10	22	45	77	B	Completed by DBST			△	Permanent bridge
5-4	Battambang-Sisophon	64.0	2	22,000	25	16	7	48	C	10	22	45	77	B	Completed by DBST			△	Overlay to Asphalt concrete by 2020
5-5	Sisophon - Poipet	47.0	2	11,600	45	20	20	85	A	10	22	45	77	B	On-going	☉			Rehabilitation under going
<b>NR. No.6</b>	<b>Phnom Penh - Sisophone</b>	<b>416.0</b>		162,400															
6-1	Phnom Penh -KM 20	20.0	4	13,000	25	12	30	67	B	10	18	50	78	B	Widening		○		Widening to 4 lanes
6-2	KM 20-Skun	55.0	4	36,000	20	16	30	66	B	10	22	50	82	A	Widening		○		Widening to 4 lanes
6-3	Skun-Siem Reap	235.0	2	83,000	10	20	12	42	C	10	22	45	77	B	Completed by DBST			△	Overlay to Asphalt concrete by 2020
6-4	Siem Reap - Sisophone	106.0	2	30,400	40	20	20	80	A	10	22	45	77	B	On-going	☉			Rehabilitation under going
<b>NR. No.7</b>	<b>Skun - Laos Border</b>	<b>459.0</b>		161,000															
7-1	Skun - Kampong Cham	43.0	4	40,000	25	20	7	52	C	10	22	50	82	A	Completed			△	Widening to 4 lanes
7-2	Kampong Cham-Kratie	216.0	2	71,000	10	20	7	37	C	8	26	50	84	A	Completed			△	Overlay to Asphalt concrete by 2020
7-3	Kratie - Stroeng Treng	136.0	2	50,000	45	20	20	85	A	6	22	40	68	B	On-going	☉			Rehabilitation under going
7-4	Stroeng Treng-Laos Border	64.0	2		45	20	20	85	A	6	22	40	68	B	On-going	☉			Rehabilitation under going
<b>NR. No.8</b>	<b>Ktoch Saeuch -NR13</b>	<b>64.0</b>	2	22,000	20	20	30	70	B	4	14	15	33	C				△	Upgrade to 1 Digit Standard
New	Phnom Penh Ring Road	50.0	4	100,000	15	12	30	57	B	10	22	55	87	A	New Construction		○		
	2nd Chruoy Changvar Bridge crossing Tanleas River	1.5	2	53,000	15	16	30	61	B	10	22	55	87	A	New Construction		○		
	2nd Mombong Bridge crossing Bassac River	1.2	2	42,000	20	16	30	66	B	10	22	55	87	A	New Construction		○		
	Battambang Bypass	30.0	2	23,000	20	16	20	56	C	8	26	50	84	A	New Construction			△	
	Siem Reap Bypass	30.0	2	23,000	20	20	20	60	B	8	26	50	84	A	New Construction		○		
	Kampong Chhnang Bypass	20.0	2	15,000	20	16	20	56	C	8	26	50	84	A	New Construction			△	
<b>Total</b>		<b>2,165.0</b>		1,156,500															

**Table 12.4.2 Evaluation of the Projects (2-Digit Road)**

No.	2 Digit National Road	Road No. connected	Length (km)	Project Cost(US \$'000)	A. Urgency/Easiness Aspect					B. Engineering, Social and Economic Aspect					Present Situation	Overall Evaluation			Recommended Projects to be done by the year 2020
					A.1	A.2	A.3	A	A	B.1	B.2	B.3	B	B		1st Priority	2nd Priority	3rd Priority	
					Financial Aspect	Negative Impacts	Urgency of Improvement	Total	Ranking	Engineering Aspect	Social Aspect	Economic Aspect	Total	Ranking					
					Max. 50	Max. 20	Max. 30	Max 100		Max. 10	Max 40	Max 50	Max 100						
1	NR. 11	NR. 1	90.4	26,000	20	18	8	46	C	8	26	23	57	C	Completed by DBST			△	
2	NR. 13		44.6	8,000	25	18	20	63	B	4	32	23	59	C				△	Upgrade to 1 Digit Standard, On-going
3	NR. 21	NR. 2	65.6	19,000	20	18	8	46	C	6	26	33	65	B	Completed by DBST			△	
4	NR. 21A		20.1	4,000	30	18	12	60	C	6	12	15	33	C				△	
5	NR. 22	NR. 3	9.6	3,000	30	18	12	60	B	8	22	32	62	B			○		Overlay to Asphalt concrete by 2020
6	NR. 31		54.8	16,000	20	18	8	46	C	4	22	24	50	C	Completed by DBST			△	Rehabilitation under going
7	NR. 32	NR. 3	33.3	6,000	25	18	20	63	B	2	19	7	28	C				△	
8	NR. 33-1		35.3	10,000	20	16	8	44	C	4	28	34	66	B				△	
9	NR. 33-2		17.0	5,000	50	16	22	88	A	4	28	34	66	B	On-going	◎			
	NR. 33A	19.7	4,000	50	16	22	88	A	4	28	15	47	C				△		
10	NR. 41	NR. 4	9.3	2,000	25	11	8	44	C	4	12	15	31	C				△	Overlay to Asphalt concrete
11	NR. 42		24.3	5,000	25	11	20	56	C	8	17	32	57	C				△	
12	NR. 44		84.8	16,000	25	18	20	63	B	2	28	24	54	C				△	Widening to 4 lanes
13	NR. 46		27.0	5,000	30	16	8	54	C	2	14	16	32	C				△	Rehabilitation under going
14	NR. 48	NR. 5	161.3	29,700	45	20	20	85	A	6	28	50	84	A	To be financed by Thai Gov.	◎			Permanent bridge
15	NR. 51		44.9	13,000	35	13	12	60	B	8	21	40	69	B	Completed by DBST		○		
16	NR. 52		8.0	2,000	30	20	20	70	B	2	14	16	32	C				△	Rehabilitation under going
17	NR. 53		27.3	5,000	30	20	20	70	B	4	28	15	47	C				△	
18	NR. 54		4.9	1,000	30	20	20	70	B	2	14	16	32	C				△	
19	NR. 55		22.3	4,000	30	20	20	70	B	2	14	24	40	C				△	Widening to 4 lanes
20	NR. 56		113.6	33,000	35	18	20	73	B	4	28	34	66	B	To be financed by ADB	◎			Overlay to Asphalt concrete by year 2020
21	NR. 57		103.3	45,000	35	16	20	71	B	6	32	42	80	A		◎			
22	NR. 59		16.3	3,000	30	18	20	68	B	2	18	16	36	C				△	
23	NR. 60	NR. 6	19.9	6,000	40	18	20	78	B	4	12	15	31	C				△	
24	NR. 61		15.9	5,000	50	18	8	76	B	8	12	23	43	C	On-going				△
25	NR. 62-1		128.4	37,000	35	14	20	69	B	4	36	26	66	B		◎			
	NR. 62-2		114.3	22,000	35	14	30	79	B	4	36	34	74	B		◎			
26	NR. 63		14.3	3,000	25	16	8	49	C	4	28	24	56	C				△	
27	NR. 64		134.0	27,800	45	12	20	77	A	4	36	50	90	A	To be financed by Thai Gov.	◎			Overlay to Asphalt concrete by year 2020
28	NR. 65		21.5	4,000	50	18	20	88	A	2	36	24	62	B		◎			
29	NR. 66-1		139.9	41,000	35	18	20	73	B	4	36	24	64	B	To be financed by WB		○		Rehabilitation under going
	NR. 66-2	145.4	42,000	35	18	30	83	A	4	22	24	50	C	To be financed by WB			△	Upgrade to 1 Digit Standard	
30	NR. 68	NR. 7	117.7	34,000	35	20	20	75	B	6	36	34	76	B	To be financed by Thai Gov.		○		
31	NR. 70		13.5	3,000	25	20	20	65	B	2	12	24	38	C				△	
32	NR. 71		57.8	17,000	45	18	8	71	B	8	26	32	66	B	ADB section completed WB section to be completed by 2007	◎			
33	NR. 72		13.5	4,000	40	18	22	80	B	6	12	33	51	C		◎			
34	NR. 73		57.4	11,000	25	18	20	63	B	2	16	24	42	C			○		
35	NR. 74		17.9	3,000	30	18	20	68	B	4	22	17	43	C				△	
36	NR. 76-1		130.7	38,000	25	20	20	65	B	4	32	24	60	B		◎			
	NR. 76-2		193.5	37,000	25	20	20	65	B	4	32	16	52	C				△	
	NR. 78-1		124.0	36,000	35	16	20	71	B	4	32	34	70	B			○		
	NR. 78-2		70.0	26,000	25	16	20	61	B	4	32	34	70	B	To be financed by Vietnam Gov partially	◎			
38	NR. 78A	36.9	7,000	25	16	20	61	B	2	32	18	52	C				△		
	NR. 78B	39.0	7,000	25	16	20	61	B	2	32	18	52	C				△		
		TOTAL	2,643.2	675,500															

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**Table 12.4.3 Evaluation of the Projects (Provincial Roads)**

SQ No.	Road No.	Province	Length	Project Cost	Engineering Aspect			Social Aspect				Economic Indicator	Total	Overall Evaluation		
					Pavement	Road Width	S-Total	Population	Poverty	Natural Environment	S-Total			1st Priority	2nd Priority	3rd Priority
					10	10	20	30	20	10	60	20	100			
1	104	Kandal	9.6	1,400	10	6	16	30	4	10	44	12	72		○	
2	111+Connection to NR 2	Takeo	41.0	5,000	6	6	12	18	8	10	36	12	60			△
3	114	Kampot / Takeo	16.4	2,000	6	6	12	18	8	10	36	20	68		○	
4	127	Kampong Speu	15.0	2,000	6	6	12	18	12	10	40	20	72		○	
5	PR 2082+2081+2076	Battambang/Pailin	101.0	15,000	6	10	16	18	12	10	40	4	60			△
6	Stung Treng - Cham Khsan	Preah Vihear	135.0	20,000	6	6	12	6	20	1	27	4	43			△
7	Kampong Thom - Kratie	Kampong Thum	102.0	15,000	6	6	12	6	12	10	28	4	44			△
8	210	Siemreap/Preah Vihear	91.7	10,000	6	10	16	12	20	10	42	4	62		○	
8-1	210 A	Siemreap/Preah Vihear	70.0	8,000	6	10	16	6	20	10	36	4	56			△
9	212	Preah Vihear	77.0	8,000	10	10	20	6	20	1	27	4	51			△
10	213	Preah Vihear	112.4	12,000	6	10	16	6	20	10	36	4	56			△
11	274	Preah Vihear / Otdar Meanchey	132.0	20,000	10	6	16	6	20	10	36	4	56			△
12	301	Stung Treng	47.4	5,000	10	6	16	6	20	10	36	4	56			△
12-1	301-1	Stung Treng	59.0	6,000	10	6	16	6	20	10	36	4	56			△
12-2	301-2	Stung Treng	59.0	6,000	6	10	16	6	20	10	36	4	56			△
13	305	Kratie	120.0	13,000	6	6	12	6	12	10	28	4	44			△
14	308	Kampong Cham	34.6	5,000	6	10	16	18	4	10	32	4	52			△
15	316	Svey Rieng / Prey Veng	35.0	5,000	6	6	12	6	8	10	24	20	56			△
16	NR 148	Pousat	114.0	17,000	6	6	12	12	12	10	34	12	58			△
16-1	NR 148 A	Pousat	120.0	18,000	6	6	12	12	12	10	34	12	58			△
17	New Road Connecting to NR 13 and NR 7	Svey Rieng / Prey Veng	61.4	9,000	6	6	12	18	4	10	32	12	56			△
		Total	1,553.5	202,400												



**Table 12.4.4 Overall Prioritization Results**

	1-Digit National Road	2-Digit National Road	Provincial Road
1st Priority Projects	NR.1-1 (Phnom Pen – Neak Leoung) NR.1-2 (2 <sup>nd</sup> Mekong Bridge) NR.2-2 (Takeo – VN Boarder) NR.3-2 (Kampot – Veal Rinh) NR.4-1 (Phnom Penh - Kompong Speu ) NR.5-1 (Phnom Penh – Penh Odongk) NR.5-5 (Ssophon - Poipet) NR.6-4 (Siem Reap - Sisophone) NR.7-3 & 4 (Kratie – Laos Border)	NR.33-2 (Kampong Trach – Loak) NR.48 (Chamker – Thai Boarder.) NR.56 (Banteay – Oddar Meanchey ) NR.57 (Battambang – Thai Boarder ) NR.62-1 (Thnal Baek - Tbeng Meanchey) NR.62-1 (Tbeng Meanchey – Peah Parasat Viar) NR.64 (Siem Reap – Dang Rek ) NR.65 (Dam Deck – Trapeang Prey ) NR.71 (Treung – Peam Chikong ) NR.72 (Kreak Tboung – Smach ) NR.76-1 (Srei Char – Mondri Kiri) NR.78-2 (Bang Lung – Vietnam Boarder)	Maintenance works only
2nd Priority Projects	NR.4-3 (NR.48 - Sihanoukville ) NR.5-4 (Battambang - Sisophon ) NR.6-1 (Phnom Penh – KM20 ) NR.6-2 (KM 20 - Skun ) Phnom Penh Ring Road 2 <sup>nd</sup> Chruoy Changvar Bridge 2 <sup>nd</sup> Monibong Bridge Siem Reap Bypass	NR.22 (Ou Chambok – Ang Tasom) NR.66-1 (Trach Chrum – Phnom Deak) NR.68 (Kralanh – Osmachth) NR.73 (Pratheath – Chhloung) NR.78-1 (Ou Pong Moan - Bang Lung) NR.78A (Rattanak Kiri – Veun Sai) NR.78B (Thrang Svay – Ta Veng)	PR.104 PR.114 PR.127 PR.210
3rd Priority Projects	NR.1-1 Widening (Phnom Pen – Neak Leoung) NR.1-3 (Neak Leoung - VT Boarder) NR.2-1 (Thakmao - Takeo ) NR.3-1 (Phnom Penh - Kampot ) NR.5-2 (Penh Odongk - Kampong Chhnang ) NR.5-3 (Kampong Chhnang - Battambang ) NR.6-3 (Skun - Siem Reap ) NR.7-1 (Skun - Kampong Cham ) NR.7-2 (Kampong Cham - Kratie ) NR.8 (Ktoch Saeuch - NR.13 ) Battambang Bypass Kampong Chhnang Bypass	NR.11 (Neak Leoung - Thnal Toteoung) NR.13 (Svay Rieng - Traok) NR.21 (Takhmao - Chey Thom) NR.21A (Takhmao - Wat Chhoung Leab) NR.31 ( Thnal Bek Koas - Kampong Trach) NR.32 (Road to Bokor - Bokor Top) NR.33-1 & NR.33A (Kampot - Kampot Trach - Loak) NR.41 (Kong Keng - Ream) NR.42 (Bek Chan – Doeng) NR.44 (Chba Morn - Khtes Village) NR.46 (Treg Tre Yeung - Thai Boarder) NR.51 (Veang Chass – Wet Ang Metrey) NR.52 (Ponley - Chhnang Trou) NR.53 (Kampong Chhnang - Teuk Phos) NR.54 (Krakor - Tonle Sap) NR.55 (Anlong Thnaot - Kam Reng) NR.59 (Thma Kom - Khoum Lvea) NR.60 (Sambor Chey - Prey Toteng) NR.61 (Prek Kdam - Thnal Keik) NR.63 (Siem Reap - Chong Khnaes) NR.66-2 (Phnom Deak - Thalabarivat ) NR.70 (Prey Toteung - Peam Chikong) NR.74 (Snuol - Khum Thnu (Vietnam B)) NR.76-2 (Mondori Kiri – Ta Ang) NR.78A (Rattanak Kiri – Veun Sai) NR.78B (Thrang Svay – Ta Veng)	PR.111 + Connecting to NR.21 PR.2081, PR.2082, PR.2076, PR.2076 (NR.59, PR.160) Stung Treng – Cham Khsan Kampong Thom - Kratie PR.210 A PR.212 PR.213 PR.274 PR.301, PR.301-1, PR.301-2 PR.305 PR.308 PR.316 PR.148 & 148 A New Road connecting NR.13 and NR.7