

DEPARTMENT OF ROADS  
PLANNING AND DESIGN BRANCH  
HMIS-ICT UNIT  
BABARMAHAL, KATHMANDU

# FINAL REPORT

## CONSULTING SERVICES

FOR

### MID-TERM REVIEW OF SECTOR WIDE ROAD STUDY AND PRIORITY INVESTMENT PLAN 2007

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# 1. Introduction & Summary

## 1.1 Background

The Department of Roads (DoR) is the main agency responsible for planning, design, operation and maintenance of the Strategic Road Network (SRN) throughout Nepal. This study, which is funded under a loan from the World Bank/International Development Association (IDA), is designed to assist the DoR and Government of Nepal (GoN) with a mid-term review of Sector Wide Road Programme and Priority Investment Plan originally prepared in 2005-07.

In the period since the previous study was completed in 2007<sup>1</sup>, there has been a considerable expansion of both the strategic and rural road networks. The length of the SRN is already greater than was forecast for 2016 and very substantial (and often unplanned) extensions have made to the rural road network – although much of this additional network is not all-weather and is not operational all year. Significant areas of the country are still without all-weather motorable road access.

The Government now wishes to review progress on the expansion and upgrading of the SRN and to prepare plans, proposals and budget estimates for its further development over the coming 6-7 years.

The previous study included an extensive and innovative assessment of accessibility based on population distribution, terrain and the available road networks. The present study has updated these calculations based on the latest population data (from the 2011 census) and the current extent of the strategic and local road networks.

## 1.2 The Study

The project is being undertaken by a joint-venture comprising three local consulting firms – Soil Test, Aviyaan and Prestige – with an international Team Leader, who additionally led the previous studies in both 2005-07 and 1995-97. The study was conducted over an initial period of four months, involving a total of 10 man-months of professional input – 8 domestic and 2 international. The contract was signed on 24<sup>th</sup> February 2014 and work commenced immediately.

The Inception Report was submitted 3 weeks after work commenced, in mid-March. A presentation of the Inception Report, together with an analysis of initial findings and a discussion of Key Issues, was held 2 months after the start, on 28<sup>th</sup> April. Subsequently an Interim Progress Report, summarising the preliminary findings was submitted at the end of May. An initial version of this Draft Final Report was prepared at the end of the contract period (end-June). The findings and recommendations were presented to the DoR at a seminar held in the DoR on 20<sup>th</sup> June.

Coordination between the DoR and the Study Team was arranged through a series of meetings with a Steering Group formed of senior DoR Engineers.

This Final Report incorporates responses to comments made at the presentation in January 5, 2015 and includes an initial outline of the proposed PIP for the period to 2021.

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<sup>1</sup> Sector Wide Road Programme & Priority Investment Plan, DHV Consultants, May 2007

## 1.3 Terms of Reference

The Terms of Reference define the main objectives of the Study as: 'to review of the 2007 Sector Wide Road Programme and Priority Investment Plan (PIP) on the basis of current conditions and to develop an investment plan and strategy for the period to 2021/22'. Additionally, the Consultant is tasked with a review of the DoR's present Goals, strategies and Policies and to provide recommendations for future strategies.

The specific objectives of these two main activities are set out – as Part I and Part II – in the ToR, as defined below.

### 1.3.1 Part I: Sector Wide Road Programme & Priority Investment Plan

- (a) to review, update and develop a futuristic national grid of road networks including both the strategic and rural roads.
- (b) to review and update an appropriate Priority Investment Plan (PIP) of strategic and proposed strategic road network for the period from 2014/15 to 2021/22.
- (c) to review and determine the optimal balance among construction of new roads (national highways, feeder roads and bridges) and improvement, rehabilitation and maintenance of the existing strategic road network.
- (d) to review and update an appropriate level of expenditure on investments for construction and maintenance given local resources and absorptive capacity constraints (financial, technical and human resource related) and the probable level of foreign assistance in the sub-sector during the period from 2014/15 to 2021/22.
- (e) to review and update the optimum maintenance costs of the strategic road networks required for the period from 2014/15 to 2021/22.
- (f) to review and compare different budget scenarios from 2014/15 to 2021/22 for the strategic road network and present the consequences of budget constraints to the society (network net present value), road users (network road users) and road agency (short term and long term agency investment and maintenance expenditures).
- (g) to review and update the optimal investment plan with allocation of resources between geographic regions, surface types, road work types and functional classification of roads.
- (h) to review and update the accessibility model developed and used in PIP 2007 study tool with present population census data of year 2011 and the Strategic Roads added after 2007.
- (i) to review and estimate an optimum investment need based on present GoN priorities, expected traffic volume and other economic activities in the area. Present the result of the network evaluation on a map produced preferably with a GIS system.

### 1.3.2 Part II: Review of DoR Goals, Strategies & Policies

- (a) To review the present DoR Goals, Strategies and Policies and develop appropriate DoR Goals, Strategies and Policies.

- (b) To review and update the existing traffic threshold criteria /policies for upgrading in general from earthen or gravel to bituminous surface.
- (c) To review the present maintenance intervention strategy and develop policy guideline for the use of particular SRN surfacing material (Surface dressing, Asphalt mix, Otta seal, etc) based on traffic volume and economic condition.
- (d) To review the present periodic maintenance approaches/ policies and develop more transparent, suitable ranking criteria considering economic values or any other appropriate analysis.
- (e) To review the present policy on road construction policy (mentioned in the standard for feeder road design).

## 1.4 Structure of the Report

Following this Introduction, the remainder of this Draft Final Report contains a further seven Chapters. These are:

### *Chapter 2: Study Overview:*

- Objectives & Output
- Goals, Strategies & Policies
- Priority Investment Plan
- Main Findings

### *Chapter 3: Existing Strategic Road Network:*

- Responsibilities and functions of the DoR
- Review overall DoR Goals, Strategies & Policies
- Revised DoR Goal
- Existing Strategic Road Network
- Cabinet Approved SRN Expansion (2012)
- Road Network Condition
- Traffic Growth

### *Chapter 4: Review of Budgets & Expenditure:*

- Analysis of Budgets & Expenditures
- Current Budget Analysis: Government and Donor Funding
- Comparison with PIP2 forecasts
- Implementation of PIP proposals

### *Chapter 5: Maintenance Obligations:*

- Approaches to Maintenance
- Definitions of Maintenance
- Annual Road Maintenance Plan (ARMP)
- Specific Maintenance Issues
- Review of Maintenance Policies and Strategies
- Upgrading Thresholds for Gravel & Sealed Surfaces

*Chapter 6: Development & Upgrading of SRN:*

- Strategy for development & upgrading of network
- Developments since PIP2 (2007)
- Implementation of PIP2 Proposals
- Completed & On-going Projects
- Criteria for Upgrading and Prioritisation
- Review Extent of future SRN
- Review of Feeder Road Construction Policy
- Screening and Ranking of Projects
- Requirements for New Construction
- Responsibilities for Strategic & Local Roads

*Chapter 7: Accessibility (2013):*

- Methodology and approach
- Results of previous analysis (2007)
- Current Analysis (2013)
- Accessibility measured by time bands (2 hour/4 hour)
- Average and total walk-time to road network

*Chapter 8: Revised PIP for 2014 to 2021:*

- Overall Strategy
- Revised PIP 2014-21
- Maintenance Needs
- Upgrading
- Network Expansion and Extension
- Priority Investment Plan

## **2. Study Overview**

### **2.1 Objectives & Output**

The previous Sector Wide Road Programme and Priority Investment Plan (SWRP & PIP, 2007) presented a detailed strategy for the development of the SRN over the ten years to 2016, including recommendations for the two fold expansion of the network. The study examined both the capital and recurrent financial implications of the proposed plan and developed an optimum maintenance strategy for the existing (& expanded) network. The 2007 Study is referred to here as PIP2: the original PIP was completed in 1997.

The PIP2 study examined a full range of possible improvements and additions to the SRN, including new roads into non-road served areas of the hills, the upgrading or improvement of existing heavily trafficked roads, increased network density in heavily populated areas, and the upgrading of roads in the Terai – including links to India. The upgrading of strategic roads in the Kathmandu Valley was also considered, together with an assessment of potential new access routes to Kathmandu from the Terai.

The PIP2 developed a maintenance strategy and programme based on an analysis of the condition of the existing and committed SRN using the HDM model. The analysis has not been repeated as the use of HDM has not been adopted within the Department. As an alternative, this Study has recommended that the Annual Road Maintenance Programme (ARMP), which is used to identify regular and periodic maintenance needs, is expanded to include rehabilitation and reconstruction, along with the associated intervention criteria.

The 2007 Study conducted a detailed examination of the accessibility provided by the overall road network and developed recommendations regarding the extent of the strategic and local networks required to achieve the desired levels of accessibility throughout the country. The analysis was undertaken using a GIS-based approach that linked the development and expansion of the road networks to the terrain and population distribution throughout the country. The situation has changed significantly over the past 7-8 years, with the expansion of both the Strategic and Local Road Networks: as a result overall levels of accessibility have improved and the revised analysis has been used to identify unserved pockets and to prioritise improvements and upgrading measures.

The present Study is tasked with producing a revised PIP for the period 2014-2021, including budget estimates and a programme of work relating to the maintenance, upgrading and expansion of the SRN. Critical issues that need to be addressed at the outset relate to length and extent of the SRN and the division of responsibilities between DoR and DoLIDAR – the central agency responsible for Local Roads that are administered and maintained through the Districts.

The revised PIP contains budget estimates for the main activities (maintenance, upgrading and new construction) developed from an assessment of need within the overall strategy devised for the SRN, with due regard to likely funding limitations and institutional capacity constraints. Funding for regular and periodic maintenance – and potentially rehabilitation and upgrading – will come from the Roads Board.

## 2.2 Goals, Strategies & Policies

Part II of the ToR requests that the Goals, Strategies and Policies of the DoR be reviewed and updated as appropriate. The Department's existing Goals, Strategies and Policies date from either 1995 or 2005 and were prepared under very different conditions, when significant areas of the country were unserved by road and the budgets available for the roads sector were much lower.

The emphasis has changed from one of providing basic access and connectivity to the provision of improved and upgraded levels of service. The focus is now on efficiency, reliability and safety as well as ensuring that the strategic network is maintained to appropriate standards in the most cost-effective manner. This should be reflected in the Overall Goal of the Department.

The content of the Strategies and Policies reflect the activities and responsibilities of the DoR. Specifically they refer to the DoR's role in regard to the development and maintenance of the Strategic Road Network and to the realisation of certain key physical targets. During this Study, the policy and strategy issues are discussed in relation to the overall preparation of the updated PIP, including both the development and maintenance of the SRN.

With regard to the previous Strategies and Policies, three main areas of concern remain valid:

- the definition of the role, responsibilities and function of the DoR and specifically the separation of the strategic and local road networks;
- improvements to maintenance practices – funding has been secured through the RBN but the overall network management practice and associated intervention criteria need review; and
- basic objectives should be revised in the context of social, political and economic change: the current requirements are more extensive than the simple provision of basic access.

The first of these aspects is critical to the overall scale and shape of the proposed plan. For the past 16 years, since the establishment of DoLIDAR, successive policy statements have consistently stressed the 'separation' of the strategic and local road networks and yet it is evident that both (a) a continuing significant proportion of the total DoR budget and Divisional man-power resources are devoted to 'local' projects not on the SRN; and (b) the SRN has been substantially extended in recent years through the inclusion of additional 'non-strategic' roads. These factors both add to the overall work-load of the Department and seriously detract from the primary activities of managing and maintain the main strategic routes within the country in an efficient and cost-effective manner.

It is recognised that the maintenance activities of the DoR are fundamental to the delivery of an effective road network to meet the needs of the country. This Study has reviewed the present strategies and policies relating to maintenance, including current practices for identifying and prioritising regular and periodic maintenance activities through the ARMP. Amendments to the associated intervention levels need to be discussed and agreed with the Department, together with suggestions to extend the present system to include additionally rehabilitation and reconstruction. Similarly, current policies and thresholds and for upgrading roads from earth to (all-weather) gravel and from gravel to a sealed bitumen surface need to be reviewed and revised in the light of current costs, demands and expectations.

The relevant Strategies and Policies are discussed in the following sections of this report: the issues related to the role and function of the DoR – and the extent of the SRN – are discussed in relation to the development SRN and the key issues relating to maintenance are included in the Chapter on Maintenance Obligations.

## 2.3 Priority Investment Plan

The content of the Priority Investment Plan (2014-21) can only be finalised following the acceptance and agreement of the strategy and policy for the development of the SRN. This will dictate the size and extent of the network and the associated maintenance, upgrading and new construction requirements and obligations. Similarly the future maintenance regime and associated costs require agreement on the strategy and approach: it is suggested that the existing approach to identifying and prioritising the regular and periodic maintenance programme (using the ARMP) is expanded to include rehabilitation and/or reconstruction by using indicators based on traffic levels, pavement age, IRI, SDI and strategic function.

Consideration of both the maintenance and construction requirements – together with estimates of budget availability – will permit the ‘balance’ of expenditure to be determined and, if necessary, the impact of budget constraints to be applied.

It is anticipated that the budget forecasts and distributions of expenditure will follow a similar pattern to the PIP2 allocations between maintenance, upgrading and new construction, including consideration of strategically important new access routes to Kathmandu from the Terai. This latter (Fast Track) proposal was included in the PIP2 and is potentially the single most important investment on the transport sector in Nepal.

## 2.4 Main Findings

This mid-term review of the 2007 PIP has concluded that the Strategic Road Network (SRN) has been expanded significantly in excess of its planned growth and that most of the additional roads are of low standard earth construction and that many are of local – rather than strategic – significance. The network expansion has been achieved by the re-designation of existing locally-built earth tracks as part of the strategic network and by the inclusion of a number of longer-distance links in areas of relatively low population density that were NOT prioritised during PIP2.

As a result the composition of the network has changed significantly: almost 70% of the length was sealed in 2007 (3,805km) and, although this has now increased to 6,369 Km, this now represents less than 51% of the current SRN<sup>2</sup>. The result is that there is now a substantial potential demand for the upgrading of the 6,125km of mostly newly designated strategic roads – and a significant risk that funds and effort devoted to these activities will detract from the primary task of maintaining the essential core elements of the national network.

In addition to the 12,494km of currently operational SRN, a further 315km are under construction and 2,093Km are planned, producing an overall total of 14,902km. This growth should not be considered an achievement of the DoR: rather it is a potential burden, with attendant liabilities for both maintenance and upgrading. Specifically, it is noted that 4,389km of the currently ‘operational’ network is classified as ‘earthen’ – mostly constructed to non-engineered standards – and not necessarily open throughout the year: these roads will require significant and costly upgrading in the coming years.

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<sup>2</sup> Based on the latest published DoR Strategic Road Network Statistics (2013/14)



### 2.4.1 Conclusions

All the additional links recommended in the PIP2 are included in the expanded SRN and most are in the current operational network. Almost all these roads previously existed as local roads or tracks: only limited lengths of 'new' strategic road have been constructed. However the 'approved network' also includes significant lengths of additional local roads and tracks, plus further proposed new alignments.

The growth in the network since 2007 has exceeded the PIP proposals, primarily as a result of the take-over of non-strategic local roads in the less densely populated northern and mid-hill areas, plus new road alignments including links to the northern border with China. These are roads that did not meet the 2007 criteria for inclusion in the SRN, which were based on strategic function and density of population served. Many of these additional roads are 'non-engineered' local roads that have been constructed through local efforts – often by excavator: they pose a major challenge to DoR due to potential demand for costly upgrading.

The PIP2 recommended – and this review supports – the construction of a new high standard and high-speed link between Kathmandu and the Terai and specifically the Indian Border at Birgunj. This is potentially the most important commercial and economic link in the country and serves the vast majority of all imports and freight movements: to bring the Indian Border to within 2 hours of Kathmandu, and thus allow a daily return trip, would revolutionise business and commercial activity.

The construction of this 'Fast Track' connection is the single most significant transport project in Nepal. It is therefore essential that resources are directed in the most effective manner towards the construction of the 'best' alignment to serve the future needs of the country. At present two effectively competing projects are being pursued, together with a number of other more minor upgrades on alternative routes. There are major issues to be considered: what is the primary objective? Will there be a Second International Airport in the Terai? Are tunnel options viable and desirable? How will the project be funded? Who will operate the project? These fundamental questions need to be answered before any significant or irreversible decisions are made.

As with the PIP2, the priority for DoR activity and expenditure is the maintenance of the existing network. The emphasis should be on the provision of a well-maintained road surface for the highly-trafficked core elements of the network and on asset preservation, coupled with year-round access, for the remainder. Given the rapid expansion of network, it is important that interventions are prioritised to ensure that the most important elements are given adequately attention.

The DoR should focus on the strategic elements of the road system to ensure an adequate and improving network to meet the fundamental economic needs of the nation. The primary issues of accessibility and connectivity have to large extent been resolved and the emphasis is now on improving the reliability, efficiency and safety of the network.



### 2.4.2 Recommendations

It is recommended that the current operational and under-construction network be reviewed against PIP2 proposals and criteria to test which links meet basic criteria for inclusion in SRN. This review should also include the upgrading and expansion programmes currently being proposed for funding by the ADB, GoI and GoN, to ensure that the roads proposed meet the basic criteria for inclusion in the strategic network. This exercise would almost certainly result in a reduced current SRN of around 10 or 11,000km, with more modest proposals for expansion thereafter.

It is however recognised that an extended Strategic Road Network of 14,902km, comprising 21 National Highways (5,568km) and 208 Feeder Roads (9,334km) has been formally approved by the Cabinet in May 2012. If this network is adopted, then it is essential to **prioritise** future works, as it will not be practical, realistic or affordable, within the seven year planning period, to upgrade and maintain this extended network to similar standards throughout.

A first step is to re-classify the network, through the introduction of new categories of National Highway and Feeder Road, so that investment and expenditure may be directed towards the more significant and important elements of the network.

Two classes of National Highway are proposed:

- NH Class 1: The 'core' network of highways: East-West Highway, main links to Kathmandu, Pokhara & major border crossings; amounting to around 1,760km; to be constructed or upgraded to Asian Highway Standards; and
- NH Class 2: Secondary Highways: links into the Hills serving two or more District HQs, the Mid-Hills Corridor, the Postal Road & access to minor border crossings; around 3,797km; constructed to sealed 2-lane or intermediate lane standards.

Similarly two classes of Feeder Road are proposed:

- FR Class 1: Strategic Feeder Roads: all remaining 51 FRs in 1995 network, access roads to District HQs & local border crossings, and all roads in PIP2 proposed SRN; approx 4,991km; constructed to single or intermediate lane sealed standards, subject to Feasibility Study; and
- FR Class 2: Secondary Feeder Roads: all other roads in the 2014 extended SRN; approx 4,016km; any future construction or upgrading (or any significant expenditure) to be subject to Feasibility Study.

The resultant network is illustrated in Figure 2.1 below, with Highways (Class 1 & 2) shown in Red & Green respectively and Feeder Roads (Class 1 & 2) shown in Black & Yellow. The list of the roads are provided in **Annex 4**.

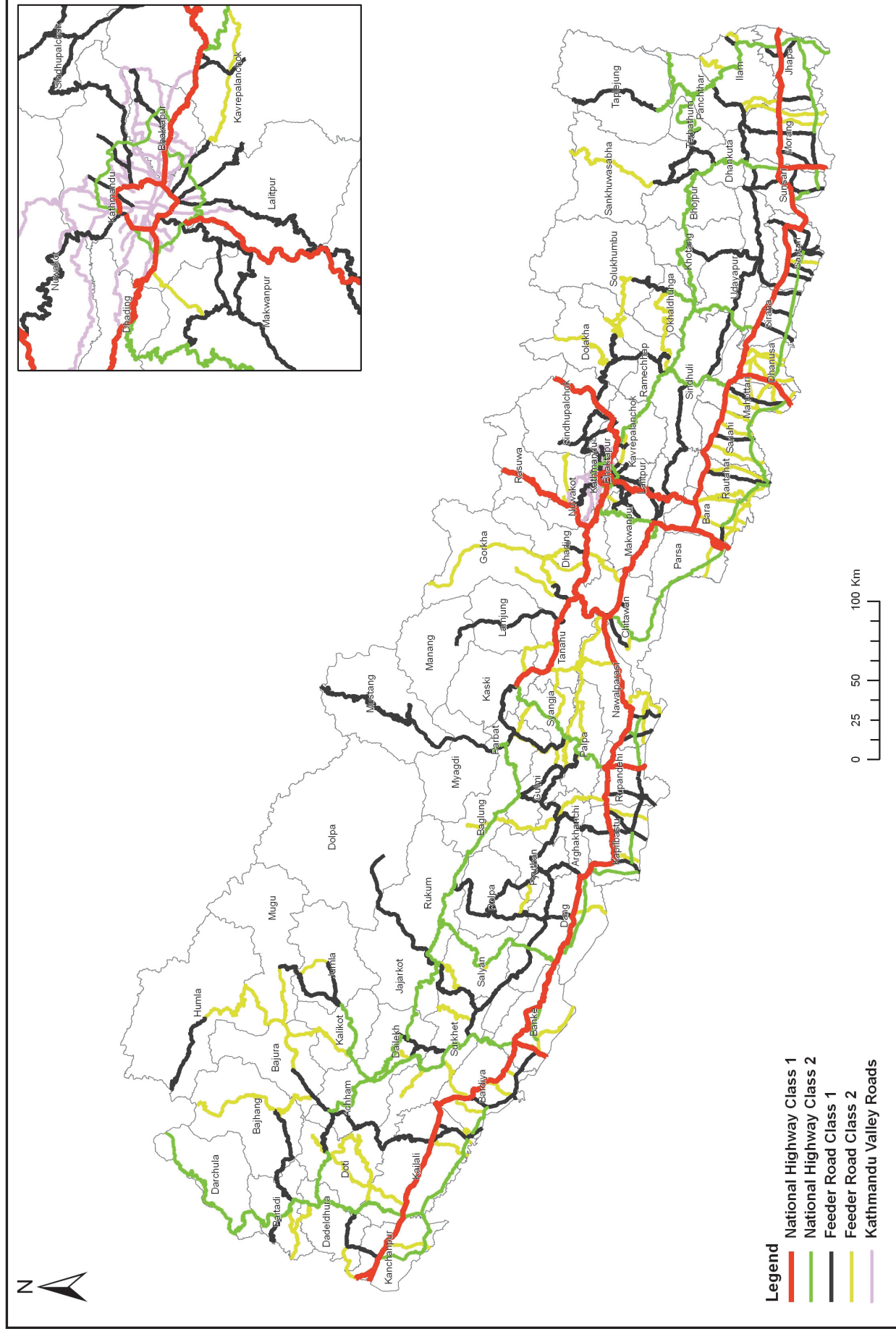
National Highways Class 1 should be maintained to the highest standards. They will generally have an asphaltic concrete surface as the higher traffic volumes will generate greater benefits as a result of the investment. The Class 1 Highway network should be progressively upgraded to Asian Highway Standards, with particular emphasis on safety features, including safety barriers, signage, improved road markings and overtaking lanes (where these can be safely provided).

Class 2 National Highways should be constructed and maintained to appropriate standards for their function and location. Asphalt concrete surfacing may be justified

for high traffic sections, with DBST elsewhere: all sections should be sealed, with progressive widening to 2-lane standards for the more heavily trafficked sections.

Class 1 Feeder Roads should be selected and identified based on a detailed analysis of their strategic function: they will generally be constructed to sealed standards, with justification for upgrading or widening based on feasibility studies and threshold traffic volumes.

Class 2 Feeder Roads are mostly those 'additional' roads included in the 2013/14 SRN that were NOT identified or prioritised in the PIP2 SRN proposals. All should be subject to a detailed feasibility study, prior to any further investment or upgrading, including an evaluation of the strategic function within the 'national' network.



### Figure 2.1: Proposed Re-Classification of the Strategic Road Network

### 3. Existing Strategic Road Network

#### 3.1 Responsibilities & Functions of DoR

The Department of Roads is responsible for the planning, design, construction and maintenance of the Strategic Road Network throughout Nepal.

#### 3.2 Review of DoR Goals, Strategies & Policies

##### 3.2.1 The 1995 Strategy

The primary reference document is the Departmental Policy Document, “The DoR Strategy”, dated July 1995. This outlines the DoR Strategy, comprising six OBJECTIVES, nine POLICY OPTIONS and fifty-one KEY MEASURES. These all lead towards the END GOAL of the DoR, which was established in 1991/92 during the preparation of the 9<sup>th</sup> Plan, as “***the reduction of total road transport costs***”.

The Objectives, Policy Options and Key Measures were described in an Annex to the 1995 Strategy Document. Much progress has been made over the past 18 years and it is appropriate to review the current status and determine whether they are still relevant in today’s context or whether additional issues should be included. The overall **goal** remains valid but could potentially be broadened to include social, equity and environmental concerns.

The six **Objectives** - in two groups ‘policy’ and ‘operational’ - are:

- (a) ‘policy’ level issues:
  - i. Policy Level Awareness;
  - ii. Network Planning; and
  - iii. Direction of Donors
- (b) ‘operational’ level issues:
  - iv. Improved Maintenance Operations;
  - v. Needs-based Budgeting; and
  - vi. Plant Management.

The **9 Policy Options**, designed to realise the above objectives, were defined as:

- (i) Decentralise Network Administration
- (ii) Establish a Network Planning/Monitoring capability in DoR
- (iii) Establish a Self-Sustaining Fund for Road Maintenance
- (iv) Improve Maintenance Operations in the Divisions
- (v) Improve Periodic Maintenance of the Strategic Network
- (vi) Improve Bridge Maintenance on the SRN
- (vii) Improve Roadside Support Maintenance
- (viii) Establish the Concept of National Standards
- (ix) Improve DoR Plant Management and Utilisation

These nine Policy Options are described below, together with an assessment of the current status and requirements for revision.

**(i) Decentralise Network Administration**

Emphasises that the DoR priority is the development and maintenance of the SRN which (in 1995) comprised 5,430km of road, of which 2,694km (50%) was bitumen surfaced. The remaining Urban, District & Village Roads (4,194km) were to be the responsibility of the Municipalities, DDCs and VDCs respectively. Although this approach has been officially adopted, in practice there is still considerable degree of overlap – especially at the Divisional level and in regard to ‘local’ bridges.

**(ii) Establish a Network Planning/Monitoring capability in DoR**

This action has been largely implemented with the establishment of the HMIS and the regular collection of data on traffic levels and road condition.

**(iii) Establish a Self-Sustaining Fund for Road Maintenance**

This action has been largely implemented with the establishment of the Roads Board Nepal which is funded through a fuel tax levy, road tolls and share of new vehicle registration taxes. The RBN allocates funds to the DoR Divisions, Municipalities and DDCs for routine, recurrent and periodic maintenance activities – although the level of funding is generally considered inadequate.

**(iv) Improve Maintenance Operations in the Divisions**

The establishment of the Strengthened Maintenance Divisions (SMDs) with an emphasis on the Routine and Recurrent Maintenance activities has significantly improved the performance of the Divisions and this – coupled with a more rigorous application of periodic or cyclic overlays (see below) – has resulted in an overall improvement to network condition and a reduced demand for premature rehabilitation or reconstruction.

**(v) Improve Periodic Maintenance of the Strategic Network**

The adoption of a periodic or cyclical maintenance programme – as applied through the ARMP process – and based on pavement age, visual surveys, traffic levels and strategic importance has been effective in extending the pavement life and reducing the requirements for early rehabilitation. It may however now be appropriate to reconsider both the number of parameters used and the threshold criteria adopted.

**(vi) Improve Bridge Maintenance on the SRN**

A separate centralised Bridge Unit has been established in DoR and a detailed inventory of SRN bridges undertaken. Separate budgets and donor-funded projects have been set up to assist with the maintenance needs. [The issue of non-SRN bridges handled by the Divisions needs to be resolved.]

**(vii) Improve Roadside Support Maintenance**

The issues associated with slope-stability have been widely examined and (in general) cost-effective solutions developed.

### (viii) Establish the Concept of National Standards

Limited progress was made (in the 1990s) in regard to the establishment of the Staged Construction Standards for Low Cost Feeder Roads – which are now subject to review. It is unclear whether National Standards have been developed and approved for other classes of road.

### (ix) Improve DoR Plant Management and Utilisation

This action was addressed through the Strengthened Equipment Division (SED) initiative, which proposed to put the Heavy Equipment Divisions (HEDs) onto a more commercial footing, whilst providing adequate, reliable and appropriate equipment on a cost-effective basis to the Divisions and local contractors.

## 3.2.2 The 2005 Strategy

The DoR 20-Year Master Plan for the SRN published in 2005 updated the Vision, Mission and Objectives of the Department. It expressed a “**vision**” of ‘Managing Roads for National Integration and Socio-Economic Development’, with an overall “**goal**” of contributing to achieving sustainable socio-economic development by providing safe affordable public road infrastructure services through building of a cost-effective, efficient and reliable road network system.

The Master Plan envisaged that the following would be achieved within 20 years (ie by 2025):

- Motorable access to all District Headquarters, mostly sealed;
- A doubling of the length of the SRN – ie to 10,000km;
- Ensuring at least 95 percent of SRN in good/fair condition;
- Reducing walking distance to 4 hours maximum in Terai and Hills<sup>3</sup>;
- Establish a Road Agency to manage central road network;
- Establish a monitoring system for effective and efficient service delivery; and
- Substantially reduce accident rate.

A **mission statement** for the Department was proposed: "to contribute towards the betterment of living conditions of the people through effective, efficient, safe and reliable road connectivity"

With an ultimate objective of contributing to the alleviation of poverty in Nepal, the **main objective** of road development was defined as: “to develop, expand and strengthen the road network in a sustainable way for enhancing the overall socio-economic development and integration of the country through balanced regional development by providing due consideration for remote areas and deprived communities”.

In order to achieve this objective, the Plan identified the following priorities:

- To maintain the road network effectively and efficiently (Asset Preservation);
- To provide motorable access to all District HQs so as to strengthen social, economic, administrative linkages;.

<sup>3</sup> With an absolute maximum in the Mountains of 3 days



- To improve existing access to District Headquarters for safe, reliable and cost effective travel;
- To develop roads to support Poverty Reduction Program and to improve accessibility in Mid-hills and Terai;
- To develop and expand the existing SRN to facilitate effective and efficient movement of goods and services and to foster economic growth;
- To develop cost effective measures by adopting innovations in pavement and bridge design;
- To develop roads to support other infrastructure development and to link areas of significant social and economic importance; and,
- To encourage private sector participation in the development, maintenance and management of roads.

### 3.2.3 Conclusions

The Consultants are of the opinion that the Overall Goal and Objectives of the Department (however defined) remain valid and that the majority of the Policy Options have been satisfactorily adopted. It is however considered that the overall goal (of minimising total transport costs) is overly specific and technical and would be better adopted as a lower level objective.

Certain specific issues however remain outstanding where clarifications may be necessary or additional topics may need to be addressed. These include:

- (a) The separation of the Strategic and Local Road Networks and the clarification of responsibilities and budgets for each. This remains a major issue despite a number of initiatives to resolve the conflicts and duplications. A major concern is the extent of the SRN and the consequent expansion of the maintenance and upgrading liabilities.
- (b) Improvements to Maintenance Practices. Considerable progress has been achieved, including the establishment of an independently functioning Roads Board with a dedicated and (relatively) secure source of funding. However further improvements are required in the procedures and practices of defining the annual maintenance programme and allocating the necessary finance.
- (c) Changes in social, political and economic conditions, as well as attitudes and perceptions, over the past 20 years. Much has changed in Nepal, including the construction of many roads, which have drastically altered the levels of access in rural and hill areas, plus significant growth in car and (particularly) motor-cycle ownership which have improved levels of mobility. Concerns are now not only about providing basic access but also reliable, safe and comfortable service levels.

These three issues are discussed in greater detail elsewhere in this document.

## 3.3 Revised DoR Goal, Strategies & Policies

The previous sections illustrate the breadth and complexity of the previous efforts to establish goals, strategies and policies for the Department. As noted above, many of the specific actions and objectives have been achieved and the overall context and conditions have changed significantly. It is necessary to develop a simplified hierarchy of goals, strategies and policies that reflect today's situation and levels of development within the Department and country as a whole.

Exact terminologies vary but, for the purposes of this exercise, it is assumed that the term 'goal' applies to the highest level target or 'desired end result': it may be something that is not wholly achievable within the Department itself but something that the Department can contribute towards. It is suggested that the Goal for the Department could be:

*"To construct and manage the SRN efficiently and effectively so as to contribute towards the overall development of the country."*

Below the overall Goal, it is necessary to develop a series of lower order policies and strategies in order to achieve desired objectives or outcomes. These can relate to the overall function of the DoR as 'manager' of the strategic network or to the specific approaches to be adopted and applied in regard to the maintenance and upgrading of the network. These issues are presented for discussion elsewhere in this document.

### 3.4 Existing Strategic Road Network

It is evident that the growth in the designated length of the Strategic Road Network over the past 6-8 years has been substantially in excess of that planned in the previous PIP or indeed in the DoR 20-Year Master Plan of 2005. This has been achieved primarily by the re-designation of existing links in the District or Local Road Network (LRN) as strategic roads. The 'upgrading' of such local roads to Feeder Road status has advantages for the Districts – in that the maintenance liability is removed from them and additional 'central level' finance is available – but presents a considerable additional burden on the DoR in regard to maintenance and the extent of potential upgrading works, as many of the roads are in poor condition and have been constructed to inadequate (non-engineered) standards.

Additionally, a number of 'national priority' roads have been introduced, that were not included in the proposals of the previous PIP and thus did not 'pass' the multi-criteria screening analysis – or the accessibility analyses – that were undertaken. Specifically, these additional 'un-prioritised' roads comprise sections of the proposed North-South Corridors, including a number of minor links to the Chinese border and sections following major rivers through the mid-hills, plus additional roads mostly in the Mid-Hills that were not previously identified as being 'strategic'.

As a result of these additions, the composition of SRN is considerably changed and the resultant overall condition is worse now than it was in 2007. As indicated in Table 3.1, the overall length of the 'operational' SRN has doubled between 2005 and 2011/12, from 5,500km to 11,600km, whilst the proportion of the network that was sealed has dropped from 70% to less than 50% – due to the inclusion of a large number of poor standard previously local roads.

In addition to the 12,494 km of operational SRN in the 2013/14 Statistics, there were a further 78km of National Highway (mostly Postal Road & Mid-Hills Highway) and 237km of Feeder Road 'under construction' (315km in total), plus an additional 2,093km of new road planned. These additions form part of the official 'Cabinet-approved' network of 14,902km.



**Table 3.1: Composition of SRN by Surface Type (2005 & 2013/14)**

Surface Type	2005 'de-facto' Network		2013/14 SSRN	
	Length (km)	Percentage	Length (km)	Percentage
Sealed	3,805	70%	6,369	51%
Gravel	985	18%	1,736	13%
Earth	638	12%	4,389	36%
Total	5,428		12,494	

Source: SWRP/PIP 2007 and Strategic Road Network Statistics, DoR, 2013/2014

All of the PIP2 proposed additions are included in the extended network of 14,902km – together with many other links that were not selected based on the accessibility and multi-criteria analyses conducted at the time.

The expansion of the Strategic Network to 14,800km should NOT be seen as an ACHIEVEMENT of the DoR – but rather as a PROBLEM or a BURDEN that potentially detracts from the primary function of the Department. The DoR itself has done little to enlarge the network: this was achieved primarily by the re-designation of existing roads and the inclusion of additional 'potential' roads.

### 3.5 Cabinet-Approved SRN 2012

The formal expansion of the SRN was approved by the Cabinet on 12-02-2009 (BS) (26<sup>th</sup> May 2012). The approved network has a total length of 14,488km, comprising 21 National Highways totalling 5,257km and 208 Feeder Roads totalling 9,231km. A total of 11,600km are in use (see above), with an additional 410km currently 'under-construction' and a further 2,750km 'planned'.

A comparison of the PIP2 proposals and the operational lengths of the currently approved network, as detailed in the 'Statistics of the Strategic Road Network'<sup>4</sup> (SSRN 2013/14) published by HMIS, is given in Table 3.2.

**Table 3.2: Growth of operational SRN (km) 2005-2013**

Road Type	Designated SRN (2005)	Operational SRN (2006)	PIP Proposals (2016)	SRN Statistics (2013/14)
National Highway	3,100 (15)	3,130		3,460 (17*)
Feeder Road	1,920 (51)	4,230		7,360 (196*)
Other (MH&PR)	-	-		1,674 (2)
Total	5,030	7,360	9,930	12,494**

Notes: \* Excludes 2 designated NHs and 13 FRs under planning only

\*\* An additional 315km u/c & 2,093km planned: Total = 14,902km

As noted above 4,889km of this extended network (36%) is of earth construction only and may not be operational throughout the year. Many of the additional roads included in the network are 'non-engineered' local roads that have been constructed through local efforts – often by excavator – without effective drainage provision or off-road supporting or retaining structures.

<sup>4</sup> There are minor differences in road lengths between the Cabinet Approved document and the HMIS SSRN

This additional 4,889km of earth road will pose a major challenge to DoR due to the potential demand for upgrading to all-weather standards, as is expected (by the public and politicians alike) with the re-designation as a Feeder Road.

Furthermore the approved SRN includes an additional 2,093km of 'planned' new roads which will require a substantial commitment of both technical and financial resources if any significant progress is to be made.

Figure 3.1 illustrates the extent of the newly expanded and approved SRN of 14,902km as published in the SSRN 2013/14. The growth of network since 2007 in excess of PIP proposals is mainly due to the take-over of elements of the local road network and the extension of network to the north and in the Mid-Hills.

### **3.6 Road Network Condition**

Regular annual surveys have been conducted of traffic volumes and the pavement condition of the Strategic Road Network. The pavement surveys involve an assessment of both the Surface Distress Index (SDI) and surface roughness, measured by the International Roughness Index (IRI): the surveys included over 5,800km of sealed roads. Manual classified traffic counts are undertaken at 160 sites throughout the country for 72 hours at each site. These surveys are all conducted by Consultants under contract to DoR, HMIS Unit.

#### **3.6.1 Current SDI Data (2012)**

The Surface Distress Index (SDI) is used as the primary indicator of road condition to assess the requirements and priorities for maintenance interventions. In 2012, a total of 5,830km were surveyed – 3,130km of National Highways, 2,630km of Feeder Road and 70km of Urban Road. The total length was slightly less than in 2011 due to works being carried out on substantial lengths of road, particularly within Kathmandu.

The SDI measure includes an assessment of all types of distress: cracks, potholes, rutting, edge break, ravelling, scabbing, bleeding, shoving, and base and sub base exposure. Incidences of distress are divided in minor and major defects that include cracking, disintegration, deformation, texture failures, pavement edge faults and patching. A 20% sample of road length was taken – involving the survey of 100m in each 500 meters of road length. Pavement condition is evaluated on a score from 0 to 5: with 0 indicating a pavement section without any defects and 5 indicating maximum possible deterioration.

The results are grouped into three bands – Good (SDI = 0.0 – 1.7), Fair (>1.7 – 3.0) and Poor (>3.0 – 5.0). The results are summarised in Table 3.3, which illustrates that around two-thirds of National Highways are in good condition and only 5% are in poor condition. For Feeder Roads, around 45% are classified as being in good condition and a further 37% in fair condition. The SDI values are dominated by major defects, particularly cracking and ravelling.

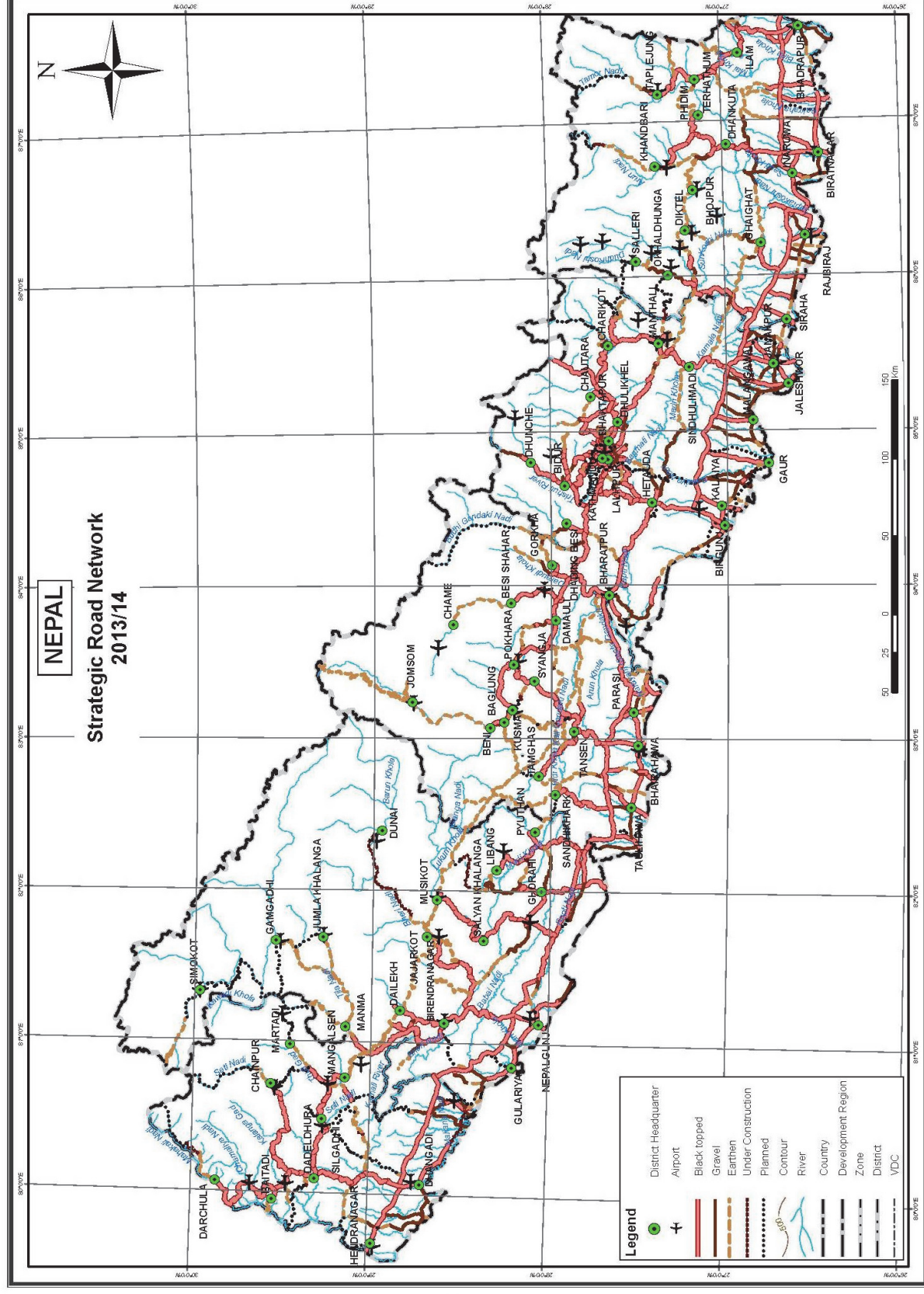


Figure 3.1: Strategic Road Network as defined in SSRN 2013/14

**Table 3.3: SRN Pavement Condition - SDI (2012) – Sealed Roads only (km)**

Road Class	Pavement Condition (SDI)			Total Length (km)
	Good	Fair	Poor	
	0.0 – 1.7	>1.7 – 3.0	>3.0 – 5.0	
National Highways	2,126 68%	834 27%	171 5%	3,131 100%
Feeder Roads	1,188 45%	969 37%	471 18%	2,628 100%
Urban Roads	26 38%	28 40%	15 22%	70 100%
All Roads	3,340 57%	1,831 31%	657 11%	5,829 100%

These results indicate a progressive improvement in SDI over previous years, as a result of the inclusion of a number of newly built (or upgraded) sections and the programme of periodic maintenance that has been implemented since 2008.

The measurement of SDI is dominated by cracking and ravelling, defects that are important to road engineers, as they are indicative of the early stages of pavement failure. These aspects may not be apparent to road users, as a road may be heavily cracked but have a good ride quality. Conversely a road may have been recently resealed, with consequent low levels of SDI, but have high roughness.

### 3.6.2 Current IRI Data (2012)

Roughness is a better measure of service quality to road users and a better indicator of the underlying condition of the pavement. The proportion of the network in poor and bad condition is much higher when judged by roughness (IRI) rather than the Surface Distress Index (SDI). It is therefore recommended that both SDI and IRI values should be considered in future when assessing the overall condition of any road section.

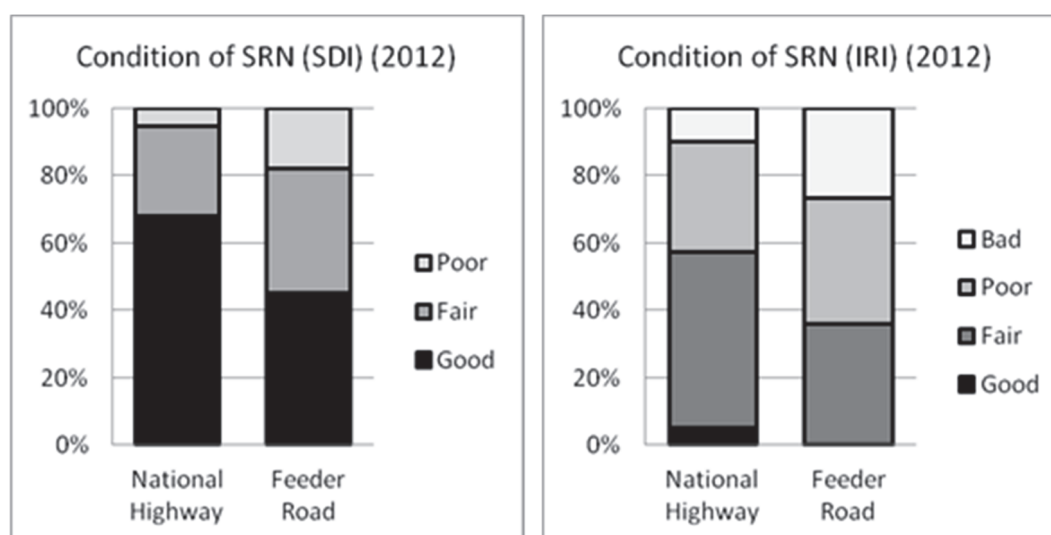
Roughness is recorded on the International Roughness Index (IRI), which is a measure of the vertical deviation of the road surface in metres per km. Four classes of condition are identified and used in Nepal: Good – IRI <4; Fair – IRI = 4-6; Poor – IRI > 6-8; and Bad – IRI > 8.

In 2012, a total length of 4,820km of sealed road were surveyed (see Table 3.4) of which half was deemed to be in Good or Fair condition, with 17% in Bad condition with an IRI in excess of 8m/km. The condition of the network as measured by both the SDI and IRI of individual sections are illustrated geographically on the DoR website.

**Table 3.4: SRN Pavement Condition - IRI (2012) – Sealed Roads only (km)**

	Pavement Condition (IRI)				Total Length (km)
	Good	Fair	Poor	Bad	
	<4	4-6	>6-8	>8	
National Highways	144.1 5%	1535.1 52%	958.7 33%	297.2 10%	2935.2 100%
Feeder Roads	4.0 0%	673.5 36%	706.3 37%	502.9 27%	1886.8 100%
All Sealed Roads	148.2 3%	2208.7 46%	1664.9 35%	800.2 17%	4821.9 100%

A comparison of the overall condition of the SRN (sealed sections only) measured by SDI and IRI respectively is illustrated in Figure 3.2 below. It can be seen that the 'surface' (measured by SDI) is recorded as being in better condition than the overall pavement and ride quality (measured by IRI).

**Figure 3.2 : Road Network Condition (2012) Sealed Roads Only**

### 3.7 Traffic Growth

Regular traffic counts have been maintained in Nepal since the late-1980s when a series of automatic traffic counters were set up at a number of key sites on the SRN in the Central, Eastern & Western Regions. The intent was to monitor traffic growth and composition on the main highways. The programme has since been expanded to include a large number of sites throughout the SRN, with manual counts undertaken annually.

The PIP2 contained an analysis of 10 selected key sites throughout the country, for which a regular and reliable series of data were available. The sites were selected to be representative of different classes of road – Terai & Hill, East-West Highway, links to Kathmandu, Highway & Feeder Road – so as to identify a range of traffic volumes and varying growth rates. The data have been updated and the individual counts are presented graphically in Figure 3.3: apart from the Mid & Far Western Regions, the counts show average growth rates of between 5% & 9% per annum.



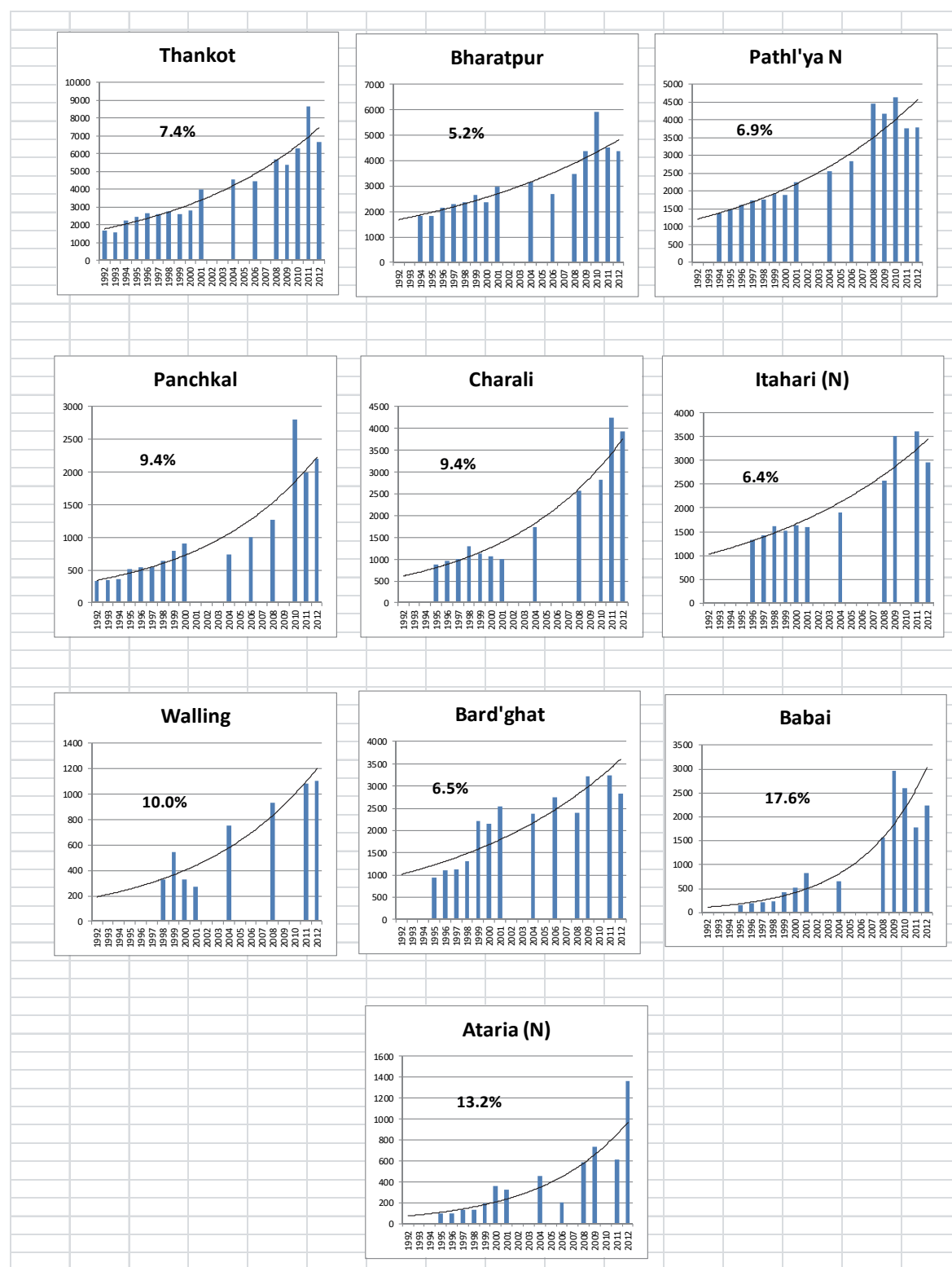


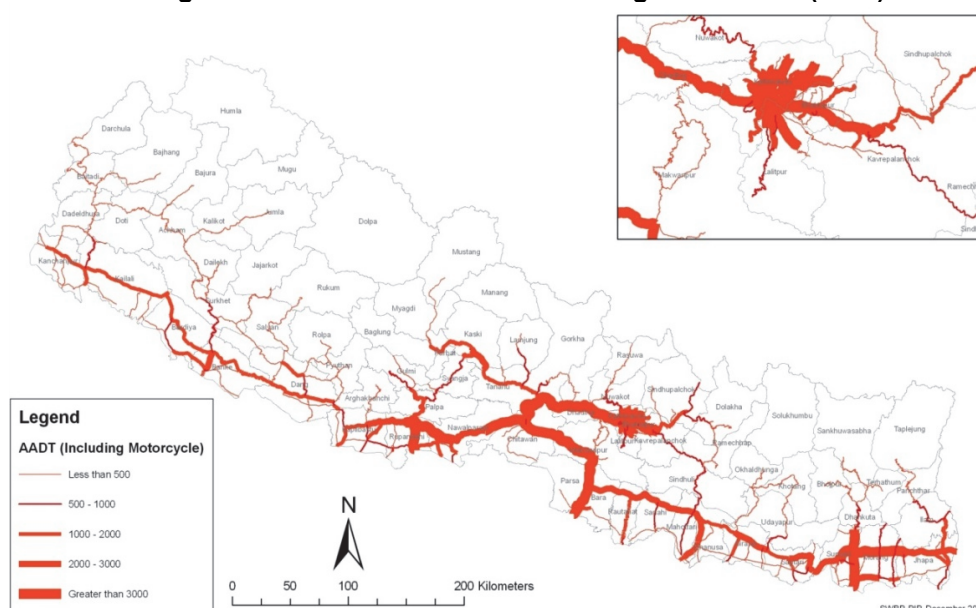
Figure 3.3: Traffic Count Data at selected Sites (1992-2012)

Overall traffic growth has typically averaged around 7% pa over the past 20 years on the main elements of the SRN, including the access route to Kathmandu and on the EWH in the Central and Eastern Regions. Higher rates of growth are evident at Panchkhal (on the Arniko Highway to the Chinese Border) and in the more remote Western areas, on account of the very much lower initial counts in the early 1990s.

These growth rates are broadly in line with PIP2 forecast of 6-8% per annum, which represents a doubling of traffic levels every 10 years.

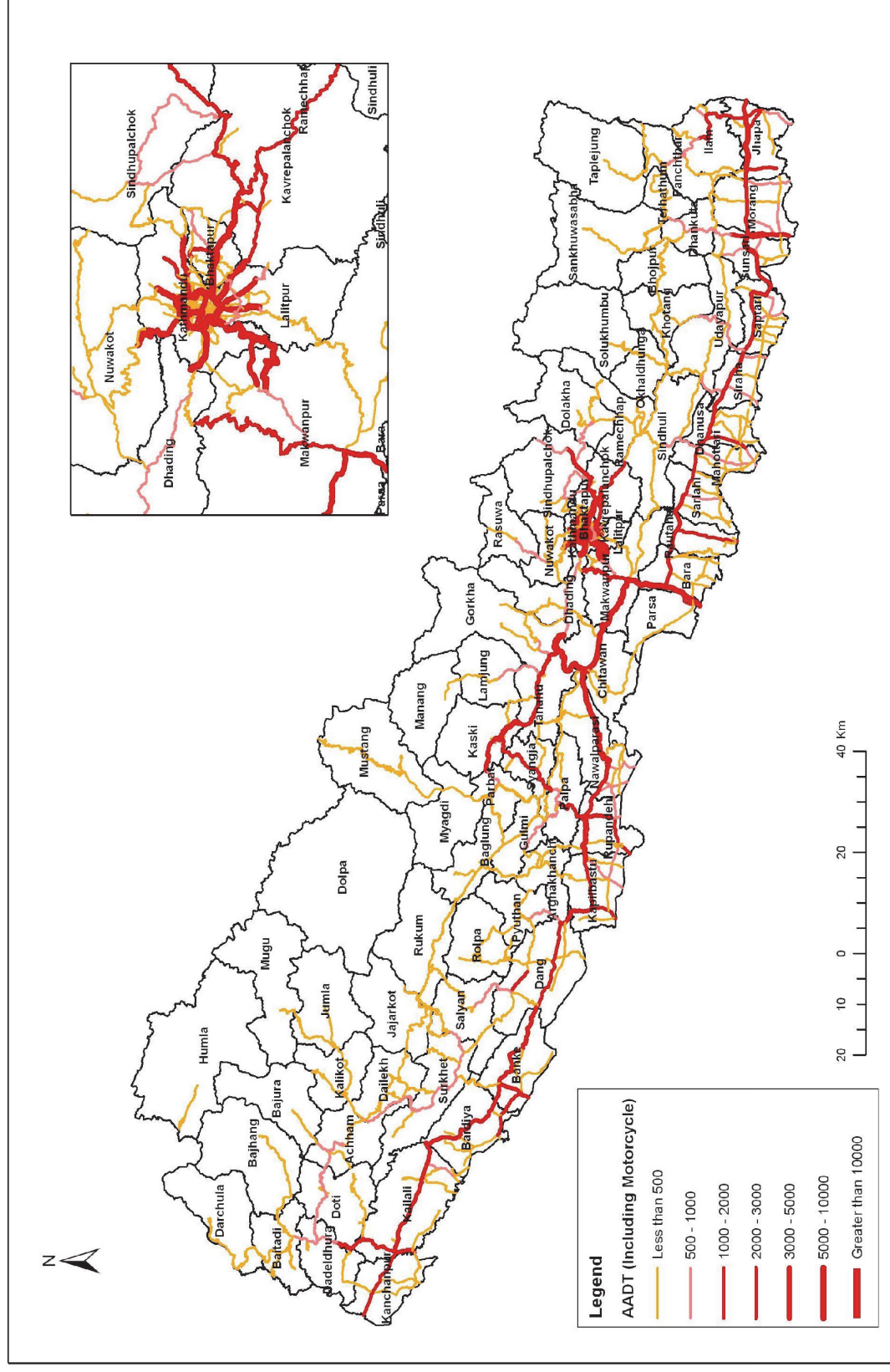
Traffic volumes across the network, as observed in 2005 and presented in PIP2, are illustrated in Figure 3.4. From this it is evident that the highest volumes are on routes to Kathmandu, on sections of the EWH and on the main commercial links to India..

**Figure 3.4: Indicative Traffic Flow Diagram – AADT (2005)**



Traffic data from the 2012 counts are presented graphically in Figure 3.5, illustrating those sections of road within each daily flow band. The highest traffic levels – between 10,000 and 20,000 vehicles per day (excl motorcycles) – are observed within the Kathmandu Valley, with volumes in excess of 5,000 vpd on the main approach route to Kathmandu. Elsewhere daily volumes in excess of 2,000 vpd are evident on much of the East-West Highway and other key routes in the Terai including links to the main border crossings with India.

Traffic volumes on the remainder of the network are generally less than 2,000 vpd and significantly lower than 1,000 vpd on most of the roads in the hills.





## 4. Review of Budgets & Expenditure

### 4.1 Background

A review and analysis of DoR budgets and expenditures – for both recurrent and capital expenditures – has been undertaken for period since the completion of the PIP2 in 2007. The objective is to compare the actual performance of the DoR against the planned budget forecasts from the PIP2. The process also identifies the proportion of “off-budget” expenditure on items that were not part of the original strategy. One serious concern is the large number of such projects that are included in the overall programme – but with only a nominal budget allocated annually.

### 4.2 Analysis of Budgets & Expenditure

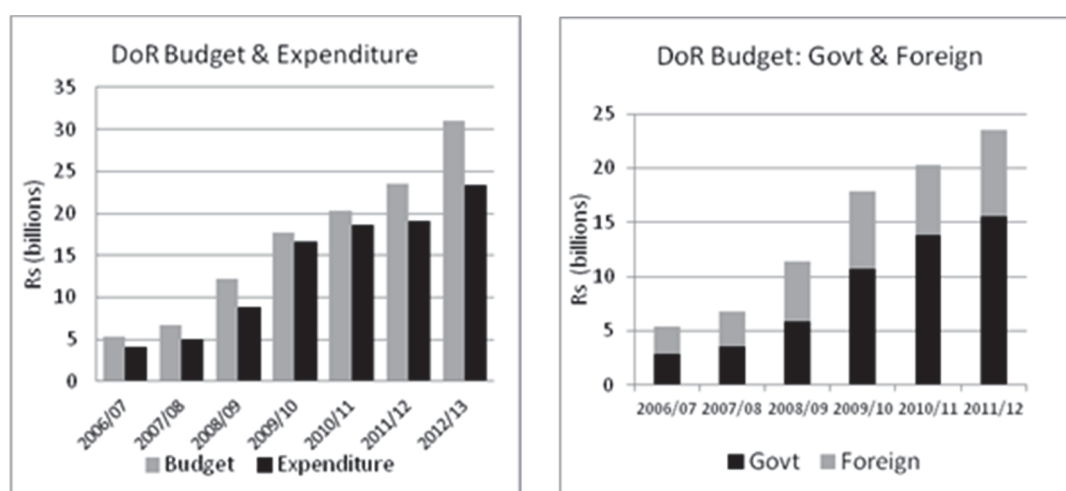
A review and analysis of both budgets and expenditures for the period since the completion of the PIP2 reveals that both have increased substantially over the past 7 or 8 years, see Table 4.1 and Figure 4.1. Since FY 2006/07, the annual budgets have increased from around Rs 5.4 billion to over Rs 31 billion in the last FY, whilst expenditure has increased from Rs 4 billion to over Rs23 billion.

**Table 4.1: DoR Budgets & Expenditure FY 2006/07 – 2012/13 (Rs ‘000s)**

FY	Budget			Expenditure		
	Govt	Foreign	Total	Govt	Foreign	Total
2006/07	2,856,446	2,540,282	5,396,878	2,223,484	1,808,599	4,032,083
2007/08	3,580,101	3,257,604	6,695,768	3,585,641	1,478,922	5,064,563
2008/09	5,869,807	5,563,383	12,284,222	5,388,208	3,439,056	8,827,264
2009/10	10,730,981	7,138,257	17,764,909	10,327,970	6,385,197	16,713,167
2010/11	13,858,055	6,396,326	20,254,381	13,009,663	5,560,367	18,698,030
2011/12	15,508,481	8,036,853	23,545,334	11,672,306	7,146,736	19,166,785
2012/13			31,050,150			23,308,429

Source: DoR Planning & Monitoring Unit

The proportion of foreign aid budget has declined progressively from around 50% in 2006/07 and 2007/08 to current levels of 30%, see Figure 4.1.

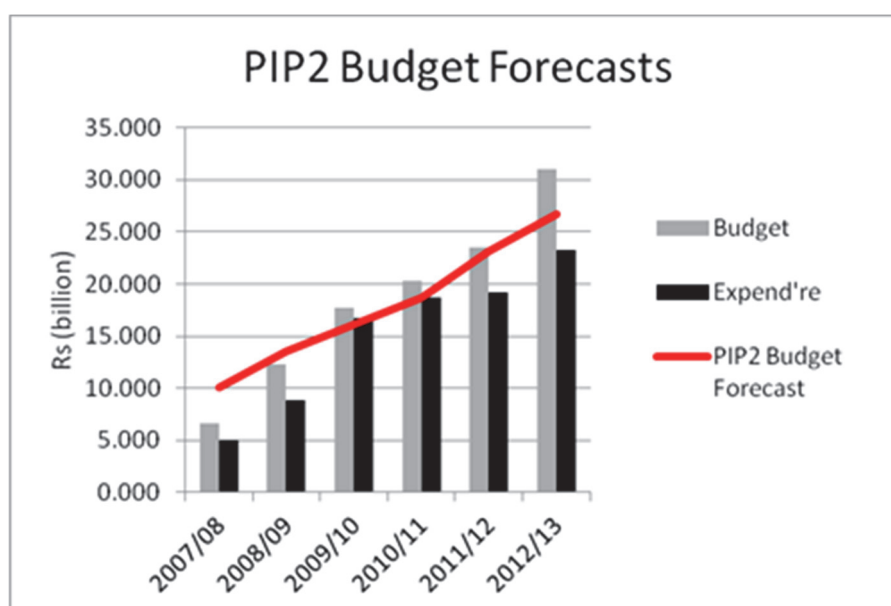


**Figure 4.1 : DoR Budgets & Expenditure (2006-2012)**

The PIP2 envisaged an annual budget of around Rs 8.5 billion in 2007, rising to Rs 13.5 billion by 2012 (at constant 2006 prices). If these budget estimates are inflated (using the Construction Price Index), the 2012/13 budget forecast becomes Rs 26.7 billion. The scale of budget and anticipated growth are broadly in line with the out-turn budgets and expenditures (see Figure 4.2) – although actual expenditures may not have followed the planned items.

**Table 4.2: PIP2 Forecast & Actual Budgets/Expenditures (2007/08-2012/13)**

FY	Constr Price Index	PIP2 Budget Forecast (Rs billion)		Actual (Rs billion)	
		2006 prices	Current prices	Budget	Expend're
2006/07 2063/64	83.57				
2007/08 2064/65	100	8.403	10.055	6.696	5.065
2008/09 2065/66	114.31	9.936	13.590	12.284	8.827
2009/10 2066/67	121.85	11.063	16.130	17.765	16.713
2010/11 2067/68	130.95	11.942	18.712	20.254	18.698
2011/12 2068/69	155.91	12.415	23.161	23.545	19.167
2012/13 2069/70	165 (est)	13.516	26.685	31.050	23.308



**Figure 4.2: DoR Forecast Budgets & Expenditure (2006-2012)**

### 4.3 Current Budget Analysis

An analysis of the most recent year's (2012/13) budgets and expenditures has been undertaken, as shown in Table 4.3, based on data provided by the DoR Planning & Monitoring Unit. The total approved budget was Rs 31 billion and expenditure during the year amounted to a little over Rs 23 billion, or 75% of the budget. The proportion of the budget spent tended to be higher for those wholly Government funded projects.

Regular maintenance activities (funded by the Roads Board) accounted for 16% of the overall budget, with donor funded projects (WB, ADB, JICA, India and China) accounting for a further 32%. Half of the total budget comprised 'other' GoN-funded projects and programmes including a series of 'Central Level' Programmes, Urban Road projects (dominated by expenditure in Kathmandu) and 32 small-scale road projects, with an average annual budget of less than Rs 50 million (US\$ 500,000).

**Table 4.3: Analysis of DoR Budget & Expenditure (FY 2012/13)**

Budget Items	Budget		Expenditure		Percent Budget Spent
	Rs (thousand)				
Regular Maintenance (Roads Board)	5,043,813	16%	2,986,607	13%	59%
Donor Funded Projects	9,889,331	32%	7,091,244	30%	72%
Central Level Programmes	10,629,882	34%	8,580,054	37%	81%
32 Sundry Road Projects	1,398,153	5%	1,127,227	5%	81%
Kathmandu Roads (& other urban)	3,518,844	11%	3,152,272	14%	90%
Sundry Items (FS, Safety, etc)	570,127	2%	371,026	2%	65%
TOTAL	31,050,150	100%	23,308,429	100%	75%

The 'Central Level' programmes involve a mix of projects including some strategic links – eg: Mid-Hills Highway (20%) and Postal Roads (15%) – but also many which are NOT strategic: for example 'Local Road & Bridge Construction' (26%), 'Roads Connecting Two Districts' (21%), and 'Roads addressing Regional Imbalance' (10%). These 'non-strategic' budgets cover a large number of small-scale projects: each of the Divisional Offices may have upwards of 150-200 contracts running on small local projects, each with an annual budget allocation of between Rs 5-10 lacs (US\$ 5-10,000). It is doubtful whether anything significant can be achieved with this level of funding, whilst effective supervision and administration of the numerous contracts (many in remote areas) is impractical with the resources available.

Eleven percent of the total DoR budget for 2012/13 (Rs 3.5 billion) was allocated to Urban Roads – mostly (70%) for the Road Widening Project in Kathmandu. The responsibility for urban roads should rest with the appropriate Municipality.

It is estimated that the 'non-strategic' elements may represent around 30%-35% of the total budget – and over 50% of the Government contribution to the budget. A review of the specific non-PIP elements of the current year's Budget (2013/14) is given below.

## Donor Funding

Donor funded projects represent around a third of the total DoR budget. An analysis of expenditures on the 12 major projects active over the period from 2006/07 to 2011/12 (see Table 4.4) reveals that a total of Rs 31.5 billion was spent, including a government contribution overall of around 25%. The major donors active in the roads sector are ADB (just over Rs 9 billion over the 6 years), WB (Rs 5.5 billion), India (Rs 3.9 billion) and JICA (Rs 3.6 billion).

These projects involve mostly the upgrading of the existing network or, in limited cases, new construction – ie the bulk of the capital expenditure on the improvement of the SRN. Excluding other non-Donor improvement projects, it would thus appear that the DoR is spending on average a little over Rs 6 billion per year on upgrading and new construction – representing around a third of total expenditure.

**Table 4.4: Major Donor Funded Projects (2006-2012)**

Name of The Project	Expenditure ( Rs thousands ) (2006/07 - 2011/12)			
	GON	Foreign	Total	Donor Percent
Postal Roads (India – from 2011)	1,974,419	758,621	2,733,040	28%
RMDP (WB) – closed 2006/07	75,567	402,634	478,201	84%
STFP/STEP (ADB)	862,360	2,258,722	3,121,082	72%
RNDP (ADB)	712,427	2,536,081	3,248,508	78%
RS DP (WB)	791,641	4,956,304	5,747,945	86%
RCSP (ADB)	1,368,359	4,283,764	5,652,123	76%
Road Improvement Project (India)	1,297,573	3,178,098	4,475,671	71%
Banepa-Sindhuli-Bardibas (JICA)	277,888	2,241,190	2,519,078	89%
Syafrubesi-Rasuwegadhi (China)	403,004	912,623	1,315,627	69%
Kathmandu-Bhaktapur (JICA)	376,934	1,351,800	1,728,734	78%
Trade Route Devel Project (WB)	33,832	161,877	195,709	83%
Flood Damage Rehabilitation	117,392	263,724	381,116	69%
Total	8,291,396	23,305,438	31,596,834	74%

#### 4.4 Comparison with PIP Forecasts

As indicated above, it is evident that the total DoR budget allocations are broadly similar to the planned level – although the distribution of expenditure is significantly different. The PIP2 budget assumed 28% of the total budget would be spent on maintenance – 10% on regular maintenance (routine & recurrent) & 18% on periodic – 32% on upgrading of earth & gravel roads to sealed bitumen, and 24% on new construction, including the then committed projects of WB, ADB & JICA. It was proposed that construction of a new link between Kathmandu and the Terai would account for around 16% of the overall budget over the 10 years, mostly in the latter (post 2011) years.

In contrast, an analysis of the 2012/13 DoR expenditure shows only 13% spent on maintenance, 30% on donor funded projects (mostly upgrading), 42% on various central-level programmes and minor road improvements and 14% on urban roads. A comparison with the PIP2 forecast budget for 2007-2011 is given in Table 4.5. The main differences are:

- the significantly lower proportion of the total funds allocated to maintenance;
- the large number of projects, with small allocations, included under the 'central-level' and sundry roads programmes; and
- the inclusion of Urban Roads (and the Kathmandu Road widening).

Additionally, it should be noted that the earlier PIP2 budget allowed for the inclusion of significant expenditures on major projects – specifically the improvement of access to Kathmandu either via the Fast Track or a tunnel approach from the west.

**Table 4.5: Comparison of PIP2 Budgets and Actual Expenditure**

PIP2 Budget 2007-2011			Expenditure (FY 2012/13)		
Category	Total Budget		Category	Expenditure	
	Rs bn	percent		Rs bn	percent
Maintenance	15,572	29%	Regular Maintenance	2,987	13%
Upgrading	17,809	33%	Donor Funded Projects	7,091	30%
New Construction	14,039	26%	Central Level Programmes	8,580	37%
			32 Sundry Road Projects	1,127	5%
Kathmandu access	3,000	6%			
			Urban Roads (incl KTM)	3,152	14%
Other	3,340	6%	Sundry Items	371	2%
TOTAL	53,759	100%	TOTAL	23,308	100%

## 4.5 Implementation of PIP2 Proposals

A detailed examination of the list of priority schemes proposed in the PIP2 has shown that – with very few exceptions – all the projects listed in Table 10.5 of the PIP Final Report are either completed, in progress or under procurement. The priority programme included seven components – see Annex 1:

### (i) Committed Schemes

A total of 16 committed schemes funded by ADB, WB, DFID, JICA, China & India were included with a total length and cost of 2,400km and Rs 21.5 billion (incl 1,500km of Terai Roads funded by India at Rs 9 billion). These are mostly complete or substantially complete, with the exception of the Indian-funded Terai Roads component on which progress is slow.

### (ii) Upgrading Schemes

These were the highest priority among the non-committed schemes – 14 upgrading schemes totalling over 700km – providing sealed road access to 9 District HQs. Nine of these are now complete, with work on-going on the remaining five: seven of the projects were taken up by the Indian Funded Road Improvement Project (RIP).

### (iii) New Construction (Feeder Roads Standard)

Five new sections of Feeder Road were proposed (total 366km) to be constructed initially to earth track standards, with upgrading subject to feasibility study. With one exception that is still at the planning stage, the remaining four tracks have been opened and sections are being upgraded to bitumen standard.

### (iv) New Construction (Earth Track)

A further 385km (four schemes accessing remote District HQs) were recommended for construction as earth tracks, mainly through local efforts. Two of these are now open (Chame & Gamgadhi) and the remaining two (Dunai & Simikot) are under construction.

(v) Upgrading of Local Roads to SRN Standards

PIP2 recommended the upgrading of a number of Local Roads to SRN standards and prioritised 11 such roads (636km), based on their strategic significance. Most were in the Mid-Hills and formed part of the proposed Mid-Hills Corridor. Work is currently on-going on 9 of these roads, which all form part of the (now extended) SRN.

(vi) New Construction to access Kathmandu

The previous PIP – in common with the earlier PIP in 1997 – recommended that a detailed feasibility study be undertaken of a potential new route linking Kathmandu and the Terai, together with possible improvements to the existing route. It was noted, in both reports, that the very substantial time and distance savings, coupled with substantial commercial traffic volumes, would likely justify the significant investment requirements and raise the possibility of commercial viability and the involvement of private sector finance.

The Government has pursued the 'Fast Track' option – a new road following the Bagmati River alignment and connecting to the East West Highway at Nijgadh, close to the site of the proposed Second International Airport. The Nepal Army (NA) has been engaged for 'track-opening' and the Government is seeking to attract the private sector to invest in the construction and operation of a four-lane road: to date, negotiations with two Indian Consortia have failed to reach agreement.

A second, alternative, 'tunnel' alignment linking more directly to Hetauda is being promoted by a privately funded Nepali-based consortium. The route is shorter but potentially more costly and challenging as involves significant tunnel construction, in total around 7km in length.

In parallel with these initiatives, the Japanese are investigating improvements to the main approach to Kathmandu from the west (Prithvi Highway) involving a tunnel to avoid the steep and unstable 15km section between the Valley Rim (Nagdhunga) and Naubise. The route options were earlier evaluated by ADB.

Both this option and the Fast Track were proposed for 'further investigation' in PIP2, together with the upgrading of alternative, more direct routes linking to Hetauda.

The critical issue now is to decide which of the options should be pursued as they all – to an extent – compete for the same traffic. The worst option could be to pursue all three, with the result that none are viable and substantial sums of money are wasted on projects that may never be satisfactorily completed.

(vii) Other Strategic Road Improvements

The PIP2 additionally recommended the upgrading of the Kathmandu Ring Road, improvements to Narayanghat-Mugling, construction of a by-pass to Hetauda, and the development of an alternative route to the Koshi Barrage in eastern Nepal. With the exception of the Hetauda by-pass, the remaining three projects are in-hand: work has started (funded by China) on the Ring Road Upgrade and the other two projects are under procurement through the WB and ADB.

## Implementation of non-PIP Schemes

A review of the current year budget (2013/14) reveals a total of 38 ‘budget heads’ for roads NOT included in the PIP2, totalling over Rs 11 billion<sup>5</sup> (US\$ 110 million) – or around a third of the total budget. These are listed in Annex 2.

Many of the projects (budget heads) are relatively small but those with an annual budget in excess of Rs 100 million (US\$ 1 million) include:

- Kanti Lokpath (Rs 120m);
- Sandikharka-Dhorpatan (Rs 160m);
- Regional Level Local Roads (to redress regional imbalance) (Rs 830m);
- Gaighat-Hetauda (Rs 150m);
- Bridges on Local Network (Rs 1,700m);
- RIP I & RIP II – not incl in PIP2 (Rs 970m);
- Urban Roads (incl Kathmandu Road Widening) (Rs 2,700m);
- Kathmandu Sustainable Transport Project (Rs 670m);
- Flood Rehabilitation (Rs 300m);
- Tourism roads (Rs 360m);
- Trade Route Development Project (Rs 940m);
- North-South Routes (to Chinese Border) (Rs 570m); and
- Potential Strategic Roads (Rs 1,000m)

This analysis confirms the ‘deviation’ of the budget from the primary objectives of maintaining and strengthening the Strategic Road Network – as originally defined in the PIP2. Of particular concern are the substantial on-going expenditures on Urban Roads (Rs 3.3 billion) and general items relating to the Local Road Network (at least Rs 2.5 billion). Additionally, significant funds are allocated to specific local roads (some of which are listed above) and to extensions and improvements to the SRN that were not prioritised under PIP: this latter group of projects include the additional links to the Chinese Border and the expansion of roads connecting to the Indian Border (under the Trade Route Development Project).

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<sup>5</sup> It is not possible to quote a figure exactly as some projects (eg RIP I & RIP II) contain some elements that are included in PIP2 and some not



## 5. Maintenance Obligations

### 5.1 Introduction

It is generally recognised that the primary function of the DoR is the maintenance of Strategic Road Network. The review of DoR Policy & Strategy (Part II of the ToR) highlighted the importance of maintenance and the need for improvements to current practice, including a review of the intervention criteria and overall approach to '**managing**' the network.

The DoR is in the process of reviewing and developing a new and comprehensive Maintenance Policy for the Strategic Road Network. The Consultants have been provided with a copy of an internal draft of the proposals and have examined this in the context of the five specific tasks set out in Part II of the ToR:

- (i) Review & revise existing DoR goals, strategies, etc;
- (ii) Update threshold & policy for upgrading from earth/gravel to BlackTop;
- (iii) Review maintenance intervention strategies & surface options based on traffic and economics;
- (iv) Review approach to periodic maintenance & develop suitable ranking criteria; and
- (v) Review feeder road (staged) construction policy.

These activities – which focus primarily on the maintenance and upgrading policies and strategies of DoR – require close cooperation and liaison between DoR and the Consultant. A Working Group comprising key members of staff of the DoR was formed to participate in these discussions.

Items (i) to (iv) above are discussed in greater detail in Section 5.3 to 5.6 below: the review of Feeder Road construction policy (item (v)) is included in Chapter 6 as it refers to capital construction works.

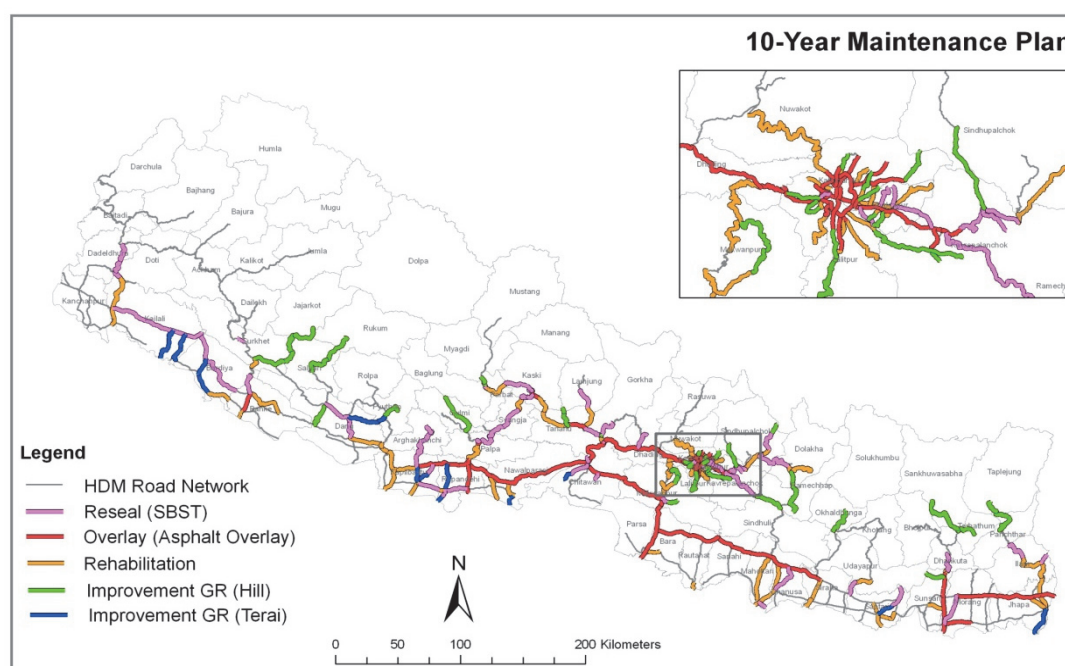
### 5.2 Approaches to Maintenance

The previous PIP2 Study evaluated the maintenance options and developed a 10-year maintenance strategy and programme based on an analysis using the HDM-4 model. HDM evaluates ALL interventions – including regular annual maintenance (calculated on a per km basis), periodic maintenance (including reseals, overlays and rehabilitation), as well as upgrading from gravel to seal. The HDM model does not specifically consider earth roads: strategies for upgrading and maintenance have to be evaluated separately. The maintenance categories defined in HDM differ marginally from the definitions adopted within the DoR.

The DoR considers Routine, Recurrent, Special and Emergency Maintenance as 'regular' activities for which budgets are allocated on a per km basis, with different rates adopted in the Hills and Terai and also potentially by class of road. Periodic or Cyclical Maintenance requirements, which generally involve a re-seal (SBST or slurry seal), are determined through the ARMP process: they are generally based on the age of the pavement with adjustments for condition (as measured by SDI), traffic volume and the strategic nature of the link. Major rehabilitation and reconstruction (including overlays) or any upgrading works are treated separately for budget and prioritisation purposes. Most commonly these works are undertaken through external donor-funded projects. [Minor rehabilitation of short sections may however be included through regular DoR budgets.]



Figure 5.1 (below) summarises the maintenance interventions recommended by the HDM-4 analysis in the previous PIP, including the improvement (upgrading) of gravel sections to black top.



**Figure 5.1: 10-Year Maintenance Plan as developed in PIP2 (2007)**

This 10-year plan was indicative of the scale and extent of maintenance works that could be expected during the plan period. In practice the actual works undertaken will have differed and will have been based on an annual assessment of the network condition: nevertheless the HDM analysis provided a realistic estimate of the overall extent of the anticipated works and of the total budgetary requirements.

### 5.2.1 Definitions of Maintenance

In the broadest sense there are generally considered to be at least eight categories of “Maintenance” Interventions:

1. Routine: Drain cleaning, minor slide clearance, sign painting, etc
2. Recurrent: Patching, pothole/edge repair, etc
3. Emergency: Temporary works, major slide clearance. etc
4. Special: Off-carriageway works, retaining walls, etc
5. Periodic: Cyclical reseal – typically every 5-8 years
6. Rehabilitation or Reconstruction\*: Restores road to original condition
7. Overlay: AC (or Base & DBST overlay) to extend life of road
8. Upgrading/Improvement: improves road width, surface type or alignment

Note: \* DoR uses the term ‘rehabilitation’ to refer to the reconstruction of short sections of road that have failed, whereas ‘reconstruction’ is used for the reconstruction of complete sections (links).

Items 1-4 are straightforward. Funding is available through the Roads Board and budgets are determined on a per km basis, dependent on terrain and potentially also on traffic levels and/or strategic importance.

Items 5, 6 & 7 – Periodic, Rehabilitation and Overlay – are the main concern, where options are available and choices have to be made: for example, whether to apply a (cheaper) reseal which will resolve immediate issues with cracking, etc or whether to apply a (more expensive) asphalt concrete overlay that will resolve the immediate problems as well as providing additional strength, an improved running surface and increasing pavement life. These activities represent the ‘cross-over’ between recurrent and capital works and need to be carefully evaluated.

Item 8 (Upgrading) is clearly capital works – and is generally separately assessed – although the HDM model can be used to identify the economically optimal timing for upgrading from earth or gravel to bitumen seal or for widening from a single lane to two lane carriageway.

## 5.2.2 Annual Road Maintenance Plan

The DoR ARMP process identifies priorities and defines budgets based on lengths of road, by Division, for the following maintenance categories: Routine, Recurrent, Periodic and Special. Some limited additional amounts are also included for specific elements of Rehabilitation, Reconstruction and Upgrading, together with allowances for Emergency Works, Bio-engineering Works, Road Safety and Routine Bridge Maintenance.

The process is based on a spreadsheet that is accessed on-line, with the required data collected centrally by HMIS. The primary data used are: section length, terrain type, traffic volume, pavement age, Surface Distress Index (SDI) and strategic function of the link. IRI data are also collected annually but are NOT an input to ARMP. It is considered that the ARMP model does not differentiate adequately between the traffic groupings and does not reflect the additional deterioration that is evident on the higher trafficked roads – and specifically the increased truck loads that are now experienced.

The results of the analysis are not fully ‘trusted’ by the Divisions, indicating that model may not be realistically assessing the options. It is also widely acknowledged that it is possible to ‘manipulate’ the results through use of ‘age’ factor, to raise the ranking of a particular project.

The procedures currently adopted by the DoR follow the guidelines and output from the ARMP spreadsheet (later developed to web-based system since 2012) to determine priorities and maintenance interventions and budgets up to – and including – periodic maintenance. The ARMP process does NOT consider the potentially more significant demands for rehabilitation or overlays.

It is evident that the existing ARMP process is in need of review and revision, in recognition of changes in the road network and traffic loadings. The present model structure provides an indication of ‘where’ and ‘when’ an intervention is required: it does not indicate “what” should be done in terms of remedial action. It is recommended that the possibilities and potential of expanding the scope of the ARMP be investigated so as to identify sections of road network for rehabilitation and/or overlay.

## 5.2.3 Funding for Maintenance

Funding for all regular maintenance – up to and including periodic reseals – is available through Roads Board Nepal (RBN). RBN receives funds from a fuel levy

(Rs 2 per litre for diesel & Rs 4 for petrol) plus 5% of new vehicle registration tax and some limited road tolls. The tolls produce a relatively small amount of money with disproportionately high costs and accompanying adverse publicity.

The annual revenue raised by Government is currently around Rs 5bn, of which Rs 4bn (80%) is passed to RBN. The funds are allocated by RBN to the DoR, Districts and Municipalities. The DoR received Rs 3.6bn in FY 2012/13. The overall arrangements are satisfactory, with a relatively secure source of funding although the need for periodic increases could be avoided if the levy were established as a percentage of fuel costs (as opposed to a flat rate).

## **5.2.4 Specific Maintenance Issues**

### **‘Routine-Recurrent’ Issues**

The introduction of individually contracted ‘lengthmen’ as part of the SMD process was widely acknowledged as a major advance in improving the quality of routine maintenance of the SRN. However, after almost 20 years, questions are now being asked as to whether the continued use of lengthmen is appropriate or cost effective. The annual expenditure on ‘Routine’ maintenance (at Rs 63,000/km) is considered high in relation to that incurred on ‘Recurrent’ maintenance (Rs76,000/km).

### **‘Otta Seal’ Issues**

A number of problems associated with early surface failures have been reported on roads treated with Otta Seal. Upwards of 1000km of roads, mostly in hilly areas in the MW & FW Regions, have been constructed with Otta Seal (generally as ‘upgrade’ from gravel) over the past 7-8 years. A number of failures were apparent within 2-3 years of construction, compared with an expected life of 5-8 years.

Otta Seals were introduced from 2006 onwards as a potential means of providing a bitumen surface over an existing gravel pavement at a relatively low cost. The approach required only a single layer of seal, mixed with locally sourced material, rather than a base layer of graded material and (imported) chips used for DBST. The bitumen content is higher with the Otta Seal but this additional cost is offset (in the hills) by the savings from the transport costs of a reduced volume of material imported from the Terai.

DoR’s experience with Otta seal is mixed and appears to be dependent primarily on the condition of the base and sub-base layers. If the seal is applied over a coarse and poorly graded and compacted gravel base, it is highly probable that the seal will fail, especially if subjected to heavy vehicle loads. The same would happen with SBST or DBST. If however the seal is laid over a well laid and compacted base and sub-base it should perform satisfactorily: in short, it is not a cheap way to compromise on the quality of the base and sub-base but may offer benefits if the transport cost of chips/aggregate required for SBST/DBST are high.

### **Alternative Maintenance Strategies**

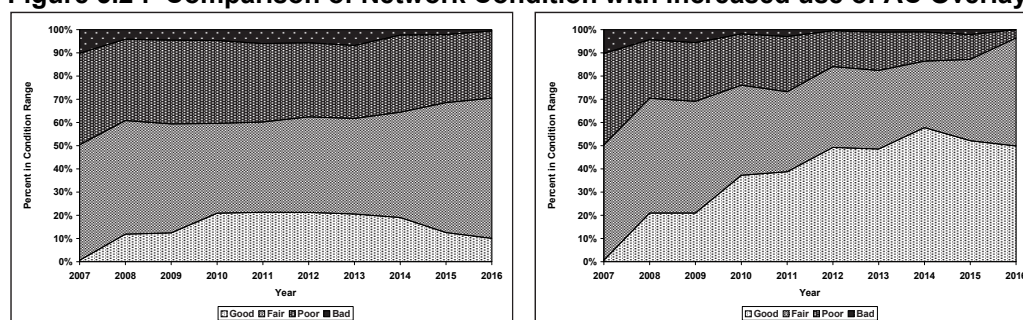
The ToR requests a review of maintenance intervention strategies, together with the development of associated policy guidelines on the criteria to be adopted regarding alternative surfacing options. It is assumed that this refers primarily to the periodic (or cyclical) maintenance activities and not to rehabilitation, reconstruction, overlay or upgrading.

One potential option would be the greater use of Asphaltic Concrete (AC) overlays in place of the regular SBST/DBST resealing. This option was examined in some detail using the HDM model in the previous SWRP/PIP2.

The conclusion was that the increased use of AC overlays, even on lower trafficked roads, was shown to be cost-effective, as it reduced the extent of subsequent expenditure on (more expensive) rehabilitation. Additionally, the AC overlays improved the overall network condition at a similar cost. Reseals (although cheap) do not reduce roughness or add strength to the pavement.

The following diagrams (Figure 5.2), taken from the PIP2 Final Report, illustrate the overall condition of the road network, throughout a 10-year cycle, comparing DoR practice, of using AC overlays only on roads with daily traffic in excess of 3000 vpd, with an alternative strategy of allowing the HDM model to determine the most effective intervention, in terms of total costs – ie the cost of the intervention, plus associated maintenance costs and total vehicle operating costs. An additional bonus is that the network is in better (and stronger) condition at the end of the 10 years.

**Figure 5.2 : Comparison of Network Condition with Increased use of AC Overlays**



Source: SWRP/PIP2 (2007)

### 5.3 Review Maintenance Strategies and Policies

The **primary reference document** is the Departmental Policy Document, “The DoR Strategy”, dated July 1995. This outlined the DoR Strategy and comprised 6 OBJECTIVES, 9 POLICY OPTIONS and 51 KEY MEASURES. These all led toward the End Goal of the DoR, established in 1991/92 during the preparation of the 9<sup>th</sup> Plan, of “**the reduction of total road transport costs**”.

The Objectives, Policy Options and Key Measures were described in an Annex to the 1995 Strategy Document. Much progress has been made over the past 18 years and it is appropriate now to review the current status and determine whether they are still relevant in today’s context or whether additional issues should be included. The overall goal should also be reviewed and potentially broadened to include social, equity and environmental concerns.

Three of the **6 Objectives** relate to ‘policy’ level issues (1. Policy Level Awareness; 2. Network Planning; and 3. Direction of Donors) and three relate to ‘operational’ level issues (4. Improved Maintenance Operations; 5. Needs-based Budgeting; and 6. Plant Management).

The **9 Policy Options**, designed to realise the above objectives, are defined as:

- (i) Decentralise Network Administration
- (ii) Establish a Network Planning/Monitoring capability in DoR
- (iii) Establish a Self-Sustaining Fund for Road Maintenance
- (iv) Improve Maintenance Operations in the Divisions
- (v) Improve Periodic Maintenance of the Strategic Network
- (vi) Improve Bridge Maintenance on the SRN
- (vii) Improve Roadside Support Maintenance
- (viii) Establish the Concept of National Standards
- (ix) Improve DoR Plant Management and Utilisation

These are each described in greater detail below, together with an assessment of the current status and requirements for revision.

**(i) Decentralise Network Administration**

Emphasises that the DoR priority is the development and maintenance of the SRN which (then) comprised 5,430km of road, of which 2,694km (50%) were bitumen surfaced. The remaining Urban, District & Village Roads (4,194km) were to be the responsibility of the Municipalities, DDCs and VDCs respectively. Whilst this has been adopted in theory, in practice there is still considerable degree of overlap – especially at the Divisional level and in regard to ‘local’ bridges.

**(ii) Establish a Network Planning/Monitoring capability in DoR**

This action has been largely implemented with the establishment of the HMIS and the regular collection of data on traffic levels and road condition.

**(iii) Establish a Self-Sustaining Fund for Road Maintenance**

This action has been largely implemented with the establishment of the Roads Board Nepal which is funded through a fuel tax levy, road tolls and share of vehicle registration taxes. The RBN allocates funds to the DoR Divisions, Municipalities and DDCs for routine and recurrent maintenance activities – although the level of funding is generally considered inadequate.

**(iv) Improve Maintenance Operations in the Divisions**

The establishment of the Strengthened Maintenance Divisions (SMDs) with an emphasis on the Routine and Recurrent Maintenance activities has significantly improved the performance of the Divisions and this – coupled with a more rigorous application of periodic or cyclic overlays (see below) – has resulted in an overall improvement to network condition and a reduced demand for premature rehabilitation or reconstruction.

**(v) Improve Periodic Maintenance of the Strategic Network**

This adoption of a periodic or cyclical maintenance programme – as applied through the ARMP process – and based on pavement age, visual surveys, traffic levels and strategic importance has been effective in extending the pavement life and reducing the requirements for early rehabilitation. It may however now be appropriate to reconsider both the number of parameters used and the threshold criteria adopted.

**(vi) Improve Bridge Maintenance on the SRN**

A separate centralised Bridge Unit has been established in DoR and a detailed inventory of SRN bridges undertaken. Separate budgets and donor-funded projects have been set up to assist with the maintenance needs. [The issue of non-SRN bridges handled by the Divisions needs to be resolved.]

**(vii) Improve Roadside Support Maintenance**

The issues associated with slope-stability have been widely examined and (in general) cost-effective solutions developed.

**(viii) Establish the Concept of National Standards**

Limited progress was made (in the 1990s) in regard to the establishment of the Staged Construction Standards for Low Cost Feeder Roads: a review of the Feeder Road Construction Policy is included in Chapter 6. It is unclear whether National Standards have been developed and approved for other classes of road.

**(ix) Improve DoR Plant Management and Utilisation**

This action was addressed through the Strengthened Equipment Division (SED) initiative, which proposed to put the Heavy Equipment Divisions (HEDs) onto a more commercial footing, whilst providing adequate, reliable and appropriate equipment on a cost-effective basis to the Divisions and local contractors.

## **5.4 Update threshold & policy for upgrading from earth/gravel to Black Top**

The “Classification and Design Standards for Feeder Roads” (February 1994) proposed a methodology for determining the threshold traffic volume for upgrading from earth to gravel and gravel to bitumen. This was further elaborated in a Discussion Paper “Threshold Traffic Levels for Feeder Road Upgrading” (May 1995).

These documents presented a methodology, using the HDM model, for calculation of the ‘total transport costs’ – i.e construction and maintenance costs plus vehicle operation costs – for typical Hill and Terai roads with increasing traffic volumes. The construction and maintenance costs and vehicle operating costs were calculated at 1995 levels. The resultant threshold traffic levels for upgrading from earth to gravel were determined as 35 and 60 vpd for Hill and Terai roads respectively: for upgrading from gravel to bitumen, the threshold levels were established as 92 and 100 vpd respectively.

The threshold traffic volumes have been re-calculated for earth, gravel and bitumen roads based on current construction, maintenance and vehicle operating costs. The analysis has assessed the benefits of upgrading from a fair-weather earth road to an



all-weather gravel surface (including all drainage structures) and, subsequently, from all-weather gravel to a sealed bitumen surface. This allows the costs and benefits to be separately attributed to each improvement stage and the associated traffic volumes required to generate the necessary benefits have been calculated.

The benefits of upgrading to an all-weather gravel surface accrue from the road being open for 12 months each year and the reduced vehicle operating costs (and higher speeds) possible on the improved surface. The benefits from subsequent upgrading to bitumen seal result from further reductions in vehicle operating costs, together with savings in the annual recurrent maintenance costs of the gravel road.

Revised thresholds have been calculated (see Annex 3) as 40 vpd (excl m/cycles) for upgrading from earth to all-weather gravel and as 90-100 vpd (excl m/cycles) for gravel to bitumen. Similar thresholds apply in both the hills and Terai. It may however be desirable to seal hill roads at a lower traffic level due to the effects of gravel loss on steep gradients and the difficulties associated with re-gravelling at regular intervals.

As with the earlier analysis, it should be emphasised that these thresholds are not absolute values but are indicative of the traffic levels required to identify a trigger point at which a detailed feasibility study should be initiated.

## 5.5 Review maintenance intervention strategies & surface options

The present intervention strategy in regard to **periodic maintenance** is determined primarily through the ARMP process, which considers the age of the pavement, the SDI, the traffic flow group and the strategic nature of each link. Data on IRI are collected but are not currently used in the analysis.

There is NO formal process to identify the needs for rehabilitation or reconstruction, nor to determine what form of treatment or improvement should be applied. Each Division can make an application, supported by evidence of failure (e.g photographs), for funding for the rehabilitation or reconstruction of specific sections of the SRN but this generally applies only to relatively short sections that have failed, rather than the comprehensive reconstruction of the whole length of a section.

The following Tables (taken from the HDM analysis conducted in PIP2, 2007) present the assumptions adopted in the HDM analysis to 'trigger' resurfacing or rehabilitation: Table 5.1 represents an interpretation of the current DoR approach, with AC overlays only applied when traffic levels exceed 3000 vpd, and Table 5.2 presents the alternative approach that was tested of applying AC Overlays at lower traffic levels and lower IRI (see Section 5.2.4 above).

**Table 5.1: Intervention Levels for Resurfacing & Rehabilitation**

IRI Range	AADT Range (incl motorcycles)		
	< 1,000	1,000 – 3,000	> 3,000
< 8	Seal	Seal	Overlay
8 – 10	Seal	Rehab	Rehab
> 10	Rehab	Rehab	Rehab

Source: SWRP/PIP2 (2007)

**Table 5.2: Modified Overlay Intervention Levels**

IRI Range	AADT Range (incl motorcycles)		
	< 1,000	1,000 – 3,000	> 3,000
< 5	Seal	Seal	Overlay
5 – 6	Seal	Overlay	Overlay
6 – 8	Overlay	Overlay	Overlay
8 – 10	Overlay	Rehab	Rehab
> 10	Rehab	Rehab	Rehab

Source: SWRP/PIP2 (2007)

The Consultants recommend the development of the current ARMP process to expand the range of possibilities considered, including – for example – the adoption of criteria and thresholds to identify the need for rehabilitation and/or reconstruction or overlay through the use of both IRI and SDI indicators, together with traffic levels, strategic indicators and age of the pavement.

The Consultants consider that the current approach adopted by DoR adequately identifies the needs for routine, recurrent and periodic maintenance but does not adequately address – in a structured manner – the needs for overlays, rehabilitation or reconstruction. These interventions are presently assessed on an ad-hoc basis, generally in conjunction with the design and development of programme of external donor financing. There is a need to introduce a more rigorous impartial approach, based on the available data and forecasts of future conditions.

It is recommended that a simplified model be developed and incorporated into the ARMP to identify the future overlay, rehabilitation and reconstruction needs, based on the data that are currently available. This may then be used as a forecasting and budgeting tool to assess the overall maintenance requirements on an annual and recurring basis, including an indicative budget for inclusion in the revised PIP to 2022.

## **5.6 Review approach to periodic maintenance & develop ranking criteria**

As indicated above, the Consultants believe that the current approach to identifying the needs for periodic maintenance, based on the ARMP, is generally appropriate, although it is recommended that the process be extended to include rehabilitation and reconstruction – as well as identifying the need for upgrading.

It is recommended (in line with the new policy document) that the approach using the ARMP is extended to include ‘Rehabilitation and Overlay’ options, based on a range of additional intervention criteria and thresholds. The ARMP model should be extended to identify and prioritise additional activities, including rehabilitation and AC overlays. This will require establishing intervention criteria based on IRI, SDI and traffic level – along the lines set down in the new policy document – together with recommended remedial actions.

It is noted that the new DoR Maintenance Policy document introduces more specific recognition of traffic volume and refines the definition of types of maintenance. The Annexes of the new Policy Document also specify a detailed series of intervention criteria, together with recommended actions: these values need to be reviewed and subsequently incorporated into an extended version of the ARMP.

## 6. Development & Upgrading of SRN

### 6.1 Strategy for Development

The previous PIP adopted a two-stage process for the development and expansion of the SRN. The first stage involved establishing the extent of the future network by identifying all potential links that could be included in an extended SRN, together with an evaluation – using a multi-criteria screening approach – of the viability and status of each link. The second phase examined the overall network and assessed the demands and priorities for the improvement or upgrading of individual links.

There is no magic number regarding the desired length of the SRN: the inclusion of any particular link should be based primarily on its **function** or position within the network. The PIP2 took the existing designated and ‘de-facto’ strategic networks (of around 5,000km and 7,500km respectively) and examined extensions to bring the total length to around 10,000km by 2016. This scale of growth was considered appropriate given the nature of the existing network, the traffic demands, the distribution of population and economic activity, and the capacity of the institutions to manage, construct and maintain the infrastructure.

The SRN as originally defined (in 1995) comprised 15 National Highways and 51 Feeder Roads – each with a clear function. National Highways were the primary links between the regions and to the main cities and border crossings: specifically, the National Highway network comprised the East-West Highway (the main unifying link from east to west in the Terai), links to the main centres and regional head-quarters in the hills, and connections to the main border crossings with India and China.

Similarly, a clear definition of Feeder Roads was established. The links to all District Headquarters were classified as Feeder Roads, together with major links between NHs (carrying over 100vpd) and links to major sites of industry, commerce, tourism or power generation. All other roads were classified as either District, Village or Urban Roads and were to be the responsibility of the respective District or Village Development Committee or Municipality.

The primary function of the SRN in 1995 was to provide connectivity to all District HQs and to enable balanced regional growth to take place in an efficient and cost effective manner. Large areas of the country were without motorable road access and a programme of staged construction of new Feeder Roads was proposed in the initial PIP1 of 1997. Few local roads existed – apart from in the Terai and urban areas – and traffic volumes away from the main centres were low and dominated by truck and bus movements.

The DoR Strategy document of 1995 recommended the decentralisation of the road network administration, with the responsibility for local roads devolved to the Districts and Municipalities. Subsequently a separate department (DoLIDAR) was established in the Ministry for Local Development for the coordination of local roads at the District and Village level. A series of District Transport Master Plans (DTMPs) were prepared in each District to coordinate the development of the local road networks at the District level.

Subsequently the PIP2, in 2005-07, refined the concept of the SRN and developed a strategy and proposals for its progressive expansion from an initial designated

network of around 5,000km in 2005, to a 'de-facto' network of 7,400km in 2007<sup>6</sup> and to networks of around 8,700km by 2011 and almost 10,000km by 2016. [The ToR for PIP2 tentatively suggested that the SRN be expanded to 7,500km by 2016: this was considered (at the time) to be the limit of a realistic expansion over 10 years – given the network size and the capacity and capability of the DoR to manage and maintain the network.]

Expansion of the SRN was undertaken (in PIP2) by examining a potential 'long list' of future links that satisfied the basic criteria to be part of the strategic network. This was defined as those roads which served traffic of a "national, regional or inter-district" nature. Roads that only served local movements were excluded. It was stressed that the test of the 'strategic nature' of a road was independent of any other tests of feasibility or economic viability.

The following criteria were adopted to define eligibility for inclusion in the SRN:

- Links to District Headquarters – not necessarily the first or only link;
- Links to *major* Border Crossings – with potential for cross-border trade;
- Links between *existing* strategic roads – improved connectivity;
- Inter-District links, especially between DHQs – improved or alternate links;
- Links or access to rural airfields – to stimulate domestic aviation; or
- Links to industrial, commercial or tourist sites – including mineral extraction.

A total of 170 potential new schemes, totalling almost 8,800km were identified, comprising 18 committed schemes, 89 existing local or District Roads, and 63 potential new alignments. All possible sources for new links were investigated and widespread consultation held within the Department. These schemes were then subjected to a multi-criteria analysis designed to test the strategic nature and significance of the link, including:

- strategic connectivity (network effects) – including Mid-Hills Corridor;
- population density served – more people = more benefits;
- improvements to accessibility – reduce population > 2/4 hours from road;
- connections to District HQs – either a first or subsequent link;
- links to border crossings – including potential as transit route;
- potential tourism or pilgrimage functions;
- areas of economic activity (mineral extraction, hydro-power, airfield, etc);
- estimated traffic volume – including diverted traffic;
- terrain difficulty & altitude (length of grades, maximum altitude); and
- human poverty index of areas traversed – pro-poor bias.

The highest ranked 100 schemes, with a total length of 5,000km, were then taken forward as candidate roads for inclusion in the extended SRN, resulting in a 2011 network of 8,700km of road, including all the then current commitments, and a 2016 'extended' network of 9,900km.

The key elements of expanded SRN as proposed by PIP2 in 2007 were:

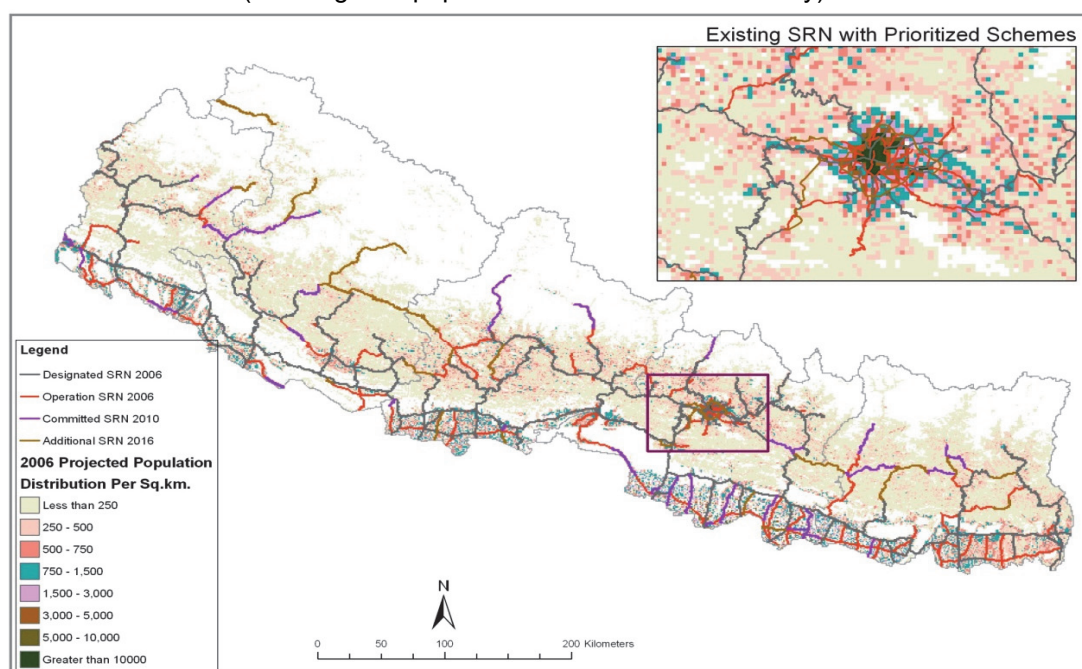
- Completion of all-weather links to ALL District HQs;
- Upgrading of unsealed roads in Terai (including the Postal Road) and main links into the hills prioritised on the basis of traffic demand;

<sup>6</sup> This 'de-facto' network included roads that had been constructed and were being maintained by DoR as if they were part of the SRN

- Improvement of the network in the Mid-Hills, including inter-District links and the development of a Mid-Hills Corridor;
- Enhancement of access to Kathmandu – including the Fast Track (or Tunnel alignment) and/or Bhimdhunga Link to Prithvi Highway;
- Capacity enhancement of key Kathmandu Valley roads – incl Ring Road, Bhaktapur-Dhulikhel, etc

Figure 6.1 illustrates the PIP2 proposals for the extended SRN, which were strongly correlated with the population distribution and density (also shown). These recommendations were accepted by the Government and the then Ministry of Physical Planning and Works.

**Figure 6.1 : PIP2 Proposals for Extended SRN 2016**  
(showing also population distribution and density)



The basic philosophy of the network expansion developed in PIP2 still holds true today. The overall objectives for the SRN are to provide for national, regional and inter-district movements on network that is maintained to appropriate standards. The essentials have changed from 1995 when connectivity into the remote areas was the primary concern and are now concerned with the provision of improved access and **service quality** – embracing issues of **reliability, safety and comfort**.

A degree of 'network redundancy' is also implied, with alternative routes being available to reduce the effect and impact of temporary road closures due to landslides or other obstructions. This implies the development of an inter-connected network of both north-south and east-west routes in the Terai and Hills: specifically this objective can be achieved through the development and upgrading of the Postal Road and a Mid-Hills Corridor, in conjunction with the East-West Highway and north-south routes that have been developed over the past five decades.

The network developed – and the methodology and criteria adopted – in the PIP2 are still considered relevant: only minor alterations and additions are appropriate. It is therefore recommended that a limit be placed on the extent of the designated SRN



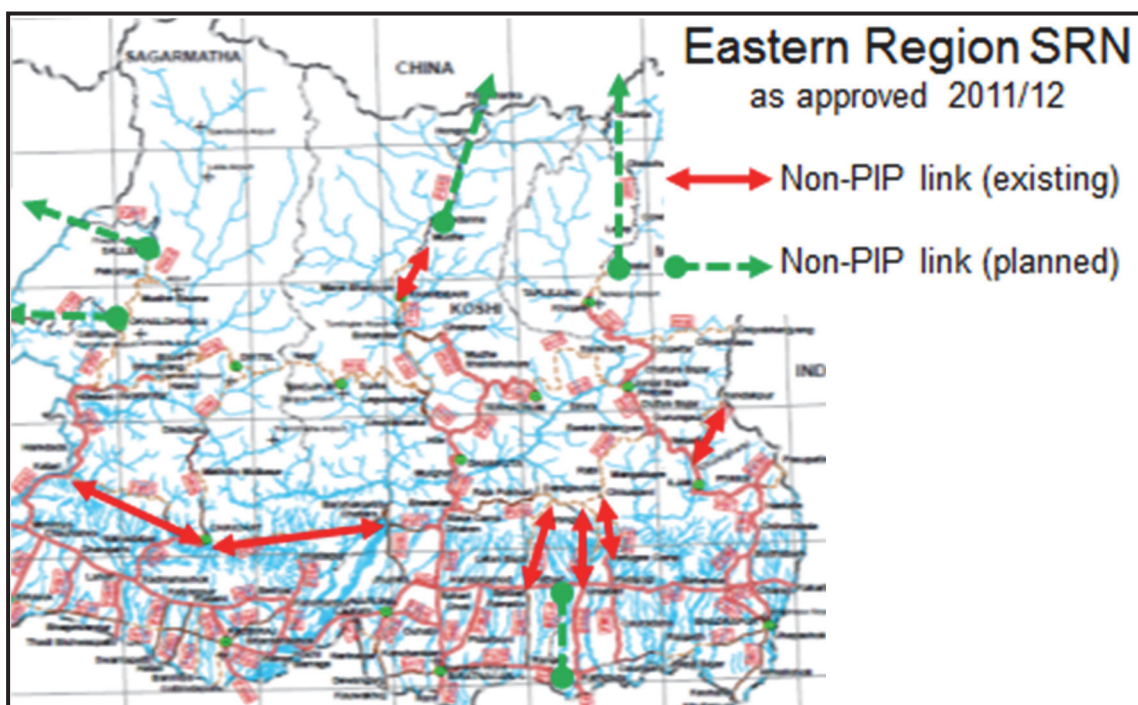
and that the primary focus of the DoR should be to maintain and upgrade this network to appropriate standards.

## 6.2 Developments since PIP2 (2007)

The expansion of the SRN since the completion of PIP2 in 2007 was described in Chapter 3 above, resulting in an operational network in 2013 of 12,494km and a 'Cabinet Approved' designated network of 14,902km.

A detailed analysis of one region has been undertaken to illustrate the extent and type of road that have been added to the Strategic Network that were NOT included in the PIP2 proposals. This is shown, for the Eastern Region, as Figure 6.2. Two types of additional road are shown: firstly additional existing roads that were not in the PIP2 proposals (in RED) and secondly (in GREEN) proposed additional new roads.

**Figure 6.2 : Additional Links in the SRN (2012) NOT in the PIP2 Proposals**  
(Eastern Region)



The newly included 'existing' links are mostly in the south of the region, either in the Inner Terai or else linking the Terai to the hills, whereas the new 'planned' links are mostly in the north and include connections to the Chinese border and east-west linkages through areas with relatively low population density. Many of these links were evaluated in the PIP2 but were not selected or prioritised. A similar pattern of additional links is evident in each of the other four Development Regions.

## 6.3 Implementation of PIP2 Proposals

A review of the priority schemes proposed in the PIP2 was presented in the budget analysis above (Chapter 4). This showed that – with very few exceptions – all the proposed PIP2 projects have either been completed or are being implemented. These included:

- 16 committed schemes funded by international donors involving upgrading or new construction of 2,400km of road: these are either complete or substantially complete, with the exception of the 1500km Indian-funded Terai Roads project;
- 14 upgrading schemes totalling over 700km which were the highest priority among the non-committed schemes, providing sealed road access to nine District HQs: 9 are now complete, with work on-going on the remainder;
- 5 new sections of earth standard Feeder Road (total 366km) with upgrading subject to feasibility study: four are open, with sections being upgraded;
- 4 new Earth Tracks accessing remote District HQs (385km): two are open and two are under construction;
- upgrading of 11 Local Roads to SRN standards (636km), based on strategic significance: work on-going on 9, including sections of Mid-Hills Corridor;
- detailed feasibility study of a new route linking Kathmandu and the Terai: the GoN has pursued the Fast Track option with the Nepal Army responsible for preliminary 'track opening'; the alternative 'Hetauda Tunnel' option is being promoted by a private company<sup>7</sup>; both schemes are currently seeking the necessary finance; and
- other strategic improvements, including upgrading the Kathmandu Ring Road and Kathmandu-Bhaktapur, and consideration of an alternative route to the Koshi Barrage: these schemes are either complete or in hand.

Overall it is evident that the PIP2 proposals have been (or are being) implemented, together with a significant number of 'off-plan' projects. The analysis of the current year's budget (see Chapter 4) suggests that up to a third of the total budget may be spent on projects not included in the PIP2. These non-PIP2 projects include Urban Roads (including the Kathmandu Road Widening Project), numerous projects under various headings on the Local Road Network (including bridges), and a number of non-prioritised improvements and extension to the SRN.

## 6.4 Completed & On-Going Projects

A number of major donor funded projects have been implemented across the SRN over the past seven years: these have mostly taken schemes proposed in the PIP2. The donors have included the World Bank, the Asian Development Bank, JICA and the Governments of India and China.

### 6.4.1 World Bank

The World Bank funded projects include:

- Road Maintenance Development Project (**RMDP**) (closed in 2006/07);
- Road Sector Development Project (**RSDP**) US\$43m + US\$75m (AF):
  - Upgrading of 6 Feeder Roads in Mid & Far-West (700km) linking to 7 District HQs: Satbanj-Jhulaghat; Satbanj-Darchula; Khodpe-Bhajang; Sitalpati-Musikot; Chhinchu-Jajarkot; Surkhet-Jumla (mostly complete);
  - 4 annual tranches of Periodic Maintenance (resealing) totalling 2,088km of National Highway & Feeder Road (complete)
- Bridges Improvement & Maintenance Programme (BIMP) US\$60m
- Nepal-India Regional Trade & Transport Project (NIRTP) (on-going):
  - Upgrading Narayanghat-Mugling to Asian Highway Standards;

<sup>7</sup> Nepal Purwardhar Bikash Company Limited (NPBCL)

- Feasibility of upgrading & safety improvements to Mugling-Naubise
- Strategic Road Development Project (SRDP) (on-going):
  - Feasibility study of upgrading of Pathlaiya-Kamala River section of the East-West highway (H01) including bridge works.

The World Bank has continued its previous involvements in the Roads Sector, with the upgrading of Hill Feeder Roads accessing District HQs in the Mid & Far West, and support for the annual periodic maintenance programme. It has also provided support for bridges on the SRN. In future the WB would appear to be reducing their involvement in periodic maintenance activities and the upgrading of Feeder Roads, whilst focussing their attention on the strategic road and access requirements of Kathmandu.

#### 6.4.2 Asian Development Bank

The Asian Development Bank funded projects include:

- Road Network Development Project (**RNDP**) (closed 2007);
- Sub-Regional Transport Facilitation Project (**STFP**) US\$20m (closed 2010):
  - Construct new access road to Birgunj ICD (11km); improve link from EWH to Bhairawa Border from gravel to 2 lane BT (29km); construct ICD at Kakarbitta (complete);
- Road Connectivity Sector I Project (**RSCP I**) US\$53m (2006-14):
  - Upgrading 3 Feeder Roads (240km): Galchi-Syabrubesi; Tamakoshi-Khurkot; Phidim-Tablejung (complete);
  - Reconstruct and upgrade to 2-lane sealed standards of 25km of National Highway, Dhalkebar-Janakpur (nearing completion);
  - SunKosi Bridge at Khurkot (under construction)
- Sub-Regional Transport Enhancement Project (**STEP**) US\$40m (2010-16):
  - Upgrading 3 Feeder Roads (140km): Harkapur-Okhuldhunga-Salleri & Chainpur-Khandbari;
  - Rehabilitation of 48km of EWH, 4-laning EWH-Indian Border (Nepalgunj), Feeder Rd rehabilitation Bhairawa-Taulihawa (23km)
- Transport Project Preparatory Facility (**TPPF**) US\$12m (2010-20):
  - Feasibility Study & detailed engineering design for 900km of high priority road sections in two phases – mostly upgrading from earth/gravel to BT surface and most (but not all) part of the PIP2 proposed SRN<sup>8</sup>
  - Phase 1 includes detailed design of a 61km diversion of the EWH to avoid the Koshi Barrage; upgrading of 4 Hill Feeder Roads in the East (140km) & 2 Terai Feeder Roads (46km)<sup>9</sup>
- Emergency Flood Damage Rehab Project (**EFDRP**) US\$26m (2009-14):
  - Re-gravelling of 38km of Feeder Road in Far West; Bridge Protection Works; Landslide Stabilisation
  - Construction of Koshi Bridge at Chatara (on EWH Diversion) (on-going)
- SASEC<sup>10</sup> Road Connectivity Project (**SRCP**) US\$75m (ADB) (2014-19)

<sup>8</sup> NB: Includes Feasibility Study of Thankot-Kulekani Tunnel (part of Hetauda Tunnel route) and Malekhu-Lohtar Tunnel

<sup>9</sup> Except for 1 Hill & 1 Terai Feeder Road, these projects are taken forward in the SRCP project – see below

<sup>10</sup> SASEC = South Asia Sub-Regional Economic Coordination

- Upgrading/New Construction of 61km of 2-lane (Asian Highway) diversion of EWH to connect to Koshi Bridge at Chatara (as an alternate route to the Koshi Barrage)
- Upgrading to 6.5m BT of 100km of earth track forming part of proposed Mid-Hills Highway in East (Leguwa-Bhojpur & Diktel-Halesi);
- Upgrading of 13km Feeder Road to Indian Border to dual lane sealed standards (Birtamod-Chandragadhi-Mechipul) & 13km to single lane BT (access to Ramechhap)

It is evident that the ADB have continued a strong presence in the Roads Sector, with an on-going series of road improvement projects focussing specifically on connectivity issues (including north-south routes and cross-border issues). The recent TPPF has set out a long-term continuing involvement for ADB, with a substantial programme of construction or upgrading of many of the 'new' Feeder Roads recently inducted into the expanded (Cabinet Approved) SRN of 14,800km.

### 6.4.3 Government of India

The Government of India (GoI) have funded, through the EXIM Bank (India), two phases of the Road Improvement Project (**RIP 1**, **RIP 2** & **RIP 3**), as well as an on-going involvement with the improvement of the Postal Roads and other Terai Roads.

- Road Improvement Project Phase 1 (**RIP 1**) US\$50m (complete);
  - Upgrading 13 Feeder Roads (530km) in all Regions; mostly to BT standards; Sanfe-Martadi; Sanfe-Mangalsen; Surkhet-Dailekh;Tulsipur-Salyan; Bhaluwang-Pyuthan; Chakchake-Liwang; Ameliya-Tulsipur; Chandranigahpur-Gaur; Hilepani-Diktel; Basantapur-Myanglung; Maldhunga-Beni; & Rajbiraj-Rupani
- Road Improvement Project Phase 2 (**RIP 2**) US\$140m (contracts awarded);
  - Upgrade to BT of 6 Feeder roads (290km); Shahid Marg; Lumbini Circuit Rd; Sanfe-Martadi; Bardhaghat-Triveni; Chahare-Bidur; Janakpur Circuit Rd;
  - Widen & Upgrade 5 existing BT Feeder Roads (240km): Lamosangu-Tamakoshi; Balaju-Trishuli; Balkhu-Dakshinkali; Bhaktapur-Nagarkot; Bharatpur-Meghauli;
- Road Improvement Project Phase 3 (**RIP 3**) US\$330m;
  - Widen & Upgrade to BT of various feeder road (631 Km)
  - Upgrade Urban Roads (80Km) in Terai
- Postal Roads and other Terai Roads (Phase 1) US\$124m (committed):
  - Upgrade 17 Feeder Roads to 7.5m formation with 3.75m DBST in 11 Terai Districts (490km);
  - Upgrade 2 sections of Postal Road to 7.5m formation with 3.75m DBST in Kailali & Parsa (114km);
- Postal Roads and other Terai Roads (Phase 2) proposed:
  - Upgrade 14 Feeder Roads (320km) to 5.5m DBST in 11 Terai Districts;
  - Upgrade 13 sections of Postal Road (571km) to 7.0m DBST in 18 Terai Districts;
  - An additional 52 bridges have been requested by GoN

The GoI have traditionally been a major contributor to the development of the road network in Nepal – initially with the construction of access roads to Kathmandu and

Pokhara and significant sections of the East West Highway. Subsequently they have been involved with the development of the road network in the Terai and more recently, through the EXIM Bank, with a programme of upgrading of substantial lengths of Feeder Roads in the Hills: this latter programme is likely to continue through much of the proposed plan period to 2021.

#### 6.4.4 Other Donors

The Japan International Cooperation Agency (**JICA**) has continued its involvement in the Roads Sector with on-going construction of the Dhulikhel-Sindhuli-Bardibas Road which, when complete, will provide an alternative route from Kathmandu to the Eastern Terai, as well as a key element in the Mid-Hills Corridor. It is expected that the link will be completed within the next couple of years: progress is generally determined by the availability of grant funding from Japan.

During the past seven years, JICA have also funded the widening and improvement of the Kathmandu-Bhaktapur Road (as recommended in PIP2): it is anticipated that JICA will continue this involvement (from Bhaktapur to Dhulikhel) in the coming years.

The Government of China (**GoC**) is funding the construction of a 16km link between the existing SRN at Syabrubesi to Rasuwagadi on the Chinese Border. It is proposed that a major border crossing will be established at this site: access routes from the Chinese side are already developed and space is available (on both sides of the border) to construct the necessary customs and immigration facilities.

The Chinese Government have commenced work on the initial phases of the widening of the Kathmandu Ring Road (originally built by the Chinese in the early 1980s) in three phases over the coming years. The road will be widened to dual 2-lanes, with service roads (or frontage roads) on each side. Improvements will also be required at all key junctions.

The UK Department for International Development (**DFID**) have focussed in recent years on support to the local road network through various phases of the on-going Rural Access Programme (RAP). Earlier phases have involved limited work on the SRN, including the construction of two bridges in Eastern Nepal and upgrading of the Feeder Road to Terhathum. Sections of initial access roads constructed under RAP have subsequently been incorporated into the SRN and also form sections of the Mid-Hills Highway.

#### 6.4.5 Government of Nepal

In addition to Government contributions to the above externally funded Donor Projects, the GoN is funding directly the following projects through the Asset Management, Contract Management and Quality Control Project (**ACQMP**): Annual Budget (2013/14) US\$18m (Rs 1.81 billion).

- Three North-South Corridors (see also below)
  - Karnali: Kalikot-Jumla-Humla & Hilsa-Simikot
  - Kali Gandaki: (sections south of Kusma)
  - Koshi: Basantapur-Kimathanka (China Border)
- Other North-South Roads:
  - Tamakoshi-Lamabagar-China Border
  - Jiri-Saleri-Tingri (Tibet)
  - Taplejung-Olangchungola (Border)



- Mulghat-Majhitar-Dobhan
- Nykache-Lagna-Tibet Border (Mugu)
- Nalyng Bhanyjang-ChheKampa-Chumchet-Sirdibas
- Bagoda-India Border (Banke)
- Nijhgardh-Patawra-Bankul-Gaur
- Sarlahi-Rautahat
- Limilapcha-Simikot (Humla)
- Seti Lokmarg (Doti & Kanchanpur)
- Chainpur-Taklakot (Bajhang)
- Trade Route Development Project US\$9.4m (2013/14 only):
  - Improvement and Widening to six-lanes of three major access routes to Indian Border: Rani-Biratnagar-Itahari-Dharan (30km); Birgunj-Pathlaiya (27km) & Belhiya-Bhairawa-Butwal (24km);

Many of the individual projects were not identified in the PIP2 Study but form part of the extended SRN as identified in 2013. Construction or upgrading of these routes should be based on the overall network priorities established.

#### **Other GoN national level initiatives include:**

Mid-Hills Highway: The GoN has established a programme to develop a second East-West connection through the Mid-Hills, to link from the Indian Border (Sikkim) at Chiyobhanjyang (Panchthar) in the east to the Indian Border (Uttarakhand) at Jhulalghat (Baitadi) in the west. The route has a total length of around 1,700km and comprises a mix of paved National Highways, existing gravel or earth roads (mostly parts of the SRN) and sections of new construction. The concept was endorsed in PIP2, although the exact alignment selected differs in the Mid-West.

The Mid-Hills Highway should not be considered (or constructed) throughout as a major traffic artery – rather it is a strategic alternative link between the hill regions, providing additional connectivity within the relatively densely populated hill areas. Some sections exist as major traffic corridors – for example Kathmandu-Pokhara and Kathmandu-Dhulikhel – but other sections will serve primarily local traffic and can be constructed to significantly lower standards. Track opening is virtually complete for the whole route and sections are proposed for upgrading to sealed surface under various donor programmes described above.

The strategic significance of an alternative east-west link became evident during the 10-year insurgency, when the closure of a single link could cut-off large sections of the country.

North-South Corridors: The Government has a programme for the development of three north-south corridors (see ACQMP above) linking the Indian border to China and broadly following the alignment of three major rivers: Karnali, Kali Gandaki & Koshi. Sections of these routes either exist or were proposed for inclusion in the PIP2 SRN.

Specifically the previous PIP proposed that the development of cross-border traffic and trade with China should be focussed initially on two locations only (Kodari and Rasuwaghadhi), with smaller secondary (local) crossings only at other locations: thus it may not be appropriate (at least in the short-term) to develop major approach routes to the border along the Karnali or Koshi corridors. Access along the upper reaches of



the Kali Gandaki (and to the border) through Mustang has already been achieved – opening the traditional trade route between India and Tibet to motorised traffic. It is however not necessarily practical or desirable to follow the lower reaches of the river and neither is the route suitable for heavy traffic.

Any sections of these routes which form part of the SRN should be upgraded in accordance with overall priorities established.

Fast Track: The GoN is pursuing the construction of a Fast Track to link Kathmandu with the Terai and the Indian Border. Construction of such a link, which could potentially reduce the travel time to the border from at least 8 hours to 2 hours, has been under consideration for at least 20 years. Many options have been suggested and examined, including upgrading of local roads, direct (tunnel) routes to Hetauda and longer routes following the Bagmati Valley south to join the East-West Highway east of Pathlaiya. The two previous PIPs (1997 and 2007) both recommended that alternatives for a high standard route be investigated: the link was shown to be both economically and financially viable, given the forecast traffic volumes and the high percentages of commercial traffic.

Following preliminary studies – and concerns over the viability and safety of tunnel options – the Government decided to proceed with the option following the Bagmati Valley and connecting with the East-West Highway at Nijhgardh, close to the site of the proposed Second International Airport<sup>11</sup> and 23km east of Pathlaiya. In 2008 the Nepal Army was tasked with opening a 76km long track on this alignment: limited sections of this track have been opened and some land acquisition undertaken. Three Indian business consortia were invited to bid for the design, construction and operation of a multi-lane expressway on the alignment but all subsequently (2013) withdrew.

The Government is presently exploring alternative funding and operation modalities.

As described elsewhere, alternative (tunnel) alignments linking Kathmandu directly with Hetauda are being investigated and proposed by a Nepali private sector consortium. Additionally GoN budgets are also being used to improve and upgrade existing local roads connecting Kathmandu with Hetauda.

A separate initiative to by-pass the critical section of the existing approach route to Kathmandu (Naubise-Nagdhunga) with the construction of a short tunnel on a new alignment linking Dharke on the Prithvi Highway directly to the Kathmandu Valley is being studied for potential Japanese funding following an earlier ADB feasibility study.

Roads Joining Two Districts: A separate budget head has been established for the construction of local roads that link adjoining districts across district borders. These roads are generally NOT part of the SRN and the logic for the DoR involvement is based on the fact that these links would not be prioritised or selected through the DTMP process which focusses on the internal District road network.

These roads could qualify for inclusion in the SRN if they formed part of an inter-District network linking either the District HQ or between other elements of the SRN. If not part of the SRN, these roads should not be the responsibility of the DoR.

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<sup>11</sup> The future of the Fast Track is closely related to the proposed Second International Airport: the feasibility of the airport requires the construction of the Fast Track to provide a 1 hour link to Kathmandu

Regional Level Roads: A similar budget exists for the construction of local roads within a District designed to redress a 'regional imbalance' in the provision of roads. It is unlikely that any such roads would be strategic in nature and thus not part of the SRN. They should not be funded by DoR.

Tourist Roads: A separate budget within DoR exists for the construction of roads to places of tourist interest or pilgrimage. Such roads should generally form part of the local road network, unless the destination is of national significance.

## 6.5 Criteria for Upgrading & Prioritisation

In addition to the expansion of the SRN to 14,902km, it is clear that a significant volume of upgrading has taken place since 2007 and that a substantial programme of further work is on-going and in the planning stage. Whilst much of this has been in accordance with the PIP2, it is also evident that the network expansion and some of the proposed improvements and upgrading go significantly beyond what was planned in 2007.

It is therefore appropriate to review the current plans and proposals and to update the recommendations and prioritisations presented in PIP2 in the light of current circumstances. The main upgrading and improvement projects completed since 2007 or presently in-hand are all broadly in line with the PIP2 proposals.

Additionally, the DoR has identified a preliminary programme of further upgrading or improvement for inclusion in subsequent ADB, GoI and GoN projects. Many of these projects were not included in the PIP2 recommendations and all should be the subject of detailed feasibility and design studies.

### 6.5.1 Review of Extent of SRN

The PIP2 identified and proposed extensions to the SRN to create a total network, by 2016, of almost 10,000km. All the elements in this network met the six basic criteria for inclusion in the SRN – links to District HQs; links to major border crossings; links between existing strategic roads; inter-District links; access to rural airfields; or links to major commercial or industrial activities – and were selected and prioritised on the basis of a multi-criteria evaluation.

The GoN has subsequently decided to expand the SRN beyond this level through the inclusion of additional links. This increase in the overall network does NOT however invalidate the previous evaluation or assessment of the strategic nature (or otherwise) of individual links. It is therefore proposed to accommodate the overall increase in length by the re-classification of network and the introduction of new categories of National Highway and Feeder Road.

Two classes of National Highway are proposed:

- NH Class 1: The 'core' network of highways, comprising the East-West Highway, main links into the Hills to Kathmandu and Pokhara (incl Fast Track) and access routes to the 8 main border crossings; approximately 1,760Km (1665Km Existing + 95 Km Planned) in length and constructed to Asian Highway Standards;
- NH Class 2: Secondary Highways, comprising the links into the Hills serving two or more District HQs, the Mid-Hills Corridor, the Postal Road and access to minor border crossings; approximate length 3,797km; to be constructed to sealed 2-lane or intermediate lane standards.

Similarly two classes of Feeder Road are proposed:

- FR Class 1: Strategic Feeder Roads, comprising all remaining 51 FRs in initial 1995 network, access roads to remaining District HQs and local border crossings, and all roads included in PIP2 proposed SRN; approximately 4,991km in length and to be upgraded to single-lane sealed standards, subject to detailed feasibility study;
- FR Class 2: Secondary Feeder Roads; all other roads identified in the 2014 extended SRN; approximate length 4,016km; construction and upgrading to be subject to detailed feasibility study.

The resultant network is illustrated in Figure 6.3.

Class 1 National Highways should be maintained to the highest standards to ensure efficient operation throughout the year: generally asphaltic concrete surfacing would be appropriate as the savings in vehicle operating costs from the higher traffic volumes will justify the higher initial capital costs. The Class 1 network should be progressively upgraded to Asian Highway Standards, with particular emphasis on the provision of safety features, including safety barriers, signage, improved road markings and overtaking lanes (where these can be safely provided).

Class 2 Highways should be similarly built and maintained to standards appropriate for their function – traffic volume, strategic role and geographic location. High traffic sections should be provided with an asphaltic concrete surface, whilst DBST (or similar) will be generally appropriate elsewhere. Progressive widening to 2-lane standards may be appropriate for the more heavily trafficked sections. All Highways shall have a sealed surface.

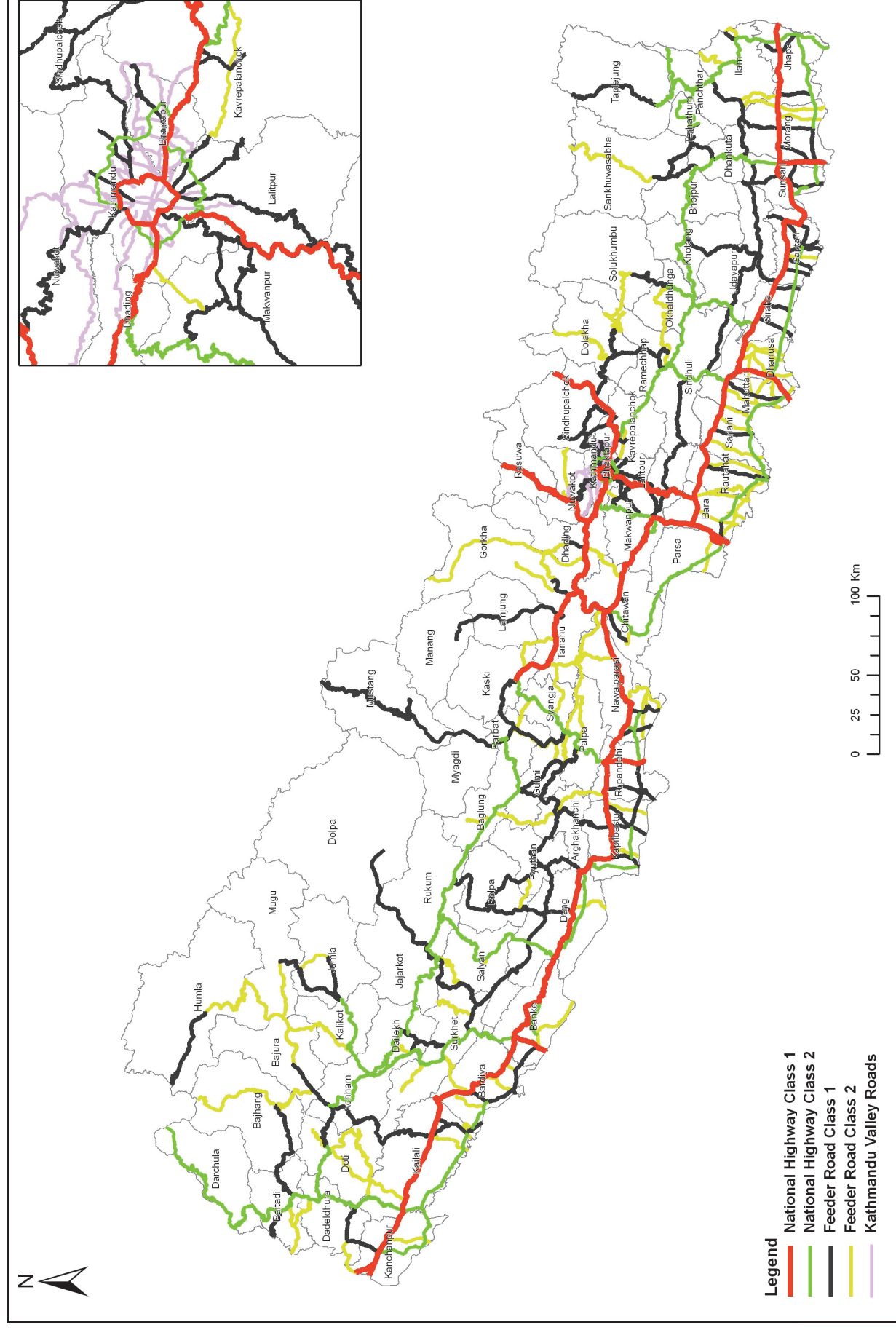
Class 1 Feeder Roads will be generally constructed to sealed standards, with the justification for upgrading based on threshold traffic levels and feasibility study. These roads have been identified and selected based on a detailed analysis of their strategic function.

Class 2 Feeder Roads comprise mostly those ‘additional’ roads included in the 2013/14 SRN that were NOT identified or prioritised in the PIP2 SRN proposals. These roads should therefore all be subject to detailed feasibility study, prior to any further investment or upgrading. This analysis should include an evaluation of the strategic importance of the road and its potential function within the ‘national’ network.

These additional roads fall broadly into two categories: (a) potentially strategic – but remote – sections of the network that were previously excluded due to a lack of demand (now or within the plan period); and (b) roads considered to be primarily of a local nature and without any true (national) strategic function.

It is suggested that the inclusion of these additional roads (around 5,000km) in the designated SRN should be reviewed (to determine their strategic function) and that the initiation of any improvement (or maintenance) work should be dependent on the outcome of the review.

All other roads which do not have a national strategic function should remain part of the Local Road Network, under the responsibility and jurisdiction of the relevant DDC.



## 6.5.2 Review of Feeder Road Construction Policy

The present road construction policy relating to Feeder Roads is contained in the DoR “Classification and Design Standards for Feeder Roads”, Second Revision, February 1994. This document argues that Feeder Road construction should be undertaken in an economical and technically acceptable manner, bearing in mind the acute budget constraints of the time and the need to construct road access to the almost 20 District Headquarters that were not connected by road. The document proposed a five stage process:

- I. Detailed Design and Project Formulation
- II. Fair weather Earth Track
- III. Fair weather Gravel Track
- IV. All weather Gravel Track
- V. All weather Bitumen Road

The document stressed the fact that construction should not commence until Stage I was complete: i.e the detailed design should be finalised and adequate resources committed for construction and maintenance. Subsequent upgrading would be based on various traffic thresholds based on a simplified HDM analysis. [This latter exercise has been updated under this project – see section 5.4.]

The situation today is different. Almost all the District HQs are connected by road and the current policy requires that this access should be by all-weather sealed road. In addition a substantial length of low-standard local District and Village level roads have been constructed throughout the country providing a basic level of access to a large proportion of the 9,000+ VDCs across the country. The upgrading of these local earth roads is the responsibility of the respective District and Village Development Committees (DDCs & VDCs).

The Feeder Road network is itself substantially larger than it was 20 years ago. Then there were 51 designated Feeder Roads, with a total length of 1900km. Each had a specific purpose or objective: eg to connect to a District HQ, major border crossings, industrial or hydro-power sites, tourist sites or else links between National Highways with traffic volumes in excess of 100 vpd. Today there are a total of 198 operational Feeder Roads with a total length of 6,600km, with a further 9 under planning.

Most of the ‘additional’ length of Feeder Road results from the re-designation of existing ‘local’ roads or tracks that have been initially constructed through local efforts of either the DDC/VDC, local communities or the Nepal Army. Many of these roads follow non-engineered alignments and were constructed by excavator, without due consideration for drainage, water management or slope stability. This situation poses a very different series of issues to that of the staged construction proposed in 1994.

The challenge for the DoR today is the upgrading – on a prioritised basis – of this additional length of Feeder Road and to bring the whole of the extended SRN up to a ‘maintainable’ standard. The threshold analysis (see 4.3.6 above) remains valid so as to ensure that the available resources are used in the most effective and economical manner.

Expectations from the SRN have also changed substantially over the past 20 years. No longer are large sections of the country satisfied with intermittent access on a poorly maintained earth road. There is a desire for all-weather access by motor-bike, jeep and minibus, in relative comfort via a sealed road. Issues of social equity require



that District Centres and other major centres have reliable access for health, security and educational purposes. Truck operators expect to be able to operate large vehicles on the main road network so as to satisfy the increasing demands for food and imported goods at an acceptable price.

The DoR needs to take stock of the extent and condition of the current SRN that it is entrusted to maintain. New construction should take a relatively small share of the overall budget availability and similarly upgrading (although necessary for a large portion of the FR network) should be carefully assessed in terms of demand.

## **6.6 Screening & Ranking of Projects**

Based on the revised Highway & Feeder Road classifications, a prioritised listing of improvement and upgrading proposals should be developed based on the multi-criteria screening procedures developed during PIP2. This should be extended to include the potential upgrading of Class 1 National Highways to Asian Highway Standards: all potential improvements or upgrading should subsequently be subject to detailed feasibility study to determine the viability.

## **6.7 New Construction**

Only limited sections of new construction are anticipated: alignments have been determined for access to all District HQs and most potential options for other new routes have been investigated or are included in the expanded SRN.

The major exception to this will be the inclusion of the Fast Track access between Kathmandu and the Terai. A decision on the preferred solution and the associated funding mechanism is required as a matter of priority.

## **6.8 Responsibilities for Strategic & Local Roads**

A final definitive decision on the demarcation of responsibilities for the Strategic and Local Road Networks is urgently required and should be implemented effectively. This will involve a clear definition of the SRN and the devolution of responsibility and budgets for ALL non-strategic roads and bridges to the appropriate local administration, either District or Municipality.



## 7. Accessibility (2013)

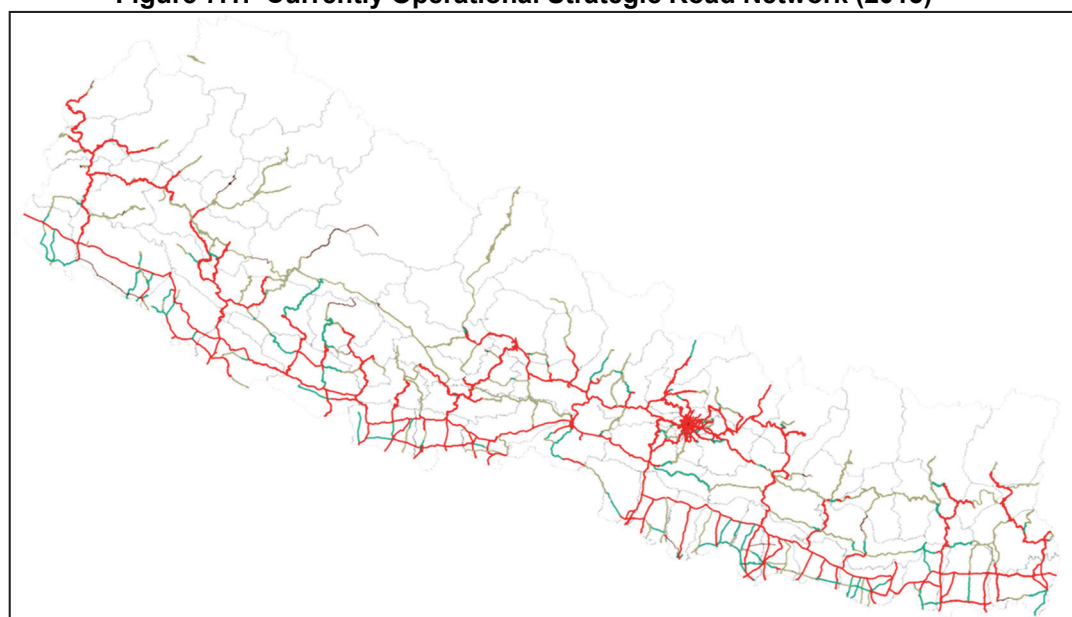
### 7.1 Methodology & Approach

Measures of accessibility are a key indicator of levels of social development and can be shown to be closely correlated with the incidence of poverty and social exclusion. The calculation of accessibility is based on an analysis of population distribution, the extent of the all-weather road network, and calculations of the walk-time to access the road network.

A comprehensive accessibility analysis was undertaken in PIP2 (2007): this has now been updated, based on population data from the 2011 census and the 2013 road network data for both the SRN and Local Road Networks.

The current extent of the ‘operational’ SRN, based on the latest available data from HMIS, is illustrated in Figure 7.1 which contains a total length of almost 12,809 km of road: 6,369 km Black-Top; 1,785 km Gravel; 4,389 km Earth; and 315km under-construction. It is noted however that much of the 4,389km of Earth Road included in the SRN may not be accessible throughout the year – and access may be restricted to certain types of vehicle.

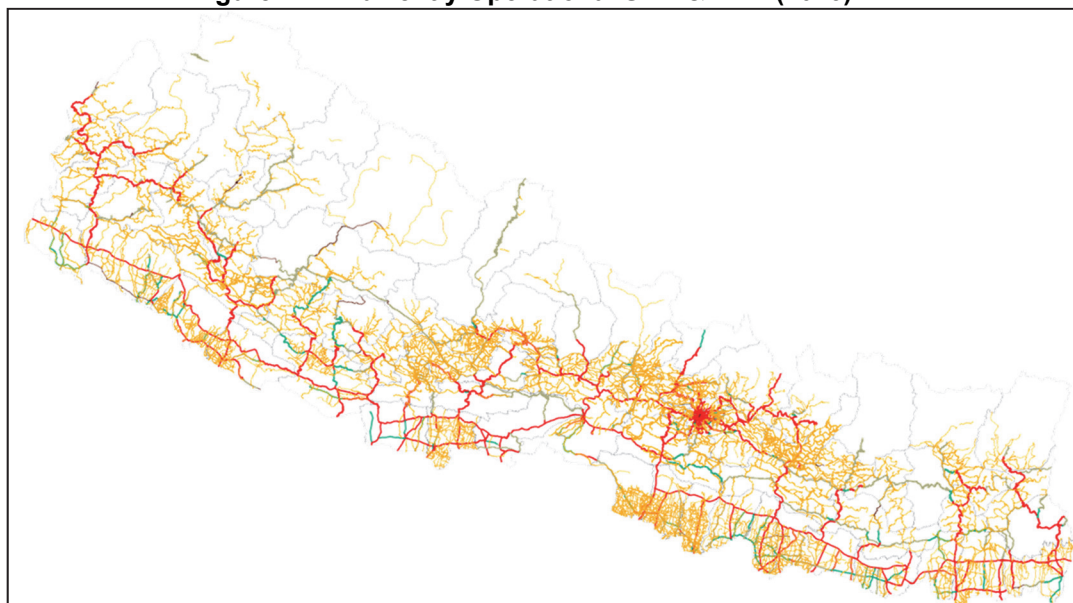
**Figure 7.1: Currently Operational Strategic Road Network (2013)**



Source: HMIS

Similarly, Figure 7.2 illustrates the available data and alignments for both the SRN and Local Road Network combined. The LRN data are assembled from individual Districts and may not be as consistent or reliable as the SRN data. Data for a total of 32,000km of local road alignments are included based on the online system (<http://rutims.aviyaan.com>) – although not all these roads may be operational or passable throughout the year. It has not been possible to verify the data.

These two networks have been used to calculate the current levels of accessibility and to identify those areas where network strengthening or additions may be justified.

**Figure 7.2: Currently Operational SRN & LRN (2013)**

Source: HMIS & rutims.aviyaan.com (RAIDP)

The data from the 2011 Census indicates a total population of 26.25 million – with 15.49 million in the Terai and 10.76 million in the Hills<sup>12</sup>. It is noted that this population is only marginally higher than that used for 2006 in the PIP2 analysis which assumed a population of 25.9 million (Terai 14.6m & Hills 11.3m). These data were extrapolated from the 2001 census and probably over-estimated the overall population. However, as might be expected, the population of the Hills has declined whilst that in the Terai (which includes also the Kathmandu Valley) has increased.

## 7.2 Results of Previous Analysis (2007)

The previous PIP2 Study analysed the accessibility afforded by the 2006 Strategic Road Network (5,030km), the proposed extended SRN (of almost 10,000km) and a combined Strategic and Local Road Network (of 14,000km). The accessibility was measured in terms of the populations within the 2 hour (Terai) and 4 hour (Hills) walk-time bands from the 'all-weather' road network. The results are illustrated in Table 7.1 below.

It can be seen that the SRN in 2006 provided access to half the population in the hills (within a 4 hour walk) and three-quarters of the Terai population (within a 2 hour walk): overall less than two-thirds of the national population (64%) was within the prescribed accessibility standards.

The PIP2 proposals to extend the SRN to almost 10,000km increased the overall proportion of the population served to 85% - comprising 70% of the population in the hills and 97% in the Terai, with less than 4 million people not served by road.

<sup>12</sup> The PIP2 refined the definitions of 'Hill' and 'Terai' based on an average slope analysis, so that – for example – areas within the Kathmandu and Pokhara Valleys were defined as 'Terai' for the purposes of determining their accessibility standards and 'hilly' areas within the Terai Districts were classed as 'Hills'.

**Table 7.1: Improvement in Accessibility (Analysis from 2007 PIP)**

	Approx Network Length (km)	Population & Percentage Served		
		Hill within 4 hrs	Terai Within 2hrs	Total
2006 Designated SRN	5,030	5.68 50%	11.07 76%	16.74 65%
2007 Operational SRN	7,360	6.52 58%	13.70 94%	20.22 78%
Extended SRN	10,000	7.94 70%	14.21 97%	22.15 86%
Extended SRN plus LRN	15,000	9.09 81%	14.51 99%	23.61 91%

Source: PIP2 (2007); DHV Consultants

This PIP2 analysis also illustrated that a further expansion of the overall road network to almost 15,000km would increase the accessibility to 91% - virtually all the Terai population would be within 2 hours walk of a road and over 80% of the Hill population would be within 4 hours.

The above analysis was based on the standard measures of accessibility defined (in Government policy) as being within 2 hours of an all-weather road in the Terai and within 4 hours in hill and mountain areas. The PIP2 additionally used an alternative indicator of accessibility based on an assessment of the overall walk-time to reach an all-weather road (measured person-hrs) – or the average walk-time (measured in hours) – of any given network. These criteria provide a more reliable indicator of the overall ‘efficiency’ of the network, as they take into account the numbers of people effected by the road and acknowledge that very real and significant benefits are available by reducing the access time to a road from, say, 2 hours to 20 minutes.

In the 2007 analysis, it was estimated that 40% of the overall population lived within 1 hour of the designated SRN (5,030km) and that this was forecast to increase to 60% with the extended SRN of 10,000km. Similarly the percentage living more than 8 hours from the SRN would reduce from 13% to 4%. Nationally, the overall walk-time to access the SRN was forecast to reduce by an average of 2 hours, from 3 hours 22 minutes to 1 hour 18 minutes.

It should be noted that the above analysis and computations only became possible through the development of the accessibility model in the 2007 PIP. These calculations have now been revised based on the 2011 population census data and the current (2013) network data.

## **7.3 Current (2013) Analysis**

### **7.3.1 Accessibility using Time-Band Criteria**

The revised accessibility analysis is based on the population data available from the 2011 census. This indicates a total population of 26.25 million – with 15.49 million in the Terai and 10.76 million in the Hills: As noted above, this total is only marginally higher than the 2006 population used in the previous analysis, due to an over-estimate of the earlier figure. The current population distribution is shown in Figure 7.3 which illustrates the concentrations of population around the main urban centres and higher densities throughout the Terai. Substantial areas of moderate density can be seen in the Mid-Hill areas, with minimal population in much of the higher mountain regions.

The accessibility afforded by the 2013 operational and under construction SRN of 12,809 Km is illustrated in Figure 7.4. Over 90% of the population are within the 2/4 hour accessibility criteria, with 77% of the Hill population within 4 hours and 97% of the Terai within 2 hours. Overall two-thirds of the population (17.2 million) are within 1 hour of the SRN and less than 9% are more than 4 hours away.

This conclusion is broadly compatible with the findings from the PIP2 Study in 2007 for the 10,000km and 15,000km networks.

The additional inclusion of the existing Local Road Network (32,000km) raises the total population served to 99% (based on the 2hr/4hr criteria) – with less than 250,000 people in the remote northern mountain areas more than 4 hours from a road. Overall 99% of the Terai population and 77% of the Hill population is within an hour of a road.

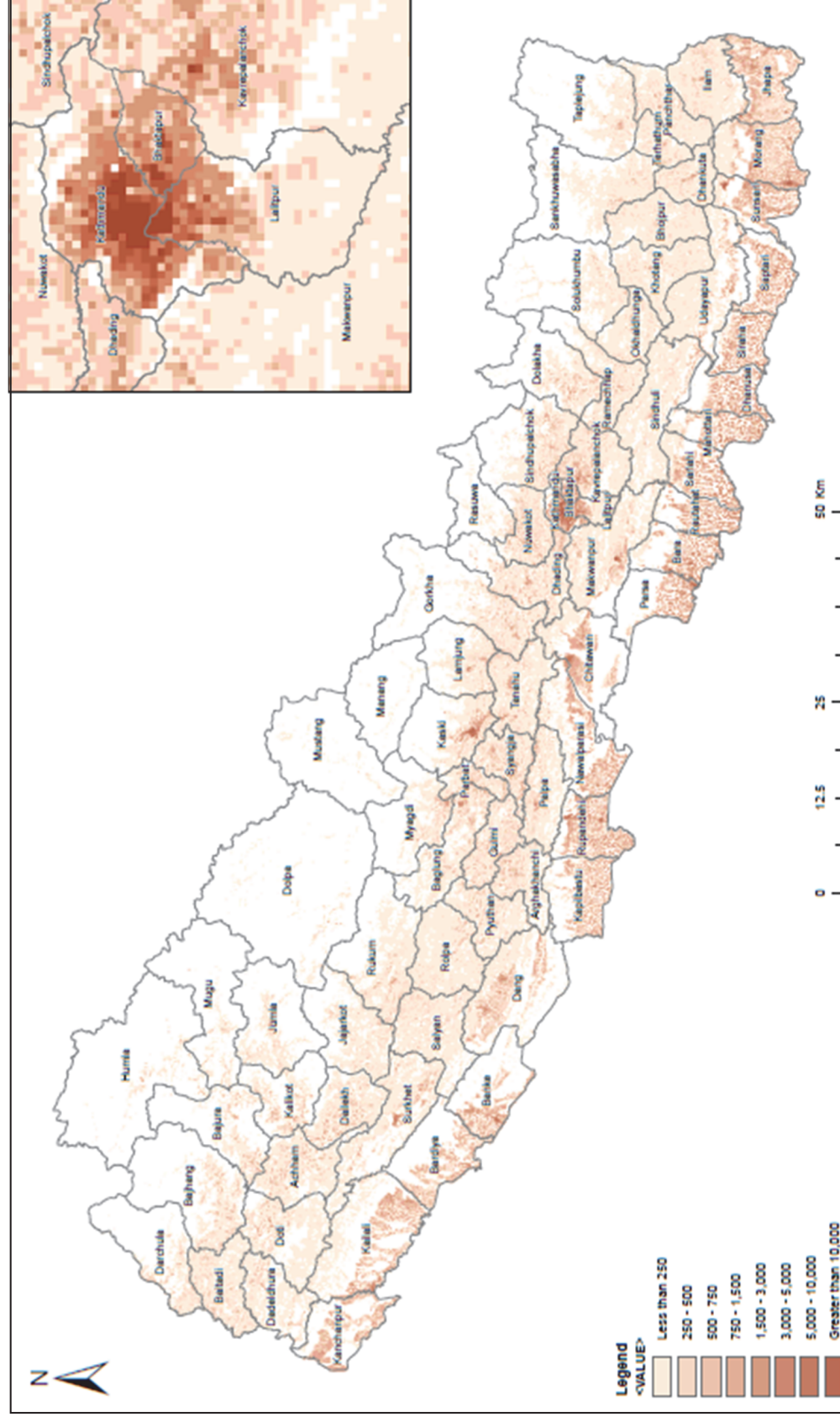


Figure 7.3: Population Density & Distribution (2011)



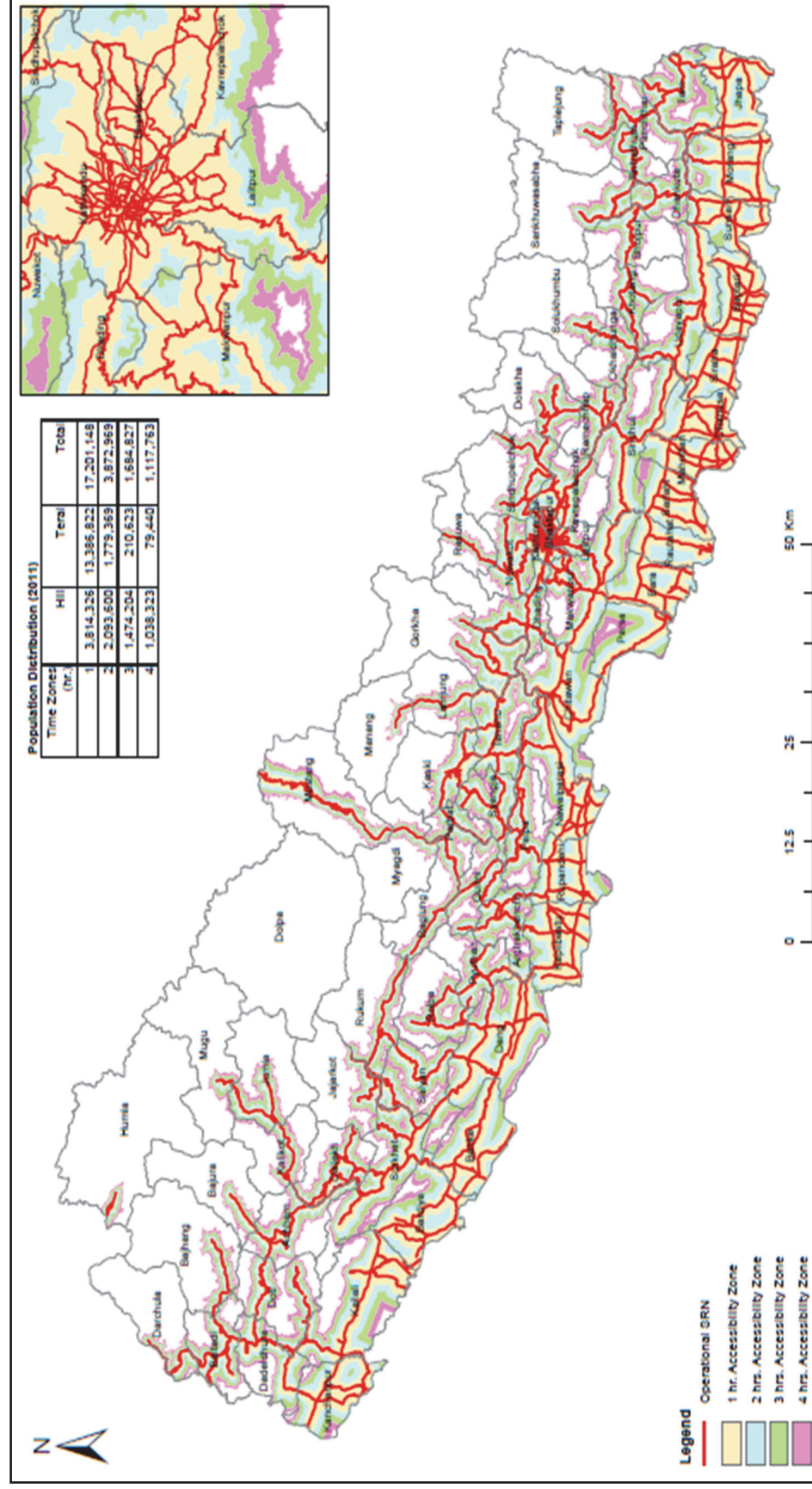


Figure 7.4: Accessibility to 2013 Operational and Under Construction SRN (13,358 Km)



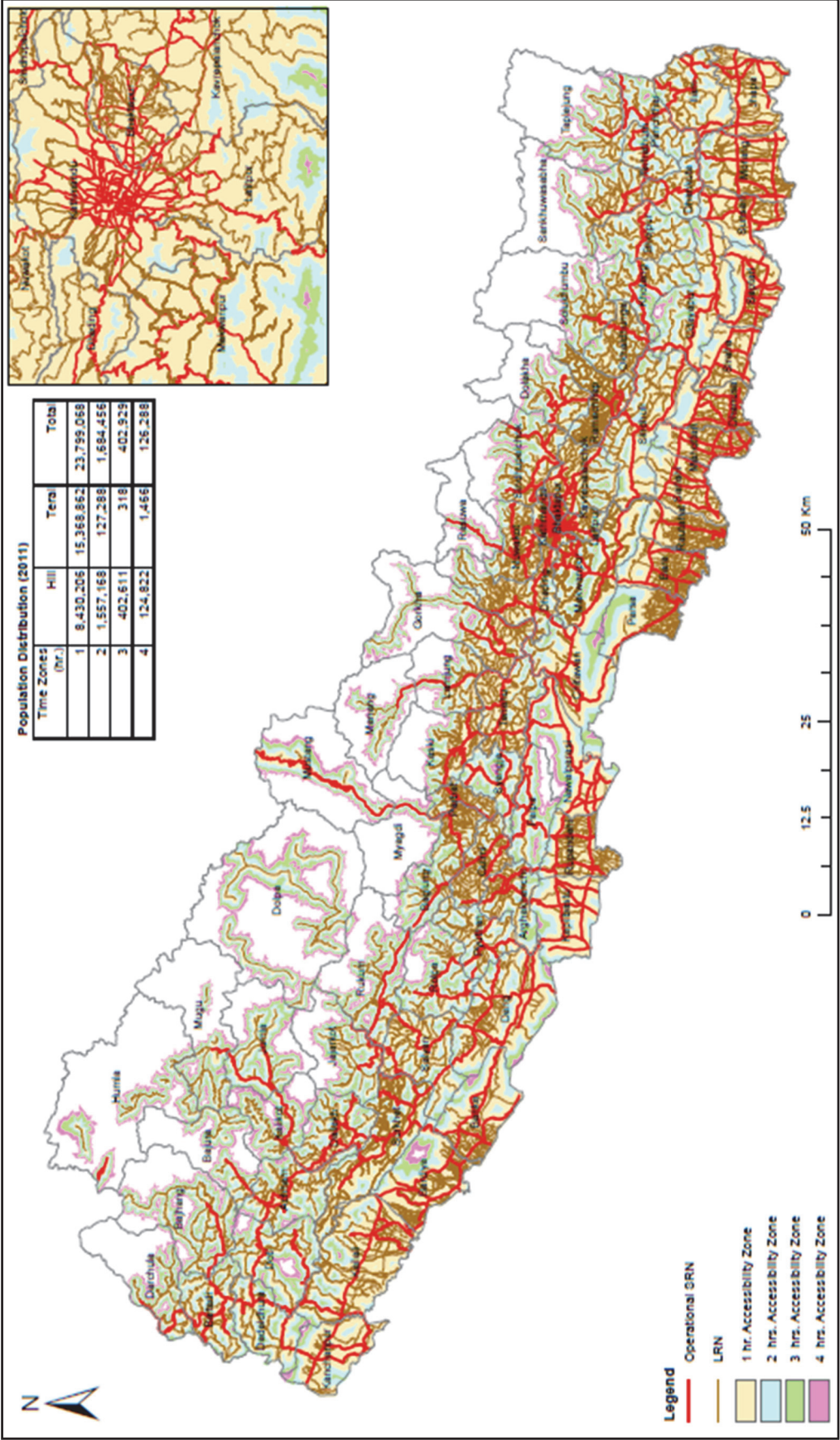


Figure 7.5: Accessibility to 2013 Combined SRN & LRN

### 7.3.2 Assessment of Total & Average Walk Time

An alternative measure of the level of accessibility provided by any network is given by calculating the total 'access time' to the nearest road for all inhabited areas. This is expressed in thousands of person-hours, representing the product of the number of people and their time (in hours) to reach the road. Thus 10 people 1 hour from a road would have the same impact as 1 person 10 hours from the road: this measure thus compensates for the relative density of the areas served by any road..

The populations in progressive time-bands from the nearest road are given in Table 7.2 for the current operational SRN and for the SRN plus LRN, together with the 2007 SRN (7,500km) for comparison. This indicates that the population within 1 hour of the SRN increases from 53 percent in 2007 to 66 percent in the 2013 Operational Network and, as a consequence, the proportion over 4 hours reduces from 20 percent to 9 percent.

**Table 7.2: Population within Time-Bands of nearest road (millions)**

Time Band Hours	Population and Percentage in given Time Bands					
	2007 SRN (7,500km)		2013 Operational SRN (12,809km)		2013 SRN + LRN	
<1	13.78	53%	17.98	69%	23.80	91%
<2	3.89	15%	3.52	14%	1.68	6%
<3	-	-	1.67	6%	0.40	2%
<4	3.03	12%	1.09	4%	0.13	0%
over 4hrs	5.10	20%	1.89	7%	0.24	1%
Total	25.80	100%	26.25	100%	26.25	100%

The inclusion of the LRN increases the percentage within 1 hour of a road to 91% of the population, with only 1% more than 4 hours from a road.

It is probably unrealistic – and undesirable – to attempt to achieve a 100 percent coverage of 4 hour accessibility in the hills. There will always be some remote areas unserved by road as it would be totally uneconomic and environmentally disastrous to construct roads into these areas for the minimal populations involved.

It can be shown that the average walk-time to access the road network in 2007 was almost 2 hours and that this reduces to 1 hour 20 minutes for the Strategic Network in 2013 and to 40 minutes if the local road network is also included.

## 7.4 Conclusions

It is evident that the expansion of the Strategic Road Network to its current (operational & under construction) length of 12,809 km has achieved the primary goal of improving the overall levels of accessibility throughout the country, as set out in the previous PIP. The role of the SRN is to provide connectivity throughout the country and to enable improved levels of accessibility to be achieved locally through the development and expansion of the local road networks.

Further expansion of the SRN – with the exception of links to the currently un-served District HQs – will not improve overall levels of accessibility significantly. Any further

Improvements to accessibility will depend on the expansion – and more critically the upgrading – of the Local Road Network to provide all-weather access in the hill areas. Analysis of the existing accessibility data on a District basis would allow such interventions to be prioritised effectively.

## 8. Revised PIP for 2014-2021

### 8.1 Overall Strategy

The 2007 PIP2 proposed a 10-year investment strategy for the Strategic Road Network for period to 2016. This comprised three main elements:

- Firstly, a definition of likely **Maintenance** requirements;
- Secondly, the **Upgrading** of existing and potential SRN elements (incl some local roads); and
- Thirdly, the **Construction** of new (strategic) links – for both rural access and network strengthening

Aside from the maintenance obligations, the PIP2 proposed a significant expansion of the SRN to around 10,000km, primarily through the incorporation of key elements of the local road network. The upgrading of existing earth or gravel roads to all-weather sealed standards was also proposed in both the Terai and hills, in order to provide an improved level of accessibility and to promote economic activity and growth.

New strategic routes were also proposed, including a high-capacity high-speed link between Kathmandu and the Terai, improved links to and between Hill Districts, and the completion of the previously proposed access routes to non-road-connected District Headquarters.

Most of what was proposed in the PIP2 has been implemented.

### 8.2 Revised PIP (2014-2021)

Preparation of the Priority Investment Plan (2014-21) requires the adoption of an overall strategy and policy for the development of the SRN. This will determine the extent of the future network and thus the associated maintenance, upgrading and new construction requirements and obligations.

Furthermore, it is necessary to determine the maintenance regime and strategy so that the associated costs may be assessed. It is proposed that the existing method of identifying and prioritising the regular and periodic maintenance programme (using the ARMP) is expanded to include rehabilitation and/or reconstruction by using indicators based on traffic levels, pavement age, IRI, SDI and strategic function.

Consideration of the maintenance, upgrading and new construction requirements – together with estimates of funding availability – allows a 'balanced' budget to be determined.

It is anticipated that the budget forecasts and distributions of expenditure will follow a similar pattern to the PIP2 allocations between maintenance, upgrading and new construction, including consideration of strategically important new access routes to Kathmandu from the Terai. This latter (Fast Track) proposal was included in the PIP2 and is potentially the single most important investment on the transport sector in Nepal.

This review of the 2007 PIP has concluded that the Strategic Road Network (SRN) has been expanded significantly in excess of its planned growth and that most of the additional roads are of low standard earth construction and that many are of local –

rather than strategic – significance. The expansion of the SRN has been achieved by the re-designation of existing local roads and earth tracks and by the inclusion of additional links in areas of relatively low population density that were not previously prioritised.

As a result there is now a substantial potential demand for the upgrading of the newly designated strategic roads and the risk that funds will be diverted from the primary task of maintaining the essential core elements of the national network. A critical function of this PIP is thus to **prioritise** the maintenance and construction of those key elements of the Strategic Network and to ensure that funding is available for these activities – ahead of other upgrading activities on less important roads.

### Extent of Network

The current (2013/14) Strategic Road Network comprises approximately 14,902km of roads, including planned and under-construction sections. Approximately 43% of the total length (6,369km) is black-topped, 12% (1,735km) has a gravel surface and 29% (4,389km) is simple earth construction, mostly with no provision of drainage structures. The remaining 16% is either planned (2,093km) or under construction (315km).

Under the present classification, approximately 5,570km (37%) are designated as National Highways (including the Mid-Hills Highway and Postal Road) and the remaining 9,330km (63%) as Feeder Roads. Of the National Highways, 60% is blacktopped and the remaining 40% is accounted for mostly by the incomplete sections of the Mid-Hills Highway and the Postal Road. Only 33% of the Feeder Roads are blacktopped, 13% are gravel and 33% are earth: the remaining 22% are under-construction or planned.

The lengths of road in each category under the proposed revised classification are presented in Table 8.1. In total there are 5,540km of National Highway, 9,010km of Feeder Road (divided between Class 1 and Class 2) and 350km of DoR roads within the Kathmandu Valley and environs. With the exception of planned new roads, all the Class 1 National Highways are blacktopped, together with 50% of the Class 2 National Highways. Similarly, half of the Class 1 Feeder Roads are blacktopped, together with almost 60% of the roads in the Kathmandu Valley area. Of the designated Class 2 Feeder Roads, only 8% is blacktopped with the majority either earth or gravel: around a third of the designated network of Class 2 Feeder Roads are 'planned'.



**Table 8.1: Road Lengths by Class (Proposed Classification)**

Road Classification		Black Top	Gravel	Earth	Under Cons.	Planned	Total
National Highway	Class 1	1,649	16	-	-	95	1,760
		94%	1%	0%	0%	5%	100%
	Class 2	1,840	529	1,143	78	197	3,787
		49%	14%	30%	2%	5%	100%
Feeder Road	Class 1	2,330	641	1,583	162	275	4,991
		47%	13%	32%	3%	6%	100%
	Class 2	349	522	1,632	75	1,437	4,016
		9%	13%	41%	2%	36%	100%
Kathmandu Valley Roads		200	27	32	-	89	349
		57%	8%	9%	0%	26%	100%
Total Length (km)		6,369	1,735	4,389	315	2,093	14,902
		43%	12%	29%	2%	14%	100%

Source: PIP Review Consultants Estimates

This table indicates the scale and extent of the potential requirement for upgrading and new construction – IF the whole of proposed network is to be brought up to desirable standards. Approximately 1,690 0km of Class 2 National Highway will need to be upgraded to sealed standards, together with about 1,850 Km of Class 1 Feeder Road. Additionally, depending on the standards of construction sought, a further 3,700km of Class 2 Feeder Road will require improvement: most is currently either simple earth construction or else in the planning stage.

### Priorities for Improvement

The above table presents an opportunity for developing improvement priorities. It is suggested that an initial priority be given to the sealing of the 1,700km of gravel and earth sections of the Class 2 National Highway, followed by the 2,220km of unsealed Class 1 Feeder Road. Specific priorities should be subject to individual feasibility studies. These works should be undertaken before consideration is given to the upgrading (or construction) of the Class 2 Feeder Roads.

A similar priority should be accorded to the upgrading of the more heavily trafficked sections of the Class 1 National Highways to full 2-lane Asian Highway standards, with a 7m carriageway, paved shoulders, improved visibility, added safety features and provision for a third overtaking lane, where feasible, and on lengthy gradients.

A practical and realistic target could be the partial completion of these initial high priority improvement projects within the 2014-2021 PIP period. Detailed programming and project selection should depend on the results of feasibility studies of individual projects but budget allowances can be estimated by allocating the work across the seven year plan period.

## 8.3 Maintenance Needs

### Regular Annual Maintenance

The first “call” on the budget in any year should be for the continuing and on-going maintenance obligations, referred to here as Regular Annual Maintenance and including Routine, Recurrent, Specific and Other Maintenance. The costs of each are estimated on a per km basis across the whole network.



- Routine: including grass cutting, drain clearing, debris removal, signs and markings, etc;
- Recurrent: minor repairs carried out on a cyclical basis, including pot-hole repairs, patching, edge-break repair, shoulders, etc;
- Specific: more substantial works as dictated by road condition – eg gravelling shoulders, building or repairing retaining walls, etc; and
- Other: traffic safety, bio-engineering, emergency maintenance, drainage rehabilitation, equipment repair and servicing,

The total annual costs of these regular maintenance liabilities over the 7 Year plan period are summarised in Table 8.2, based on an assumed increase in the length of the bitumen sealed network from the current 6,400km to 10,800km by 2021/22. This assumes that all National Highways and Class 1 Feeder Roads are sealed by the end of the plan period.

**Table 8.2: Regular Annual Maintenance (Rs million)**

Type of Maintenance	Rate Rs 000 /km	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Total
Length Maintained BT (km)		6,369	7,107	7,844	8,582	9,319	10,057	10,794	
Routine	62.4	397	443	489	535	582	628	674	3,748 (28%)
Recurrent	76.3	486	542	599	655	711	767	824	4,583 (34%)
Specific	77.2	492	549	606	662	719	776	833	4,637 (35%)
Other	6.8	43	48	53	58	63	68	73	408 (3%)
Total		1,418	1,583	1,747	1,911	2,075	2,240	2,404	13,378 (100%)

*Source: Consultants Estimates based on Rates provided by DoR*

The annual Regular Maintenance liability increases from Rs 1.4 billion in 2015/16 to Rs 2.4 billion by 2021/22 (at constant 2014 prices). Funding for these Regular Annual Maintenance expenditures should unequivocally be available through the Road Fund, itself funded through a fuel levy, tolls, and vehicle registration and licence fees.

The growth in the paved network from 6,400km to 10,800km by the end of the plan period implies an average annual increase of 740km per year, comprising 600km of upgrading and 140km of new construction.

### Periodic Maintenance

Periodic maintenance involves the resealing, overlay or rehabilitation of existing roads on a cyclical or demand responsive basis. The PIP2 assessed the periodic maintenance requirements of the SRN using HDM-4 to optimise the maintenance interventions by minimising the overall costs to both the department and road users.

It has not been possible to utilise the HDM model during this review and the expenditures on periodic maintenance have been estimated by applying agreed average rates for reseals, overlays and rehabilitation at appropriate intervals, ranging from 5 to 8 years depending on the class of road, surface type and traffic level.

The results are summarised in Table 8.3 for the 6,400km of currently sealed road in the SRN. The analysis is based on agreed rates for reseals (SBST), AC overlays and rehabilitation: it assumes that AC overlays are applied to 2,500km of National Highway and SBST reseals to the remaining 1,200km of National Highway and 2,700km of currently sealed Feeder Road. Reseals are assumed at a 4 year interval and overlays at 6 years. Rehabilitation is assumed after 12 years.

**Table 8.3: Summary of Periodic Maintenance (2014-2021)**

Type of Maintenance Intervention	Intervention Cost (Rs mill per km)		Length (km)		Total Cost Rs million		Total Cost Rs million
	AC	Seal	NH	FR	NH	FR	(NH & FR)
Reseal	n/a	2.38	1,200	2,700	2,856	6,426	9,282
Overlay	3.50	n/a	2,500		12,500	n/a	12,500
Rehabilitation	8.00	5.00	3,700	2,700	29,600	13,500	43,100
<b>Total</b>			<b>7,400</b>	<b>5,400</b>	<b>44,956</b>	<b>19,926</b>	<b>64,882</b>

The approach and parameters used reflect current DoR practice: the analysis in the previous PIP demonstrated that lower overall costs (to DoR and road users) – and an improved network condition – could be achieved through the greater use of asphalt concrete overlays, on roads with lower traffic levels. It is recommended that this approach be adopted in the future<sup>13</sup>.

## 8.4 Upgrading

### Upgrading to Sealed Standards

The above prioritisation has indicated that the upgrading to sealed standards of approximately 3,500km of presently gravel or earth Highways and Feeder Roads (Class 1) should be considered in the plan period to 2021. To complete this by 2021 would be an ambitious target, representing around 500km of newly sealed road per year – or three times the length planned over the ten-year period of PIP2.

The unsealed sections of the National Highway (Class 2) network comprise around 950km of the Mid-Hill Highway in the Eastern and Mid & Far Western Regions, plus a further 520km of the Postal Road. Priority should be given to the sections of the Mid-Hills Highway in more densely populated Districts and in the Eastern Region where inter-District connections are required in the Hills. The sections of the Postal Road are subject to prioritisation and upgrading under Indian funding.

Upgrading of the unsealed Class 1 Feeder Roads will represent a continuation of the current programmes of improvement of key routes into the Hills and connecting with District Headquarters. The target should be the provision of all-weather sealed road access to all District Headquarters by 2021, with priorities established on the basis of individual feasibility traffic demand.

The estimated costs of the upgrading programme are presented in Table 8.4, based on the upgrading to AC surface for the 1,690km of National Highways and to DBST for the 1,850 km of Feeder Road. It is assumed that this work would be completed over the seven year period to 2021/22.

<sup>13</sup> This change will not however influence the overall budget allocations

**Table 8.4: Recommended Upgrading to Sealed Standards**

	Length (km)	Cost Rs million per km	Total Cost (Rs billion)	Average Cost / year (Rs bn)
National Highways	1,690	50.00 for AC two lane	84.5	12.07
Feeder Roads	1,850	35.00 for DBST two lane	64.75	9.25
<b>Total</b>	<b>3,540</b>		<b>149.25</b>	<b>21.32</b>

### Upgrading to Asian Highway Standards

In addition to the above upgrading to sealed standards, it is recommended that key, heavily trafficked strategic sections of the Class 1 National Highway network should be progressively upgraded to full Asian Highway Standards. Initially, the main route linking Kathmandu with the Indian Border at Birgunj (via Mugling, Narayanghat and Hetauda) should be widened to provide a consistent 2-lane 7m carriageway, with paved shoulders and improved safety features.

It is noted that the approach routes to the main border crossings with India have recently been improved to 4 or 6 lane standards under various ADB Sub-Regional Development Projects. Subsequent priorities for upgrading to Asian Highway Standards would likely include the Arniko Highway (Kathmandu to Chinese Border) and the busier sections of the East West Highway.

## 8.5 Network Expansion/Extension

As noted elsewhere, there is no fundamental justification for an overall increase in the length of the Strategic Network. All key destinations within the country are or will be connected to the SRN in the near future, when current commitments are completed, and the network density is considered appropriate. Local accessibility will be enabled by the existing and future District level road networks.

However, around 740km of additions (classified as 'under construction' or 'planned') to the network of National Highways and Class 1 Feeder Roads are included in the currently designated SRN. It is assumed that these additions will be completed during the plan period, representing around 100km of new road per year.

### Network Additions and Strengthening

The analysis above is concerned with the existing sealed network of 6,400km and the potential upgrading to sealed standards of a further 3,500km of National Highway and Class 1 Feeder Road. This will create a network of around 10,800km of mostly sealed roads by 2021.

In addition there are around 5,000km of unsealed roads comprising the remainder of the presently designated SRN. It is to be expected that these roads will be progressively upgraded to sealed standards during subsequent plan periods – ie after 2022.

The 10,800km network of National Highways and Class 1 Feeder roads will form – and should remain – the primary concern of the DoR and should comprise the “core” of all future DoR activity and spending. However there are a limited number of additions to the network that require consideration. These include:

- Kathmandu-Terai-Indian Border Fast Track
- Kathmandu Outer Ring Road
- Koshi River Crossing Diversion to EWH
- Remote Area Access
- North-South Trade & Transit Routes
- Network Strengthening in Central Region

### *Kathmandu-Terai Fast Track*

Improved connections between Kathmandu and the Terai – and the Indian Border – have been a key component of both the previous PIPs, in 1997 and 2007. The project is potentially the most significant transport investment in Nepal, reducing the transit time for buses and trucks between Kathmandu and the Border to around 2 hours from the current levels of 6-8 hours or more, depending on conditions.

There have been many studies and a number of initiatives in recent years, involving a series of different route and funding options. The most significant of these has been the GoN proposal to utilise the Nepal Army to open a 76km long track – on an alignment through the Bagmati River Valley developed in a 2008 design study – linking the outskirts of Kathmandu, with the East West Highway at Nijgadh (23km east of Pathlaiya). Following track-opening, the intention was to let a design and build contract to a private sector developer.

Progress has however been mixed: the track is only partially constructed; it proved impossible to follow the designed alignment; land acquisition is incomplete; and, most importantly, no agreements have been reached with potential investors. The project is under review and it is recommended that more detailed engineering and financial analyses be conducted before further decisions are made regarding either the alignment or the construction and funding modalities.

The project is too important for Nepal to fail and it is thus imperative that a viable alignment is selected and an effective means of implementation (and funding) is adopted. The road should be constructed to appropriate standards – as a four-lane divided highway with controlled access – as it will form the primary access to Kathmandu for the foreseeable future.

The possibility also exists to develop a second International Airport for Kathmandu at Nijgadh in conjunction with the Fast Track and, combined, the two projects offer the potential of developing a major urban agglomeration in the Terai which could stimulate and rejuvenate the national economy and reduce the current pressures on the Kathmandu Valley.

### *Kathmandu Outer Ring Road*

Proposals for a 72km long Outer Ring Road around the foothills of the Kathmandu Valley are included in the current SRN. This was originally promoted as a 'land pooling' scheme with land donated for the road as part of urban development proposals for the area. Construction should be closely coordinated with urban development activities and It is suggested that the project should be promoted jointly with the Kathmandu Valley Development Authority.

### *Koshi River Crossing Diversion to EWH*

A new crossing of the Koshi River is under construction at Chatara that will provide an alternative link to eastern Nepal, potentially replacing the existing EWH route which crosses the Koshi Barrage. New approach roads from the east and west will be required to connect to the EWH and these should be constructed to full Asian Highway Standards.

### *Remote Area Access*

Schemes are in hand to connect all District Headquarters to the SRN, however these links need to be upgraded to provide all-weather access and some additional inter-District links are required to ensure adequate connectivity and security of access.

### *North-South Trade & Transit Routes*

There is significant potential for trade and transit traffic between India and China, in which Nepal is well placed to participate. Previous studies have investigated possible routes and have recommended that investment be concentrated initially at the existing crossing at Kodari (on the Arniko Highway) and at Rasuwagadhi (north of Kathmandu) where customs and immigration facilities on the Chinese side have recently been completed and road access is available. Trade volumes across other more remote crossings on the Chinese border are mostly insignificant (and of a local nature only).

It is recommended therefore that investment in north-south transit routes be focussed on upgrading access routes to the main existing crossings at Kodari and Rasuwagadhi, so as to accommodate increased volumes of containerised traffic. Routes linking to the major crossings to India at Birgunj and Bhairawa should be similarly upgraded.

### *Network Strengthening in Central Region*

Economic activity and growth are strongly focussed on the Central Region – and specifically the Greater Kathmandu Valley Area. As a result traffic volumes are greatest in this area and further investments to improve, upgrade and strengthen the road network may be required. Reference has been made above to the Fast Track and to the Kathmandu Outer Ring Road, and additional investment will be required to upgrade the Arniko Highway up to Banepa and Dhulikhel, to provide a high capacity spine road serving the expanding communities to the east of Kathmandu.

Similarly, despite the proposed construction of the Fast Track, improvements will be required to the main approach to Kathmandu from the Prithvi Highway: this could take the form of a new link (or tunnel option) to replace or supplement the existing route from Naubise to Thankot.

### **New Construction**

Only limited amounts of new construction, as indicated above, are proposed in the forthcoming PIP period. Over the past decade considerable lengths of new road have been built (or planned) both at the District level and as extensions of the SRN to District HQs. The emphasis is now on the consolidation and upgrading of these roads to provide reliable and sustainable access.

## 8.6 Bridges on the Strategic Network

The DoR Bridge Unit is responsible for the construction and maintenance of bridges on the SRN: a separate budget is provided on an annual basis to cover both recurrent and development (capital) expenditure. The Bridge Unit maintain their own inventory of bridges and this forms an adequate basis to establish annual maintenance requirements, together with a refurbishment or replacement programme as required.

The Recent (2012) Bridge Inventory Study and Condition Survey identified 1709 bridges in SRN. Around 96 bridges in need of urgent repair works, 172 bridges needs investigation for rehabilitation and about 443 needs minor repair works. These works should be programmed and prioritised and an on-going inspection regime established.

As noted in the Survey, the bridges on the 'Russian' section of the East-West Highway between Pathlaiya and Dhalkebar which are of substandard width (5.5m between kerbs) and do not allow commercial vehicles to pass – except at a crawl. Due to the length of some of these bridges, this creates severe difficulties and dangers to traffic, to pedestrians and to slow-moving vehicles. Given the ever increasing traffic volumes – and thus conflicts between opposing vehicles – the situation will deteriorate rapidly and a solution will be required.

For the lower volume hill roads, bridges are generally constructed in conjunction with upgrading and improvement projects in accordance with the overall design requirements to achieve an all-weather connection. It is suggested that a set of guidelines be developed to assist with the selection of the appropriate form of crossing (ford, culvert, causeway, floodway, submersible bridge, RCC bridge, steel truss bridge, etc) in conjunction with the forecast dry-weather and flood conditions and anticipated traffic volumes. It is observed that in some cases bridges on low-volume roads have been over-designed and permanent structures provided where simpler causeways might have been appropriate.

The proposed midhill highway requires substantial numbers of bridges and most of them are already in construction phase. Similarly, the proposed (Government of India funded) programme of improvements to Terai roads will require the provision of a substantial number of bridges (or causeways) across major rivers and water-courses.

It is estimated that the SRN bridge program will require roughly NRs 40 Billion worth of capital investment to meet all needs identified. The World Bank's proposed intervention under the Bridge Improvement and Maintenance Program Support (BIMPS) is a USD 60m loan/grant from IDA to support the SRN bridge program which relates solely to bridges on the Strategic Roads Network. The GON would not be able to fund all SRN bridge program needs over the next five years even with the Bank's proposed support. DOR has therefore recognized the importance of using the Bridge Management System (BMS) to prioritize expenditures. The first priority for the program is to preserve existing assets. In particular those bridges that need urgent maintenance to remain functional. The next priority is the completion of bridges that have been started but remain incomplete. Of the new bridges DOR has a number of priorities including the completion of routes in remote areas that lack all weather access and in strengthening the bridges on the high volume routes.

The allocation for the bridge works for the year 2015/16 is about NRs 4.88 billion which includes NRs 2.08 billion for new bridges, NRs 0.9 billion for bridge maintenance and repair, NRs 0.13 billion for design/supervision and NRs 1.77 billion



for bridges under the LRN. The DoR involvement in the LRN bridges will gradually reduce and the DoLIDAR will take over the new construction and maintenance works.

## 8.7 Priority Investment Plan

The PIP (2014-21) has been developed to assist in the planning and management of the Strategic Road Network. The currently designated National Highways and Feeder Roads have been sub-divided into two classes to assist in the prioritisation of both maintenance and upgrading.

The current network contains approximately 14,902km of road, including 5,550km of National Highway and 9,350km of Feeder Road: overall 43% of the network is sealed – 60% of the Highways and 33% of Feeder Roads. Just over 2,000km of the total network length (14%) is still in the planning stage.

The proposed re-classification designates a core 1,760 km of National Highways as being of strategic national significance and sub-divides the Feeder Roads into two groups. The Class 1 Feeder Roads are basically those that were included in the Extended Network proposed in the 2007 PIP: additionally approximately 350km of road with the environs of Kathmandu Valley are separately identified.

The PIP comprises three elements:

- Maintenance – Regular, Periodic & Rehabilitation;
- Upgrading – from earth/gravel to seal or to higher standards;
- New Construction – new links to Kathmandu

The first priority or obligation is for the **maintenance** of the existing (sealed) network of approximately 6,400km. Regular maintenance activities include routine annual expenditures (calculated on a per km basis) and periodic maintenance involves reseals or overlays at fixed pre-determined intervals. It is suggested that a revised approach be adopted with increased emphasis on the use of AC overlays which not only improve the running surface but provide additional strength and longevity: AC overlays can be justified even on lower trafficked roads. Exceptionally, sections of road that have failed may also require a more extensive rehabilitation – basically a reconstruction to return the section to an ‘as-built’ condition.

Regular maintenance is required on all gravel roads, involving annual (or bi-annual) grading and the replacement of lost material. In general it is considered that gravel surfacing is unsuitable in the Hills, due to the rate of loss of gravel on gradients and the haulage cost of replacement material: upgrading to a bitumen seal is preferable.

Limited ‘holding’ maintenance should also be applied to earth sections of the SRN: due to the rapid expansion of the length of designated SRN, it is recommended that no expenditure be incurred on Class 2 Feeder Roads, unless specifically justified by individual study.

A programme of **upgrading** from earth/gravel to sealed standards is proposed, with priorities established through feasibility studies. A preliminary objective should be the sealing of links to all District Headquarters, followed by National Highways (Class 2) and Class 1 Feeder Roads – a total of 3,500km. This target would entail the upgrading of at least 500km of road annually – well in excess of previous programmes.

It is not proposed that any upgrading be undertaken on the remaining 2,500km of existing earth and gravel Class 2 Feeder Roads.

It is estimated that the annual budget requirement for the above maintenance and upgrading activities is of the order of Rs 14.4 billion per year: Rs 1.9 billion for Regular Annual Maintenance, Rs 6.3 billion for Periodic Maintenance, and Rs 5.1 billion for Upgrading to sealed standards of around 600km of road per year.

In parallel, key heavily trafficked sections of the Class 1 National Highway network should be upgraded to full Asian Highway standards, with enhanced safety features and capacity improvements (improved overtaking sight distances and a third lane where feasible). Initially the main access route to Kathmandu (Birgunj-Hetauda-Narayanghat-Mugling-Kathmandu) should be improved, followed by the Arniko Highway to the Chinese border and subsequently the link to the Rasuwagadhi border crossing from Galchhi on the Prithvi Highway.

Limited **new construction** is envisaged over the plan period due to the substantial increases in network length that have occurred in recent years – and the extent of local road building that has taken place. Over 2,000km of Class 2 Feeder Road are shown as being ‘Under Planning’ and work on these roads should generally be deferred, pending completion of the higher priority maintenance and upgrading programmes.

However, priority should be given to the construction of the Fast Track link between Kathmandu and the Terai (and Indian Border) as this major project would produce not only significant economic and transport benefits in its own right but also has the potential of transforming the relationship between Kathmandu and the Terai and stimulating major growth in the national economy. Coupled with the development of a Second International Airport at Nijgadh, the Fast Track could allow development of a major new urban centre in the Terai and simultaneously relieve the pressures for urbanisation in the Kathmandu Valley, allowing Kathmandu to revert to being the national, cultural, political and historic capital.

Overall the PIP envisages a period of consolidation (rather than expansion) and progressive upgrading to appropriate standards. The budget requirement is calculated with this vision and presented in table below. A total of NRs 317.015 billion (45.2 billion/year) is required for next 7 years (till 2021/22) to cover the SRN related works (maintenance, upgrade and new construction).

In addition to these, the Kathmandu valley road expansion, upgrading of the road to 4 lanes and upgrading of Arniko Highway up to Kodari, completion of the Postal Highway and Midhill Highway will require substantial investment.

Recently, the MoPIT published a 5 year strategic plan for the development of the transport sector in Nepal. The 5 years plan covers the period from 2015/16 to 2020/21 (2073 – 2078 BS). The plan emphasis on upgrading of the existing road network which includes upgrading to four lane of 941 Km of roads and upgrading of 4564 Km of road within 5 years period. The upgrading of the roads connecting the north-south borders are given higher priority. The plan also includes upgrading of the earthquake affected road (400 Km) and 87 bridges.

**Table 8.5: Summary of Draft DoR Budget for SRN (2015/16-2021/22) Rs million**

Items	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Total
Regular Annual Maintenance	1,418	1,583	1,747	1,911	2,075	2,240	2,404	13,378
Periodic Maintenance (AC Overlay, reseal & Rehab)	9,269	9,269	9,269	9,269	9,269	9,269	9,269	64,882
Upgrade NH & FR to Two Lane (1690 Km – AC/Two Lane) (1850 Km- DBST/Two Lane)	17,000	17,000	17,000	20,500	20,500	25,500	31,750	149,250
New Construction (2400 Km)	7,500	8,750	8,750	8,750	8,750	8,750	8,750	60,000
Bridge Works	3,110	3,421	3,763	4,139	4,553	5,009	5,510	29,505
<b>Total by Year</b>	<b>38,297</b>	<b>40,023</b>	<b>40,529</b>	<b>44,569</b>	<b>45,148</b>	<b>50,767</b>	<b>57,682</b>	<b>317,015</b>

## Annexes

## ANNEX 1: Current Status of PIP2 (2007) Recommendations

Based on Table 10.5 of SWRP/PIP Final Report, April 2007, updated to mid-2014.

Scheme	Length (km)	Donor Agency	Status (2013/14)
<b>A. COMMITTED SCHEMES</b>			
Basantapur-Mude-Chainpur-Khandbari	96	ADB	Part Complete
Galchhi-Devighat-Syabrubesi	79	ADB	BT Complete
Khurkot-Manthali-Tamakosi	64	ADB	BT Complete
Phidim-Taplejung	87	ADB	BT Complete
Pokhariya-Parawanipur (Birgunj ICD)	10	ADB	BT Complete
Bhumahi-Parasi-Bhairahawa ICD	30	ADB	BT Complete
Baitadi-Satbanjh-Gokuleshwar	74	WB/IDA	BT Complete
Khodpe-Jhota-Chainpur	110	WB/IDA	BT Complete
Bangesimal-Rakam-Tila River (km135)	135	WB/IDA	BT Complete
Sun Koshi-Okhaldhunga	42	ADB	On-going
Hile-Leguowaghat-Bhojpur	92	ADB	Under procurement
Nepalthok-Khurkot	32	Japan	On-going
Kathmandu-Bhaktapur	10	Japan	Complete
Syabrubesi-Rasuwegadhi	26	China	On-going
1400km of Terai Roads	1,500	India	On-going
Sabha-Bramadev (Tanakpur Link)	13	India	On-going
Total	2,400		
<b>B. UPGRADING SCHEMES - EXISTING DoR ROADS (to Sealed Standards)</b>			
H03 Barabise - Kodari	8		BT Complete
F13 Bhalubang – Chakchake – Rolpa (Liwang)	108	India	BT Complete
H11 Ameliya – Tulsipur	30	India	BT Complete
F30 Panchkhal – Melamchi	23		BT Complete
F47 Chhinchu – Devisthal – Jajarkot	107	WB/IDA	On-going
H18 Maldhunga-Beni	13	India	BT Complete
H11 Tulsipur – Shitalpati – Salyan	54	India	BT Complete
F14 Chakchake - Pyuthan	25	India	BT Complete
H11 Shitalpati – Musikot	86	WB/IDA	On-going
F133 Tulsipur – Purandhara – Botechaur	86		On-going
F48 Lower Dhungeshwar - Dailekh	28	WB/IDA	BT Complete
H20 Sanphebagar-Martadi	57	India	Part Complete
H25 Mangalsen-Belkhet/Rakam	51		Mid Hills
H25 Safebagar-Mangalsen	38	India	BT Complete
Total	714		
<b>C. NEW CONSTRUCTION (to FR Standards - sealing subject to FS)</b>			
Karnali Rajmarg (km135 to Jumla)	118	IDA/WB	On-going
Martadi-Kolti	51		Planned

Scheme	Length (km)	Donor Agency	Status (2013/14)
Hilepani-Diktel	67	India/ADB	Part Complete
Beni-Jomsom	80		Track Open (NA)
Okhaldhunga-Salleri	50	ADB	On-going
Total	366		
<b>D. NEW CONSTRUCTION (as Earth Track mostly through local efforts)</b>			
Jajarkot-Dunai	144		Under Construction
Simikot-Hilsa	88		Under Construction
Besisahar-Chame	65		Track Open
Nagma-Gamgadhi	88		Track Open
Total	385		
<b>E. UPGRADING OF LOCAL ROADS TO SRN STANDARDS</b>			
Baglung-Burtiwang	90		On-going
Kaligandaki-Kushma	67		On-going
Sandhikharka-Tamghas	31		On-going
Sandhikharka-Pyuthan	49		
Tamghas-Warmitaksar	19		Part Complete
Pharping-Kulekhani-Bhimphedi	24		On-going
Bhedetar-Ranke	115		On-going
Okhaldhunga-Khurkot	43		On-going
Phidim-Myaglung	75		On-going
Bhojpur-Diktel	55		Widening complete
Daijee-Jogbuda-Budar	68		No progress
Total	636		
<b>F. NEW CONSTRUCTION TO ACCESS KATHMANDU</b>			
Kathmandu-Terai Fast Track **	65		Track Opening
Sitapaila-Bhimdhunga-Dharke **	33		Budget approved
<b>G. OTHER STRATEGIC ROAD IMPROVEMENTS</b>			
Kathmandu Ring Road Upgrade	28	China	Started
Bhaktapur-Banepa-Dhulikhel	20	Japan	Planning
Narayanghat-Mugling Improvement	36	WB/IDA	Under Procurement
Hetauda By-Pass	15		Planning
Koshi Barrage Replacement **	50	ADB	Under Procurement



## ANNEX 2: Non-PIP (2007) Roads currently under construction

Listing of Roads included in current (2013/14) budget that were not included or prioritised in 2007 Sector Wide Road Programme & Priority Investment Plan.

Scheme		Budget Allocation (FY 2013/14) Rupees million
1	Sagarmatha Highway (H09): Gaighat-Diktel	90.00
2	Mahakali Highway (H14): Darchula-Tinka	2.51
3	Kanti Lokpath (F120): Hetauda-Tikabhairaabh	120.57
4	Roads linking two Districts	90.00
5	Ganesh Man Singh Marga (F180): Thankot-Chitlang	40.00
6	Gangate-Labdh-Samudratar-Galphu Bhanjyang (F082, F181)	45.00
7	Sanljhandi-Sandhikharka-Dhorpatan (F196)	160.00
8	Byas Marga (Damauli Bazar) (F128): Buddha Singh Marga	44.00
9	Regional Level Roads	830.00
10	Damak-Chisapani (F158)	12.50
11	(Dharan-Chatara-)Gaighat-Hetauda (F057)	150.00
12	Tallo Dhungeswor-Satkhamban-Dullu Pipalbot	20.00
13	Devesthal-Kanaidanda-Chaurjhari (F193)	20.00
14	Gumi-Patiharna Chaur (F183)	15.00
15	Tanakpur Link Road (Sabha-Brambhadev)	15.00
16	RIP1 – Sankhu-Melamchu; Tokha-Gurje Bhanjyang-Chhahaare; Chandranigahapur-Gaur; 3 roads linking Raajbiraj	970.00
17	RIP2 – Lamosangu-Tamakoshi; Lumbini Buddhist Circuit Road; Bardeghat-Paldanda-Tribeni; Balaju-Ranipauwa-Kakani-Trishuli; Chhahare-Bidur; Baalkhu-Daakchhinkali; Bhaktapur-Nagarkot; Bharatpur-Meghauli; Janakpur Circular Road	
18	Mirdi-Kyakni-Bhimad (F186)	15.00
19	Putalikheta-Karkineta-Kushma (F185)	24.20
20	Km11-Chhepetar-Bhaluswara-Warpac (F184)	77.63
21	Fikkal-Shriantu Danda (F156)	30.00
22	Koshi Corridor (Khandbari-Kimatharka)	200.00
23	Benighat-Arughat-Larke Bhanjyang (F196)	46.00
24	Bridges on Local Road Network (LRN)	1,700.00
25	Kathmandu Valley Roads Construction & Improvement	400.00
26	Other Urban Roads	500.00
27	Kathmandu Valley Road Widening Project	1,800.00
28	Seti Highway: Tikapur-Lode-Chainpur-Taklakot (F195)	100.00
29	Chepan Marga (Thori-Bhandara-Lothar-Malekhu) (F161)	60.00
30	Rehabilitation of Flood Damaged Roads & Bridges	298.37
31	Kathmandu Sustainable Urban Transport Project	667.82
32	Tourism Roads	360.00
33	Trade Development Project: Rani-Biratnagar-Itahari-Dharan; Birgunj-Pathlaiya; Belahiya-Butwal	940.00
34	Sub-Regional Connectivity Project: Birtamod-Mechi Bridge, Manthali-Ramechhap	

<b>Scheme</b>		<b>Budget Allocation (FY 2013/14) Rupees million</b>
35	Other North-South Roads (9 roads)	270.00
36	Patan-Pancheswar (F175)	30.00
37	Khutiya-Dipayal (F204)	30.00
38	Potential Strategic Roads	1,000.00
<b>TOTAL</b>		<b>Rs 11 billion</b>

## ANNEX 3 - THRESHOLD TRAFFIC LEVELS FOR FEEDER ROADS

### I. Introduction

The “Classification and Design Standards for Feeder Roads” (February 1994) proposed a methodology for determining the threshold traffic volume for upgrading from earth to gravel and gravel to bitumen. This was further elaborated in a Discussion Paper “Threshold Traffic Levels for Feeder Road Upgrading” (May 1995).

These documents presented a methodology, using the HDM model, for calculation of the ‘total transport costs’ – i.e. construction and maintenance costs plus vehicle operation costs – for typical Hill and Terai roads with increasing traffic volumes. The construction and maintenance costs and vehicle operating costs were calculated at 1995 levels. The resultant threshold traffic levels for upgrading from earth to gravel were determined as 35 and 60 vpd respectively for Hill and Terai roads. The resultant threshold traffic levels for upgrading from gravel to bitumen for Hill and Terai roads were established as 92 and 100 vpd respectively. It was emphasised that these figures were not absolute values but were indicative trigger points at which a detailed feasibility study should be initiated.

The threshold traffic volumes have been re-calculated based on current upgrading and maintenance costs, and users’ costs (vehicle operating costs and values of travel time). The analysis has assessed the benefits of upgrading from a fair-weather earth road to an all-weather gravel surface (including all drainage structures) and, subsequently, from all-weather gravel to a sealed bitumen surface.

The benefits of upgrading to an all-weather gravel surface are obtained from the reduced users’ costs (lower vehicle operating costs and lower travel time due to higher speeds) on the improved surface assuming that the road being open for 12 months each year<sup>14</sup>. The benefits from the bitumen seal are obtained from further reductions in users’ costs and savings in the annual recurrent maintenance costs of the gravel road.

### II. Traffic

The following traffic compositions are used for the calculation of threshold traffic: the impact on motor-cycles is excluded from the calculation as the potential benefits per vehicle are small and the effects of upgrading cannot be accurately predicted.

**Table 2: Traffic Composition**

Car	Utilities	Medium Truck	Medium Bus	Tractor
5%	15%	40%	30%	10%

<sup>14</sup> For the unimproved earth surface it is assumed that the road would be closed to vehicular traffic for 90 days during the monsoon

The following traffic growth rates are estimated for the calculation of threshold traffic:

**Table 3 : Estimated Normal Traffic Growth Rate (%)**

Period	Growth Rate (%)	
	Utilities/Bus/Car	Truck/ Tractors
2014-20	8.5	6.8
2021-34	6.8	5.4

Source: Consultants' estimates, 2014

10% of normal traffic is assumed to be generated after each stage of the upgrading from earth to gravel, and from gravel to paved.

### III. Maintenance Policy

The maintenance policies considered for calculating the threshold traffic are based on planned activities. The activities are given in Table 4 and Table 5.

**Table 4 : Routine/Recurrent Maintenance**

Earthen Road	Gravel Road	Paved Road
a) Routine maintenance	a) Grading once a year b) Spot re-gravelling of 5% of surface area per year c) Routine maintenance	a) Patching of 0.5% of the surface area b) Routine maintenance

**Table 5 : Periodic Maintenance**

Gravel Road	Paved Road
a) Re-gravelling in Hill roads at a fixed interval of 5 years.	a) Resurfacing (SBST) in Hill roads at a fixed interval of 5 years
b) Re-gravelling in Terai roads at a fixed interval of 6 years.	b) Resurfacing (SBST) in Terai roads at a fixed interval of 6 years

### IV. Costs

All costs are estimated in economic prices. Economic prices reflect the resource cost or value of an item to the society. The economic prices are obtained by using Domestic Price Numeraire. Any duty, tax or subsidy included in the financial price is excluded and the shadow exchange rate factor (SERF) and shadow wage rate (SWR) are used to estimate economic costs. Table 6 shows economic costs.

**Table 6 : Economic Costs**

Cost Items	Hill Road	Terai Roads
Routine Maintenance (Earthen) (NRs./Km/yr)	44,904	38,841
Routine Maintenance (Gravel) (NRs./Km/yr)	44,904	38,841
Routine Maintenance (Paved) (NRs./Km/yr)	38,168	31,432
Recurrent Maintenance (Earth) (NRs./Km/yr)	14,968	14,968
Recurrent Maintenance (Gravel) (NRs./Km/yr)	22,452	22,452
Recurrent Maintenance (Paved) (NRs./Km/yr)	71,098	56,878
Periodic Maintenance (Gravel) (NRs./Km)	898,080	898,080
Periodic Maintenance (Paved) (NRs./Km)	748,400	733,432
Upgrading Earth to Gravel (NRs./Km)	6,788,736	7,725,733
Upgrading Gravel to Paved (NRs./Km)	4,531,562	4,708,932

## **V. Users' Costs**

### **V.1 Vehicle Operating Costs (VOC)**

Vehicle Operating Costs (VOCs) of vehicles are calculated using Road Economic Decision Model (the HDM-4 module calibrated to Nepali condition). The RED model is the appropriate computer model for calculating VOCs in low traffic volume roads.

In order to predict the vehicle operating costs, the model requires three sets of data:

1. Unit prices of each VOC component
2. Characteristics of vehicles
3. Characteristics of the road

#### **Unit Prices of VOC Components**

In predicting VOCs the model first predicts the consumption of the following vehicle operating cost components as a function of operating conditions and then multiplies these consumptions by the unit prices of each resource.

1. Vehicles
2. Fuel
3. Tires
4. Maintenance Labour
5. Crew Costs
6. Depreciation

The prices of vehicles and tires and fuel are obtained from dealers and Nepal Oil Corporation in Kathmandu. The prices are subject to customs and excise duties and value added tax. All these duties and taxes are excluded from the financial prices to estimate economic prices. The costs of crew members such as drivers, helpers and maintenance labour are obtained from drivers and workshops.

### **Vehicle Characteristics**

The characteristics of the representative vehicles are considered as shown in Table 7.

**Table 7 : Vehicle Characteristics**

Vehicle Type	Fuel Type	No. of Wheels	Operating Weight (tonnes)	ESA	No. of Passengers	% of Private Trips
Med Truck	D	6	14.50	4.00	-	0
Bus	D	6	10.00	0.80	45.0	0
Car	P	4	0.80	0.00	2.5	50
Utility	D	4	1.50	0.01	1.5	20
Tractor	D	6	4.00	0.20	-	0

*Source: Vehicle Specifications*

### **Road Characteristics**

The characteristics of representative roads considered for the calculation of threshold traffic volumes are obtained from the average of roads in the Hill districts and Terai districts. The characteristics considered are given in Table 8.

**Table 8 : Characteristics of Representative Roads**

Characteristics	Hill Road	Terai Road
Link Length (km)	50	50
Average Curvature (Deg/Km)	500	50
Average Rise and Fall (m/Km)	60	2
Rainfall (m/year)	0.21	0.21
Formation Width (Earthen and Gravel) (m)	4.5	6.0
Carriage Way Width (Paved) (m)	3.5	3.5
Total Shoulder Width (Paved Surface) (m)	1.0	2.5
Effective Lane (m)	1.0	1.0
Surface Characteristic (Earthen) (IRI m/Km)	12.0	12.0
Surface Characteristic (Gravel) (IRI m/Km)	8.0	8.0
Surface Characteristic (Paved) (IRI m/Km)	4.0	4.0

Financial prices and costs of various input data required by the RED model for predicting VOCs are converted to economic prices by excluding duties and taxes. Table 9 shows economic VOCs calculated by the RED model for roads.



**Table 9 : VOC in the Roads (NRs./Km)**

Vehicle Types	Hill Roads			Terai Roads		
	Earthen	Gravel	Paved	Earthen	Gravel	Paved
Car	27.84	23.26	19	25.33	20.2	15.56
Truck	99.46	92.37	82.97	66.16	53.69	39.85
Utilities	37.16	31.16	25.4	32.18	25.56	19.55
Bus	83.53	75.23	66.2	60.17	47.84	35.9
Tractor	51.7	47.83	42.75	43.2	38.47	32.47

Source: RED Model, 2014

## V.2 Travel Time Costs (Value)

The values placed by travelers on travel time savings are best established using revealed or stated preference surveys. In the absence of survey results, there are two approaches to valuing time savings:

- use of an empirical relationship between VOT and GDP per capita using regression between pairs of values from stated and revealed preference studies; or
- use of appropriate income levels.

The latter approach is used. The value of time for work or business trips is assumed to be related to average regional incomes. Non-work trips are given no value. The value of pedestrian/passenger travel time is higher for the passengers with higher incomes.

The values of travel time of respective passenger vehicles are calculated by dividing their value of time by speeds. The speeds are derived by using Road Economic Decision (RED) Model (HDM-415 module calibrated to Nepali condition). This model is considered the most suitable for vehicle speeds on the roads of Nepal. Table 10 shows the obtained values.

**Table 10 : Value of Time of Passenger Vehicles (NRs./Km)**

Vehicle Types	Hill Roads			Terai Roads		
	Earthen	Gravel	Paved	Earthen	Gravel	Paved
Car	12.55	10.16	8.67	11.10	8.20	6.13
Bus	37.41	32.62	28.18	32.03	24.01	18.20
Utilities	18.01	14.76	12.62	15.34	11.52	8.80

Source: RED Model, 2014

## VI. Threshold Traffic Level

Economic Evaluation of upgrading of earthen road to gravel standard and gravel to paved standard in both the Hill and Terai have been carried out. For the evaluation cost streams of 20 years at different traffic levels in earthen and gravel roads are compared and Economic Internal Rate of Returns (EIRRs) have been calculated. Similarly, cost streams of gravel and paved roads at different traffic levels are compared to obtain EIRRs. The cost streams include upgrading costs, maintenance costs, VOCs and values of travel time.

<sup>15</sup> Highway Design and Maintenance Standards Model, the World Bank

The net costs are the benefit of upgrading of roads since VOCs and travel time of vehicles are reduced due to improved road surfaces and maintenance costs of road are increased requiring maintaining higher standard road.

Threshold traffic level is the level of traffic when the EIRR is equal to 12%. Below the threshold level the EIRR becomes lower and upgrading of the road is not economically feasible since present value (PV) of cost (upgrading costs, maintenance costs, VOCs and values of travel time) discounted at 12% become more than PV of existing cost (maintenance costs, VOCs and values of travel time). Above the threshold level the net PV always become positive and provide benefits to economy. Table 10 shows the threshold traffic levels for upgrading earth to gravel road and from gravel to paved road in Hill and Terai.

**Table 11 : Threshold Traffic for Upgrading of Roads**

Activity	Threshold Traffic (VPD)	
	Hill	Terai
Upgrading Earth to Gravel	42	37
Upgrading Gravel to Paved	102	84

## VII. Conclusion

The threshold traffic levels for Hill and Terai do not necessarily justify the implementation of the upgrading activities immediately. They are indicative only and are intended:

- (i) to provide a trigger point for initiating detailed feasibility study on the specific road;
- (ii) to make the case against the premature or delayed upgrading and to ensure the economic use of scarce resources; and
- (iii) to assist in the preparation of rolling plans for upgrading works.

**ANNEX 4 : List of Roads with Classifications**

Table 4.1: NH 1 Class Roads

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
1	H01	Mahendra Rajmarg (MRM)	0.00	1027.67	1027.67	
2	H02	Tribhuvan Rajpath (TRP)	0.00	28.04	28.04	
3	H02	Tribhuvan Rajpath (TRP)	134.54	156.20	21.66	
4	H03	Araniko Rajmarg (ARM)	2.74	112.83	110.09	
5	H04	Prithvi Rajmarg (PRM)	0.00	173.43	173.43	
6	H05	Narayanghat-Mugling Rajmarg (NMIRM)	0.00	36.16	36.16	
7	H06	Dhulikhel-Sindhuli-Bhittamod Rajmarg(DSRM)	0.00	48.87	48.87	
8	H08	Koshi Rajmarg (KRM)	0.00	29.65	29.65	
9	H10	Siddhartha Rajmarg (SRM)	0.00	24.10	24.10	
10	H12	Ratna Rajmarg (RRM)	0.00	22.33	22.33	
11	H16	Kathmandu Ringroad	0.00	28.00	28.00	
12	H19	Shabha( MRM) Bramhadev	0.00	13.30	13.30	Planned
13	H20	Kathmandu Terai Fast Track	0.00	81.80	81.80	Planned
14	F021	Kathmandu - Trisuli - Dhunche - Rasuwagadhi	59.33	143.96	84.63	
15	F068	Pokhariya - Jitpur	0.00	10.20	10.20	
16	F069	Galchhi - Debighat	0.00	20.00	20.00	
<b>Total</b>					<b>1759.93</b>	

Existing : 1664.83

Under construction : 0.00

Planned : 95.10

Table 4.2: NH 2 Class Roads

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
1	H02	Tribhuvan Rajpath (TRP)	28.04	134.54	106.50	
2	H06	Dhulikhel-Sindhuli-Bhittamod Rajmarg(DSRM)	48.87	208.87	160.00	
3	H07	Mechi Rajmarg (MERM)	0.00	268.06	268.06	
4	H08	Koshi Rajmarg (KRM)	29.65	111.46	81.81	
5	H10	Siddhartha Rajmarg (SRM)	24.10	181.22	157.12	
6	H11	Rapti Rajmarg (RPRM)	0.00	168.68	168.68	
7	H12	Ratna Rajmarg (RRM)	22.33	113.08	90.75	
8	H13	Karnali Rajmarg (KARM)	0.00	202.00	202.00	
9	H14	Mahakali Rajmarg (MKRM)	0.00	360.15	360.15	
10	H14	Mahakali Rajmarg (MKRM)	360.15	375.15	15.00	Under construction
11	H14	Mahakali Rajmarg (MKRM)	375.15	455.15	80.00	Planned
12	H15	Seti Rajmarg (SERM)	0.00	65.96	65.96	
13	H17	Ratuwa River-Rangeli (Postal)	0.00	32.00	32.00	
14	H17	Ratuwa River-Rangeli (Postal)	32.00	42.00	10.00	Under construction
15	H17	Ratuwa River-Rangeli (Postal)	42.00	48.00	6.00	Planned
16	H17	Ratuwa River-Rangeli (Postal)	48.00	81.00	33.00	
17	H17	Ratuwa River-Rangeli (Postal)	81.00	82.00	1.00	Under construction
18	H17	Ratuwa River-Rangeli (Postal)	82.00	83.00	1.00	Planned
19	H17	Ratuwa River-Rangeli (Postal)	83.00	96.00	13.00	
20	H17	Ratuwa River-Rangeli (Postal)	96.00	101.00	5.00	Under construction
21	H17	Ratuwa River-Rangeli (Postal)	101.00	103.00	2.00	Planned
22	H17	Ratuwa River-Rangeli (Postal)	103.00	163.00	60.00	
23	H17	Ratuwa River-Rangeli (Postal)	163.00	166.00	3.00	Under construction
24	H17	Ratuwa River-Rangeli (Postal)	166.00	255.00	89.00	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
25	H17	Ratuwa River-Rangeli (Postal)	255.00	255.50	0.50	Under construction
26	H17	Ratuwa River-Rangeli (Postal)	255.50	266.00	10.50	Planned
27	H17	Ratuwa River-Rangeli (Postal)	266.00	282.00	16.00	
28	H17	Ratuwa River-Rangeli (Postal)	282.00	293.00	11.00	Under construction
29	H17	Ratuwa River-Rangeli (Postal)	293.00	315.00	22.00	
30	H17	Ratuwa River-Rangeli (Postal)	315.00	316.00	1.00	Under construction
31	H17	Ratuwa River-Rangeli (Postal)	316.00	318.00	2.00	Planned
32	H17	Ratuwa River-Rangeli (Postal)	318.00	342.00	24.00	
33	H17	Ratuwa River-Rangeli (Postal)	342.00	343.00	1.00	Under construction
34	H17	Ratuwa River-Rangeli (Postal)	343.00	499.50	156.50	
35	H17	Ratuwa River-Rangeli (Postal)	499.50	507.50	8.00	Planned
36	H17	Ratuwa River-Rangeli (Postal)	507.50	562.50	55.00	
37	H17	Ratuwa River-Rangeli (Postal)	562.50	563.50	1.00	Under construction
38	H17	Ratuwa River-Rangeli (Postal)	563.50	565.50	2.00	Planned
39	H17	Ratuwa River-Rangeli (Postal)	565.50	598.50	33.00	
40	H17	Ratuwa River-Rangeli (Postal)	598.50	600.50	2.00	Under construction
41	H17	Ratuwa River-Rangeli (Postal)	600.50	602.50	2.00	Planned
42	H17	Ratuwa River-Rangeli (Postal)	602.50	614.50	12.00	
43	H17	Ratuwa River-Rangeli (Postal)	614.50	618.50	4.00	Planned
44	H17	Ratuwa River-Rangeli (Postal)	618.50	645.50	27.00	Under construction
45	H17	Ratuwa River-Rangeli (Postal)	645.50	741.70	96.20	
46	H17	Ratuwa River-Rangeli (Postal)	741.70	742.20	0.50	Under construction
47	H17	Ratuwa River-Rangeli (Postal)	742.20	745.20	3.00	Planned
48	H18	Puspapal Lokmarg (Midhill)	0.00	1032.00	1032.00	
49	H21	Kathmandu Outer Ringroad	0.00	61.00	61.00	Planned
50	H21	Kathmandu Outer Ringroad	61.00	72.00	11.00	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
51	F052	Mirchaiya - Katari - Okhaldhunga - Salleri	0.00	112.00	112.00	
52	F130	Bhumahi - Parasi - Bhairahawa	0.00	29.15	29.15	
53	F133	Maldhunga - Beni	0.00	13.00	13.00	
54	F143	Ranjha (H12) - Nepalganj Airport	0.00	2.00	2.00	
55	F153	Bastipur - Makri- Pashupatinagar (Hetauda Bypass)	0.00	15.00	15.00	Planned
56	F178	Bijulebhanjyang - Lamidanda	0.00	10.46	10.46	
<b>Total</b>					<b>3786.84</b>	

Existing : 3512.34

Under construction : 78.00

Planned : 196.50



Table 4.3 : FR 1 Class Roads

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
1	H07	Mechi Rajmarg (MERM)	268.06	311.06	43.00	
2	H07	Mechi Rajmarg (MERM)	311.06	391.06	80.00	Planned
3	H09	Sagarmatha Rajmarg (SARM)	0.00	157.97	157.97	
4	H13	Karnali Rajmarg (KARM)	202.00	233.00	31.00	
5	F001	Birtamod - Chandragadhi	0.00	12.53	12.53	
6	F002	Damak - Gaurigunj	0.00	21.96	21.96	
7	F003	Bhardaha - Rajbiraj	0.00	17.75	17.75	
8	F004	Rupani - Kunauli	0.00	23.10	23.10	
9	F005	Chauharwa - Madar	0.00	26.66	26.66	
10	F006	Nawalpur - Malangwa - Sonbarsa	0.00	29.19	29.19	
11	F007	Chandranigahapur - Gaur - Baiganiya	0.00	45.44	45.44	
12	F008	Bardaghat - Surajpur - Harpur	0.00	23.05	23.05	
13	F009	Sunwal - Parasi - Mahespur	0.00	20.95	20.95	
14	F010	Jitpur - Khunuwa	0.00	33.39	33.39	
15	F011	Taulihawa - Gorusinghe - Sandhikharka	0.00	83.13	83.13	
16	F012	Chanauta - Krishnanagar	0.00	20.06	20.06	
17	F013	Bhaluwang - Liwang	0.00	130.84	130.84	
18	F014	Pyuthan - Chakchake - Ghorahi	0.00	75.00	75.00	
19	F015	Lamahi - Tulsipur	0.00	46.62	46.62	
20	F016	Bhuregaun - Gulariya - Murthiawa	0.00	35.31	35.31	
21	F017	Junga - Rajapur - Bhimapur (IB)	0.00	34.12	34.12	
22	F018	Birgunj - Kalaiya	0.00	11.66	11.66	
23	F019	Bhaise - Bhimphe	0.00	12.00	12.00	
24	F020	Palung - Kulekhani	0.00	20.57	20.57	
25	F021	Kathmandu - Trisuli - Dhunche - Rasuwagadhi	4.38	59.33	54.95	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
26	F022	Balkhu - Dakchhinkali - Kulekhani	0.00	35.59	35.59	
27	F023	Satdobato - Tikabhairab	0.00	11.57	11.57	
28	F024	Satdobato - Phulchoki	0.00	23.24	23.24	
29	F025	Lainchaur - Maharaigunj - Budhanilkantha	0.00	9.39	9.39	
30	F026	Chabahil - Sankhu - Jhule - Chautara	0.00	70.45	70.45	
31	F027	Jorpati - Sundarijal	0.00	7.13	7.13	
32	F028	Bhaktapur - Nagarkot	0.00	23.00	23.00	
33	F029	Banepa - Khopasi	0.00	9.54	9.54	
34	F030	Panchkhal - Melamchi - Helambu	0.00	63.00	63.00	
35	F031	Dolaighat - Chautara	0.00	25.11	25.11	
36	F032	Lamosangu - Ramechhap	0.00	124.92	124.92	
37	F033	Tamkoshi - Jiri	0.00	38.00	38.00	
38	F034	Malekhu - Dhading	0.00	17.50	17.50	
39	F035	Anbukhaireni - Gorkha	0.00	24.69	24.69	
40	F036	Dumre - Besisahar - Chame	0.00	108.43	108.43	
41	F037	Bharatpur Bypass Road	0.00	4.49	4.49	
42	F038	Fikkal - Pasupatinagar	0.00	10.75	10.75	
43	F039	Biratnagar - Rangeli	0.00	23.88	23.88	
44	F040	Hile - Basantapur - Tehrathum	0.00	48.18	48.18	
45	F041	Pokhara - Sarangkot	0.00	4.80	4.80	
46	F042	Pokhara - Baglung - Beni - Jomsom - Ghoktang	0.00	292.00	292.00	
47	F043	Bartung - Tamghas - Wamitaksar	0.00	80.20	80.20	
48	F043	Bartung - Tamghas - Wamitaksar	80.20	98.80	18.60	Planned
49	F044	Bhairahawa - Lumbini - Kakrahawa	0.00	30.78	30.78	
50	F045	Lumbini - Taulihawa	0.00	24.55	24.55	
51	F046	Nepalgunj - Gulariya	0.00	35.22	35.22	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
52	F047	Chinchu - Jajarkot - Dunai	0.00	143.00	143.00	
53	F047	Chinchu - Jajarkot - Dunai	143.00	260.00	117.00	Under construction
54	F048	Birendranagar - Dailekh	0.00	67.01	67.01	
55	F049	Khodpe - Chainpur	0.00	108.68	108.68	
56	F050	Satbanj - Jhulaghat	0.00	42.05	42.05	
57	F051	Silgadhi - Sanfebagar	0.00	67.00	67.00	
58	F052	Mirchaiya - Katari - Okhaldhunga - Salleri	112.00	169.90	57.90	
59	F053	Basantapur - Chainpur - Khandbari - Kimathangka	0.00	94.30	94.30	
60	F054	Duhabi - Inaruwa	0.00	14.00	14.00	
61	F055	Lahan - Bhagwanpur -Thadi	0.00	18.00	18.00	
62	F056	Jhumka - Chatara - Barahachhetra	0.00	26.00	26.00	
63	F057	Dharan - Chatara - Gaighat-Katari-Sindhuli-Hetauda	0.00	346.50	346.50	
64	F058	Bhedetar - Rajarani - Rabi - Ranke (MERM)	0.00	116.00	116.00	
65	F059	Birtamod - Sanischare - Budhabare	0.00	12.86	12.86	
66	F061	Rangeli - Kanepokhari - Dandagaun - Budhabare	0.00	54.00	54.00	
67	F062	Ghinaghat (MRM) - Biratchok	0.00	23.00	23.00	
68	F063	Inaruwa - Kaptanganj	0.00	24.00	24.00	
69	F064	Phattepur - Kanchanpur - Rajbiraj - Gobindapur	0.00	54.00	54.00	
70	F065	Kathauna - Pato	0.00	16.50	16.50	
71	F066	Kalyanpur - Subharpatti	0.00	18.00	18.00	
72	F067	Dhangarhi- Vidyannagar - Bariyarpatti	0.00	17.00	17.00	
73	F070	Khurkot - Manthali	0.00	11.00	11.00	
74	F071	Panchkhal - Palanchok Bhagawati	0.00	11.00	11.00	
75	F072	Gwarko - Panauti - DSRM	0.00	21.18	21.18	
76	F073	Bakhundol (ARM) - Bogatigaun (Ktm University Road)	0.00	2.00	2.00	
77	F114	Bardibas - Jaleswor	0.00	42.00	42.00	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
78	F120	Hetauda - Tikabhairab (Kanti Rajpath)	0.00	82.40	82.40	
79	F121	Pharping - Kulekhani	0.00	12.00	12.00	
80	F122	Bhimphedi - Kulekhani	0.00	15.00	15.00	
81	F124	Tandi (MRM) - Sauraha	0.00	7.00	7.00	
82	F125	Bharatpur - Meghauli Airport - Dhruwa	0.00	25.00	25.00	
83	F127	Dumre (PRM) - Bandipur	0.00	8.00	8.00	
84	F131	Malunga (SRM) - Mirmi - Gupteswor(Kaligandaki-Kushma)	0.00	19.00	19.00	
85	F131	Malunga (SRM) - Mirmi - Gupteswor(Kaligandaki-Kushma)	19.00	27.00	8.00	Under construction
86	F131	Malunga (SRM) - Mirmi - Gupteswor(Kaligandaki-Kushma)	27.00	36.50	9.50	Planned
87	F131	Malunga (SRM) - Mirmi - Gupteswor(Kaligandaki-Kushma)	36.50	85.00	48.50	
88	F132	Ridi - Rudraben i- Wami Taksar	0.00	57.00	57.00	
89	F134	Tamghas - Sandhikharka - Pyuthan	0.00	51.00	51.00	
90	F134	Tamghas - Sandhikharka - Pyuthan	51.00	84.00	33.00	Planned
91	F134	Tamghas - Sandhikharka - Pyuthan	84.00	132.00	48.00	
92	F135	Ramapur (MRM) - Lumbini	0.00	18.00	18.00	
93	F136	Shivgadhiya - Padariya (Lumbini-Circumambulatory)	0.00	12.60	12.60	
94	F141	Tulasipur - Purandhara - Botechaur	0.00	86.00	86.00	
95	F144	Tallo Dungeswor - Mathillo Dungeswor	0.00	8.22	8.22	
96	F145	Hilsa (IB )- Simikot	0.00	60.00	60.00	
97	F145	Hilsa (IB )- Simikot	60.00	95.00	35.00	Planned
98	F146	Sanphebagar- Martadi - Kolti - Sukhadhik	0.00	57.00	57.00	
99	F151	Daiji (MRM )- Jogbudha - Budar (MKRM)	0.00	68.60	68.60	
100	F152	Leguwaghat - Sabha Khola (Boharatar)	0.00	28.00	28.00	
101	F154	Nagma-Gamgadhi	0.00	89.00	89.00	
102	F166	Kagbeni-Muktinath	0.00	26.00	26.00	
103	F179	Shahid Road	0.00	110.00	110.00	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
104	F179	Shahid Road	110.00	147.00	37.00	Under construction
105	F179	Shahid Road	147.00	177.00	30.00	Planned
106	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	0.00	31.00	31.00	
107	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	31.00	100.00	69.00	Planned
108	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	100.00	123.00	23.00	
<b>Total</b>					<b>4991.06</b>	

Existing : 4553.96

Under construction : 162.00

Planned : 275.10

Table 4.4 : FR 2 Class Roads

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
1	F053	Basantapur - Chainpur - Khandbari - Kimathangka	94.30	159.30	65.00	
2	F053	Basantapur - Chainpur - Khandbari - Kimathangka	159.30	169.30	10.00	Under construction
3	F053	Basantapur - Chainpur - Khandbari - Kimathangka	169.30	207.40	38.10	Planned
4	F060	Bardanga-Urlabari - Madhumalla - Daregaunda	0.00	56.00	56.00	
5	F072	Gwarko - Panauti - DSRM	21.18	41.18	20.00	
6	F074	Nuwakot Darbar Access Road	0.00	8.00	8.00	
7	F106	Charikot - Dolakha - Lamabagar - Lapchehaun	0.00	35.00	35.00	
8	F106	Charikot - Dolakha - Lamabagar - Lapchehaun	35.00	90.00	55.00	Planned
9	F107	Birendrabazar -Yadukuha - Mahinathur	0.00	42.00	42.00	
10	F108	Janakpur - Yadukaha	0.00	18.00	18.00	
11	F109	Dharapani (MRM) - Dhanusadham - Janakpur	0.00	26.00	26.00	
12	F110	Janakpur (H06) - Jatahi	0.00	14.00	14.00	
13	F111	Jaleswor - Matihani	0.00	7.00	7.00	
14	F112	Janakpur(H06) - Manara - Bathanaha	0.00	17.00	17.00	
15	F112	Janakpur(H06) - Manara - Bathanaha	17.00	20.00	3.00	Planned
16	F113	Janakpur - Kurtha - Samsi	0.00	25.00	25.00	
17	F115	Matihan (MRM) - Gashala - Samsi	0.00	26.00	26.00	
18	F116	Phuljor (MRM) -Bayalbas - Tribhuwannagar	0.00	22.00	22.00	
19	F116	Phuljor (MRM) -Bayalbas - Tribhuwannagar	22.00	24.00	2.00	Planned
20	F117	Nayaroad (MRM) - Barhathwa - Madhubani	0.00	42.00	42.00	
21	F118	Tamagadhi (MRM) - Simraungadh(IB)	0.00	40.00	40.00	
22	F119	Manmat (MRM) - Kalaiya - Matiarwa (IB)	0.00	28.00	28.00	
23	F123	Dhadingbesi - Arughat - Gorkha	0.00	71.00	71.00	
24	F125	Bharatpur - Meghauli Airport - Dhruwa	25.00	33.00	8.00	
25	F126	Anptari (H05) - Devghat	0.00	4.00	4.00	



SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
26	F128	Damauli (PRM) - Neupanebesi - Bhorletar	0.00	32.00	32.00	
27	F129	Talchok (PRM) - Khudimuhan (Beganas Lake)	0.00	3.50	3.50	
28	F137	Pipara (MRM) - Chakar Chauda (IB)	0.00	27.00	27.00	
29	F138	Lamahi (MRM) - Koilabas (IB)	0.00	34.00	34.00	
30	F139	Holeri- Sworgadwar - Jaluki (Bhingri)	0.00	35.00	35.00	
31	F139	Holeri- Sworgadwar - Jaluki (Bhingri)	35.00	44.00	9.00	Under construction
32	F140	Sitalpati (H11) - Salyan	0.00	9.00	9.00	
33	F142	Nepalganj - Baghauda	0.00	47.60	47.60	
34	F142	Nepalganj - Baghauda	47.60	50.00	2.40	Under construction
35	F146	Sanphebagar- Martadi - Kolti - Sukhadhik	57.00	111.00	54.00	Planned
36	F147	Sati (Khairipur) - Khakraula	0.00	5.00	5.00	
37	F148	Muda (MRM) - Bhajani - Lalbojhi (IB)	0.00	21.00	21.00	
38	F149	Sahajpur - B.P. Nagar - Silgadhi (Dipayal)	0.00	48.00	48.00	
39	F149	Sahajpur - B.P. Nagar - Silgadhi (Dipayal)	48.00	53.00	5.00	Under construction
40	F149	Sahajpur - B.P. Nagar - Silgadhi (Dipayal)	53.00	83.00	30.00	
41	F149	Sahajpur - B.P. Nagar - Silgadhi (Dipayal)	83.00	108.00	25.00	Planned
42	F150	Kaluwapur (MRM) -Shreepur - Belauri (IB)	0.00	30.00	30.00	
43	F155	Bramhadev- Jogbuda	0.00	30.00	30.00	Planned
44	F156	Phikkal ( MERM) - Srianu - Baudhadham	0.00	33.00	33.00	
45	F157	Ilam ( MERM) - Maipokhari - Sandakpur	0.00	35.00	35.00	
46	F158	Damak (MRM) - Chisapani	0.00	43.00	43.00	
47	F158	Damak (MRM) - Chisapani	43.00	44.00	1.00	Planned
48	F159	Khurkot - Ramechhap - Sanghutar - Okhaldhunga	0.00	33.00	33.00	
49	F159	Khurkot - Ramechhap - Sanghutar - Okhaldhunga	33.00	42.00	9.00	Under construction
50	F159	Khurkot - Ramechhap - Sanghutar - Okhaldhunga	42.00	98.00	56.00	Planned
51	F160	Janakpur Circumambulatory	0.00	6.00	6.00	
52	F160	Janakpur Circumambulatory	6.00	53.00	47.00	Planned

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
53	F160	Janakpur Circumambulatory	53.00	80.00	27.00	Under construction
54	F161	Lothar (MRM) - Chuniyadhara - Malekhu	0.00	62.00	62.00	
55	F162	Beganastal - Bhorletar	0.00	25.50	25.50	
56	F163	Khairanitar (PRM) - Bhimad - Kawaswoti (MRM)	0.00	41.00	41.00	
57	F163	Khairanitar (PRM) - Bhimad - Kawaswoti (MRM)	41.00	49.00	8.00	Planned
58	F163	Khairanitar (PRM) - Bhimad - Kawaswoti (MRM)	49.00	106.00	57.00	
59	F164	Gagangaunda (PRM)-Begnastal	0.00	2.00	2.00	
60	F165	Pratapur-Raninagar-Triveni	0.00	19.00	19.00	
61	F167	Gaindakot - Rampur - Pipaldanda-Maldhunga	0.00	133.00	133.00	
62	F167	Gaindakot - Rampur - Pipaldanda-Maldhunga	133.00	139.00	6.00	Planned
63	F167	Gaindakot - Rampur - Pipaldanda-Maldhunga	139.00	207.00	68.00	
64	F167	Gaindakot - Rampur - Pipaldanda-Maldhunga	207.00	211.00	4.00	Planned
65	F167	Gaindakot - Rampur - Pipaldanda-Maldhunga	211.00	245.00	34.00	
66	F168	Banggadhi (MRM) - Mainapokhar	0.00	8.40	8.40	
67	F169	Kothiya - Thakurdwara - Amreni (MRM)	0.00	21.00	21.00	
68	F170	Baddichour - Gutu	0.00	30.00	30.00	
69	F171	Bhuregaun (MRM) - Bangesimal (Surkhet)	0.00	21.00	21.00	
70	F171	Bhuregaun (MRM) - Bangesimal (Surkhet)	21.00	68.00	47.00	Planned
71	F172	Karnali Corridor (Manma - Kolti)	0.00	43.00	43.00	
72	F172	Karnali Corridor (Manma - Kolti)	43.00	196.00	153.00	Planned
73	F173	Gangadhi - Sukadik	0.00	65.00	65.00	Planned
74	F174	Silgadhi - Khaptad	0.00	8.00	8.00	
75	F174	Silgadhi - Khaptad	8.00	30.00	22.00	Planned
76	F175	Patan - Pancheswor	0.00	32.00	32.00	
77	F175	Patan - Pancheswor	32.00	62.00	30.00	Planned
78	F176	Ugratara - Melauli	0.00	24.00	24.00	
79	F176	Ugratara - Melauli	24.00	29.00	5.00	Under construction

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
80	F176	Ugratara - Melauli	29.00	65.00	36.00	Planned
81	F177	Jumla Khalanga - Gamgadhi	0.00	55.00	55.00	Planned
82	F180	Ganeshman Marg (Thankot-Markhu )	0.00	20.00	20.00	
83	F181	Tadi-Labdu-Samundratar-GolphuBhanyang	0.00	40.67	40.67	
84	F182	Tallo Dungeshwor - Dullu	0.00	18.00	18.00	
85	F183	Shivanagar - Gumi - Patihalnachaur	0.00	45.00	45.00	
86	F184	11 Kilo (F035) - Chhepetar - Bhaluswara - Barpak	0.00	48.60	48.60	
87	F185	Putalikheth - Karkineta - Majhbeni(Kusma)	0.00	23.00	23.00	
88	F185	Putalikheth - Karkineta - Majhbeni(Kusma)	23.00	31.00	8.00	Under construction
89	F185	Putalikheth - Karkineta - Majhbeni(Kusma)	31.00	47.00	16.00	Planned
90	F186	Mirdi - Chitre - Bhimad	0.00	59.00	59.00	
91	F187	Trafficchok(MRM)-Baniniya (IB)	0.00	21.00	21.00	
92	F188	Banke (MRM) - Sangrampur (IB)	0.00	22.00	22.00	
93	F189	Gadhimai - Kawahigoth (IB)	0.00	10.00	10.00	
94	F190	Dumkibas (MRM) - Tribeni	0.00	22.00	22.00	
95	F191	Kathawa (IB) - Tribeni	0.00	19.00	19.00	Planned
96	F192	Rajapur-Daulatpur-Sati	0.00	7.00	7.00	Planned
97	F192	Rajapur-Daulatpur-Sati	7.00	13.00	6.00	
98	F193	Chaurjahari - Bas khola - Devisthal	0.00	42.00	42.00	
99	F194	Sajhandi - Satyawati - Badahare River	0.00	178.50	178.50	
100	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	123.00	180.00	57.00	Planned
101	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	180.00	202.00	22.00	
102	F195	Tikapur-Muda-Saphe Bagar-Dadakot-Gothalakhet-Chainpur-Saipal-Urai Bhaniyang	202.00	264.00	62.00	Planned
103	F196	Benighat-Arughat-Larke Bhaniyang	0.00	68.00	68.00	

SN	Road Ref No	Road Name	From Chainage	To Chainage	Length (km)	Status 2014
104	F196	Benighat-Arughat-Larke Bhanjyang	68.00	165.00	97.00	Planned
105	F197	Aryabhaniyang (SRM)-Rampur	0.00	41.00	41.00	
106	F198	Birgunj Bypass	0.00	7.21	7.21	
107	F199	Gandhi Manamohan Marga	0.00	25.00	25.00	Planned
108	F200	Kharindrapur(MRM)-Shitalpur-Bilmi	0.00	18.00	18.00	Planned
109	F201	Jiri-Salleri Road	0.00	160.00	160.00	Planned
110	F202	Jiri-Those-Bamti Road	0.00	44.00	44.00	
111	F203	Gulariya-Bagahighat-Rammapur	0.00	22.00	22.00	Planned
112	F204	Khutiya-B.P.Nagar-Gadhasera--Dipayal	0.00	4.00	4.00	
113	F204	Khutiya-B.P.Nagar-Gadhasera--Dipayal	4.00	32.00	28.00	Planned
114	F204	Khutiya-B.P.Nagar-Gadhasera--Dipayal	32.00	37.00	5.00	
115	F204	Khutiya-B.P.Nagar-Gadhasera--Dipayal	37.00	93.00	56.00	Planned
116	F204	Khutiya-B.P.Nagar-Gadhasera--Dipayal	93.00	95.00	2.00	
117	F205	Nijgadh-Pataura-Bankul-Gaur	0.00	41.00	41.00	
118	F205	Nijgadh-Pataura-Bankul-Gaur	41.00	56.00	15.00	Planned
119	F206	Gaur-Pipara-Samanpur-Santapur-Nunthar Road	0.00	38.00	38.00	Planned
120	F207	Parsa-Bara-Rautahat-Gandaknagar Road	0.00	80.00	80.00	Planned
121	F208	Triveni-Sanahi-Gandak Nahar Sadak-Nawalparasi	0.00	32.00	32.00	
122	F209	Holangadi-Dharampani-Dhungakhani	0.00	6.30	6.30	
<b>Total</b>					<b>4015.78</b>	

Existing : 2503.28

Under construction : 75.40

Planned : 1437.10

## Annex 5: Details of Budget for SRN (2015/16-2021/22)

		2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	Total	Comments
Total Length Maintained by DoR (BT Only) km		6,369	7,107	7,844	8,582	9,319	10,057	10,794		
Regular Annual Maintenance										
Routine	Rs/km/year	397	443	489	536	582	628	674	3,748	
Recurrent	Rs/km/year	486	542	598	655	711	767	824	4,583	
Specific	Rs/km/year	492	549	606	663	719	776	833	4,638	
Other	Rs/km/year	43	48	53	58	63	68	73	408	
Sub-Total (Regular Maintenance)		1,418	1,583	1,747	1,911	2,075	2,240	2,404	13,378	
Periodic Maintenance										
Reseal (Length)	NH	171	171	171	171	171	171	171	1,200	
	FR	386	386	386	386	386	386	386	2,700	
AC Overlay (Length)	NH	357	357	357	357	357	357	357	2,500	
	FR	0	0	0	0	0	0	0	0	
Rehabilitation (Length)	NH	529	529	529	529	529	529	529	3,700	
	FR	386	386	386	386	386	386	386	2,700	
Reseal (Cost)	NH	408	408	408	408	408	408	408	2,856	@ 2.38 Million per Km
	FR	918	918	918	918	918	918	918	6,426	@ 2.38 Million per Km
AC Overlay (Cost)	NH	1786	1786	1786	1786	1786	1786	1786	12,500	@ 5 Million per Km
	FR	0	0	0	0	0	0	0	0	
Rehabilitation (Cost)	NH	4229	4229	4229	4229	4229	4229	4229	29,600	@ 8 Million per Km
	FR	1929	1929	1929	1929	1929	1929	1929	13,500	@ 5 Million per Km
Sub-Total (Periodic Maintenance)		9,269	9,269	9,269	9,269	9,269	9,269	9,269	64,882	
Upgrading Works										
Upgrade to AC for NH/Two Lane	Km	200	200	200	200	200	300	390	1,690	
	Cost	10,000	10,000	10,000	10,000	10,000	15,000	19,500	84,500	@ 50 Million per Km
Upgrade to seal for FR/Two lane	Km	200	200	200	300	300	300	350	1,850	
	Cost	7,000	7,000	7,000	10,500	10,500	10,500	12,250	64,750	@ 35 Million per Km
Sub-Total (Upgrade)		17,000	17,000	17,000	20,500	20,500	25,500	31,750	149,250	
New Construction (SRN)										
	Km	300	350	350	350	350	350	350	2,400	
	Cost	7,500	8,750	8,750	8,750	8,750	8,750	8,750	60,000	@ 25 Million per Km
Bridge Works										
Rehabilitation/Maintenance		900	990	1,089	1,198	1,318	1,449	1,594	8,538	
New Construction in SRN		2,080	2,288	2,517	2,768	3,045	3,350	3,685	19,733	@ 10% increment from base cost
Design / Supervision		130	143	157	173	190	209	230	1,233	
Sub-Total (Bridge Works)		3,110	3,421	3,763	4,139	4,553	5,009	5,510	29,505	
Total by Year		38,297	40,023	40,529	44,569	45,148	50,767	57,682	317,015	