

## Executive Summary

### Name and Location of Project and Project Proponent

**Name of Project: *Drujegang - Balung Road, Dagana Dzongkhag, Bhutan***

Name and Address of Proponent:

Rural Access Project  
Department of Roads  
Ministry of Works and Human Settlement  
Royal Government of Bhutan  
Thimphu, Bhutan  
Telephone- 327451

After the encouraging experience of the Rural Access Project I (RAP) with the financial support of the World Bank, the Department of Roads is planning to undertake the implementation of Rural Access Project II as follow up/next credit of the World Bank. The Environmental Friendly Road Construction (EFRC) technique was adopted under RAP I to minimize the environmental degradation during construction and subsequent operation with the financial and technical support of SNV Bhutan. RAP I project is expected to be completed in June 2006. Prior to the completion of RAP I, the Department of Roads (DOR) is making preparatory works for RAP II, which is to be implemented soon after the completion of RAP I. The Drujegang - Balung Feeder Road Project is one of the sub-projects to be implemented under RAP II. The survey, design and cost estimation of this sub-project is prepared by DOR. The total length of this sub-project is 42.5 kilometer. The proposed road starts from Thangna village of Drujegang geog and passes through Budachhu, Petakha, Jinchela, Tsangkha village of Tsangkha geog and finally through Kompa, Bana, ends at Balung. The estimated populations to be served by this road include 6000 living in 558 households. The proposed road is planned to be developed as feeder road category having 5.1 meter formation width with gravel surface and necessary structures such as retaining wall, culverts, slope protection works, and other water management structures. The longitudinal gradient of the proposed road project varies from 0 to 10%. The construction of the road will also adopt the EFRC technology.

In accordance with the Environmental Assessment Act 2000, and Regulation for the Environmental Clearance of Project (2002), all the road project of feeder road category must undergo Environmental Assessment (EA) level studies to obtain development permits or public financing prior to the implementation of project. The proposed project falls under this category and the DOR is carrying out EA studies through domestic consultants. However, during the course of the EA study and project planning, no objection certificates from relevant stakeholders have been obtained and will be submitted together with the EA report for necessary approval and clearance by the National Environment Commission (NEC).

The alignment of proposed road sub-project has been finalized after rigorous studies of alternative alignment. During this exercise, two alternatives were assessed. Based on the analysis, the proposed alignment has been finalized in terms of the road passing through comparatively flatter gradient with less possibility of disruption of road services due to landslide and less numbers of cross drainage works. The comparison of both the alignments is presented in section 3.3.3 of this main report.

The summary of potential environmental adverse impacts due to the implementation of proposed project is presented in **table E.1**.

**Table E1: Potential Environmental Impacts**

Likely Impacts	Environmental Impacts				Significance
	Nature	Magnitude	Extent	Duration	
<b>Construction Phase</b>					
Impact due to Earthwork Excavation and Disposal <ul style="list-style-type: none"> <li>Approx. 180,627 m<sup>3</sup> for first 15 km</li> <li>Approx. 331,150 m<sup>3</sup> for the remaining stretch of Drujegang – Balung Road.</li> </ul>	Direct	Medium	Site Specific	Short Term	Significant
Impact due to Operation of Quarry Site	Direct	Medium	Site Specific	Short term	Insignificant
Impact due to Change in Land Use <ul style="list-style-type: none"> <li>Chuzhing 3.72 ha, Kamzhing-9.63 ha, Tseri 0.12 ha, cardamom cultivation-0.12 ha, Orange orchards-2.72 ha, Shoksing-0.06ha, Chirpine forest-0.41 ha, Broad leaf forest-3.47 ha and Scrub forest-1.02 ha from the detail assessment of first 15 km of Drujegang – Balung road.</li> <li>49 ha agriculture land which includes Chuzhing, Kamzhing and orchard will be affected remaining stretch of Drujegang – Balung Road.</li> </ul>	Direct	Low	Site Specific	Long Term	Insignificant
Impact on Water Resources Damage on irrigation System, Water supply System, and river water quality degradation	Direct	High	Local	Long Term	Insignificant
Slope Instability and Erosion	Indirect	Medium	Site Specific	Medium Term	Insignificant
Air and Noise Pollution	Direct	Low	Local	Short Term	Insignificant
Impact due to use of blasting materials	Direct	Medium	Local	Short Term	Insignificant
Water Pollution	Direct	Low	Local	Short Term	Insignificant
Loss of Forest <ul style="list-style-type: none"> <li>4430 m<sup>3</sup> for the trees will be removed for first 15 km of detail assessment and</li> <li>Approximately, 8200 m<sup>3</sup> for the remaining stretch of the alignment.</li> </ul>	Direct	Medium	Local	Long Term	Significant
Pressure on Forest Product	Indirect	Medium	Local	Long Term	Insignificant
Disturbances on Wildlife	Indirect	Low	Local	Short Term	Insignificant
Rare and Endangered Species	Indirect	Low	Local	Short Term	Insignificant
Pressure on Social Service and Facilities	Indirect	Medium	Local	Short Term	Insignificant
Occupational Health and Safety	Direct	High	Site Specific	Short Term	Insignificant
Health and Sanitation	In direct	Medium	Local	Short Term	Insignificant
Impact on Local Culture	Indirect	Low	Local	Short Term	
<b>Operation Stage</b>					
Soil Stability and Management	Direct	Medium	Site Specific	Long term	Insignificant
Road Accident	Direct	Medium	Local	Long Term	Insignificant
Air and Noise Pollution	Direct	Medium	Local	Long Term	Insignificant
Water Pollution	Indirect	Low	Local	Long Term	Insignificant
Road Safety Measures	Direct	High	Local	Long Term	Insignificant
Development of Ribbon Settlement	Indirect	Medium	Local	Long Term	Insignificant
Depletion of Forest Resources	Indirect	Medium	Local	Long Term	Insignificant
Socio-economic and Other Issues	Indirect	Low	Local	Medium	Insignificant

The mitigation measures for potential anticipated negative impacts are suggested in **table E2**.

**Table E2: Suggested Mitigation Measures**

Activities/Issues	Mitigation Measures	Location
<b>A. Pre-construction Stage</b>		
Selection of Alignment as per EA Study	Select best among the alternate route in consideration with minimize the adverse impacts and maximize the beneficial impacts (Please refer section 3.3.3 and 3.4 of EA main report)	Project Area
Implementation of EA recommendation in project, planning and design	Incorporation of EA recommendation in project planning and design	Road Corridor
Inclusion of Mitigation Measures in Project Cost, Bid Documents, and contract	Incorporation of EA recommendation in Bid Documents and Contract	Along the Road Corridors
Construction Logistics	Arrangement of logistics in time including necessary precautions for storage,	Construction Camps, sites
Land and Properties Acquisition	Compensation and rehabilitation to 45 affected households suggested in table 6.2 of EA main report	Specific locations (please refer 6.3.1.9 of EA main report)
<b>B. Construction Stage</b>		
Site Clearance/removal of vegetation	<ul style="list-style-type: none"> <li>Removal vegetation within 5.1 m formation width only</li> <li>Bio-engineering with native plants (<i>Alnus nepalensis</i>, <i>Bambusa nutan</i> and two grass locally known as <i>Peer</i> and <i>Lingma</i>)</li> <li>Avoid felling tall &amp; matured trees particularly <i>Ficus benghalensis</i> which is one of the main sources of food for Hornbills</li> <li>Compensatory plantation within road corridors to restore lost habitat</li> <li>Tree felling shall be done parallel to road alignment</li> <li>Installation of log barriers to prevent debris rolling down hill.</li> </ul>	Along the road alignment Specific location (9+500 – 12+000 km)
Construction, operation and shifting of camps	<ul style="list-style-type: none"> <li>Briefing labourers/construction workers on local culture and rules and regulations of kingdom on illegal activities such as felling of trees, fishing and hunting.</li> <li>Camps to be placed in secure location and be able to protect inhabitants from rain, excessive sunshine and other extreme condition</li> <li>Providing cooking gas or kerosene to discourage use of scarce firewood</li> <li>Waste disposal facilities such as dustbins and garbage to be provided</li> <li>Health screening for labourers</li> <li>Fire fighting equipment to be provided</li> <li>Separate clean drinking water to be supplied to reduce water use competition and for proper sanitation</li> <li>Adequate Pit latrines to be constructed at the campsites</li> <li>Camp areas to be cleaned and bare surface be revegetated to restore aesthetic value</li> </ul>	Labour camps to be constructed nearby takeoff and at chainage 7+500 (on a fallow land)
Management of Harvested Forest Product	<ul style="list-style-type: none"> <li>Sell/Auction the harvested forest product (timber/fuel wood) if feasible</li> <li>Local should be given opportunity to buy timber at subsidized rural rate</li> <li>Trees felled in Sokshing area could be given to the owner as a compensation for loss of their resources.</li> </ul>	Along Road Corridor where forest is to be cleared (0+000 – 15+000 km)
Compensatory Plantation	Plantation of tree at least 5 times in Nos. of destruction in suitable area in nearby the project area	Along chainage 8+000 – 10+000), in consultation with communities
Change in Land Use	<ul style="list-style-type: none"> <li>Avoid fertile agricultural land,</li> <li>provide compensation and rehabilitation to 45 households that falls within the ROW as suggested in Table 6.1 of the EA main report</li> </ul>	Road Alignment Chainage (0+000 – 15+000 km)
Spoil Disposal	<ul style="list-style-type: none"> <li>using spoils for reclaiming the degraded land in consultation with local community</li> <li>No disposal shall allowed in the areas of fragile slopes, floodways, farmland, forest areas, natural drainage path, religious and cultural sites, canal and other infrastructures</li> <li>Dispose spoils in the designated sites (refer table 6.1 of the EA report)</li> <li>Build many spoil benches for filling disposal area rather than few larger ones to avoid slope overloading</li> <li>Compact spoil benches at every 0.5 m thickness</li> </ul>	All along the road corridor. Spoil should be dumped along specified chainage of 2+000 – 2+100, 4+900 – 4+930, and 8+700 km

Activities/Issues	Mitigation Measures	Location
	<ul style="list-style-type: none"> <li>Disposal Site shall be rehabilitated with appropriate bioengineering works and proper drainage</li> </ul>	
Earthwork and Excavation	<ul style="list-style-type: none"> <li>Selection of proper alignment avoiding unstable and fragile zone</li> <li>Top soil shall be scrapped and stored for future reuse for bioengineering application</li> <li>Slope cutting activities to be carried out during dry season</li> <li>Slope cutting to be limited to 1:1 (detail provided in table 6.2 of the EA report)</li> <li>Slope cutting to be done with excavators and spoils to be carried to safe locations to designated site proposed in this EA report.</li> <li>Log barriers/ Check dams to be built to avoid damage of vegetation, properties and injuries to passerby</li> <li>Apply appropriate Bioengineering technique such spreading top soil, broadcasting seeds, grass slips, seedling of local plants such as <i>Alnus nepalensis</i>, <i>Bambusa nutans</i> and transplantation of grasses (locally known as <i>Peer and Lingma</i>)</li> </ul>	<p>All along road alignment but specifically at location of fragile zones of chainages:</p> <ul style="list-style-type: none"> <li>1+800 – 2+000 in Thangna village</li> <li>4+000 – 4+500 near Rotpachhu</li> <li>5+780 – 6+000 near Budachhu</li> <li>10+000 – 11+000 steep slopes of Petakha village, Tsangkha geog</li> </ul>
Slope Instability and Erosion	<ul style="list-style-type: none"> <li>Select an appropriate road alignment as recommended by EA &amp; Geological and Geotechnical studies. In this case, select alignment I of alignment option II.</li> <li>Cut &amp; fill approach shall be applied as far as possible. Slope cutting shall be limited 1:1.</li> <li>Revegetate cut &amp; fill slopes or exposed areas as soon as possible by using local plant species such as <i>Alnus nepalensis</i>, <i>Bambusa nutans</i> and transplantation of grasses (locally known as <i>Peer and Lingma</i>)</li> <li>Slope cutting to be carried out only during dry season</li> <li>Construction of proper drainages as recommended by Geological and Geotechnical Studies shall be adopted</li> <li>Adoption of appropriate bioengineering technique along with civil structures such as breast and retaining wall for slope stabilization. (For detail refer table 6.2 of the EA report)</li> </ul>	<p>All along the chainage.</p> <p>Specifically at Chainages :</p> <ul style="list-style-type: none"> <li>0+000 – 5+700</li> <li>6+100 – 15+000</li> </ul>
Quarries, borrow pits and stock pile (Note: As per geological & geotechnical study, RAP II, March 2006, there are no suitable quarry sites within 15 km stretch of Drujegang – Balung road. Construction materials to be transported from outside road corridor). However, the impacts and mitigation measures are provided.	<ul style="list-style-type: none"> <li>Selection of quarry site away from critical habitat, settlements, cultivated area as far as possible</li> <li>Separate clearance from DGM is necessary for Quarrying activities</li> <li>Quarrying operation to be done from crown of the slope and gradually moving down-slope in a phased manner</li> <li>Scrapping topsoil for future use in bioengineering application</li> <li>Provision of appropriate safety gadgets such as gloves, helmets, face masks, ear plugs, goggles, safety ropes to be tied around the waist, etc., to workers</li> <li>Quarrying activities to be carried out during daytime only</li> <li>Spraying of water to control excessive dust produced</li> <li>Restoration of quarry site and access road using appropriate bioengineering measures</li> </ul>	<p>Specific location of quarrying and stock piling</p>
Wild life and Habitat	<ul style="list-style-type: none"> <li>Remove/clear vegetation only within 5.1m formation width.</li> <li>Log barrier/Check dams to be constructed to avoid further damage on habitat downhill due to spoil/rock sliding</li> <li>Project along with Contractor and Drujegang Forest Beat Officer will make sure that no indiscriminate felling of tall and matured trees especially the <i>Ficus benghalensis</i>. Fig fruits are one of the main sources of food for Hornbills.</li> <li>Contractor along with Project Office shall be responsible to provide special instruction and training to its staff and workforce on conservation issues and benefits</li> <li>As a compensatory measure, Contractor shall plant locally available plants with particular emphasis on <i>Ficus benghalensis</i> to help restore the lost habitat.</li> </ul>	<p>All site from Chainage (0+000 – 15+000 km)</p> <p>Check dams needed at chainage 4+250 – 5+000, 5+500 – 6+000 and 8+000 – 10+000</p>
Handling and Use of Blasting Materials	<ul style="list-style-type: none"> <li>Transportation, handling and storage of explosive should follow the prevailing rules (Explosive rules of the Ministry of Home Cultural Affairs),</li> <li>Store explosive in steel container, which are fire and theft proof,</li> <li>Do not store gelatin, detonators, and cortex, together,</li> <li>Dispose waste safely by burying them in 5-8 feet deep pits,</li> <li>Adopt controlled blasting practice with limited charge where possible,</li> <li>Use Acconex near habitation and protected areas,</li> <li>Make provision of well equipped first aid kits, health facilities, and fire fighting equipment on construction site,</li> <li>Allow only trained or certified blasters to carry out all blasting activities,</li> </ul>	<p>Road Chainage 6+200, 7+500, 8+400 and 11+500 km where rock cutting by blasting materials is required.</p>

Activities/Issues	Mitigation Measures	Location
	<ul style="list-style-type: none"> <li>• Maintain coordination with Dagana administration, police, and Gup of Drujegang and Tsangkha Geog on schedule of blasting to ensure that nearby community people are informed,</li> <li>• Use appropriate warning signals by using whistles, flags, megaphone to ensure safety of traveling vehicle and people,</li> <li>• Adopt appropriate OHS ( provision of helmets, gloves, masks, etc),</li> <li>• Conduct blasting exercise during day time</li> </ul>	
Disruption of Drainage System	<ul style="list-style-type: none"> <li>• provide adequate numbers of drainage structures in order to have minimum interference with and impact on natural drainage pattern of the area,</li> <li>• Construct side drains, lined drain to tap excessive water and dispose to natural drain,</li> <li>• Planting of fast growing plant species such as <i>Alnus nepalensis</i>, Bamboos and local wetland grass called <i>Peer</i>, with high water absorptive capacity in marshy area which will lower the water table and reduce surface drainage,</li> <li>• avoid surface water discharge into farmland or risky locations,</li> </ul>	Along the road alignment (0+000 – 15+000 km) but more specifically along the chainage 4+000 to 6+000 and 10+500 to 15+000
Disruption of Community Infrastructures	<ul style="list-style-type: none"> <li>• Avoid damaging water supply line for lower Thangna village</li> <li>• Provide temporary/alternative arrangement for drinking water or foot and mule tracks</li> <li>• Restore all disturbed infrastructures to the condition before disturbance or improve where appropriate, and</li> <li>• Avoid contamination of water resources systems during construction</li> </ul>	Chainage (Water Supply 0+400m, Irrigation at 0+700, 0+950, 4+400 Km, foot trails/Mule tracks at 10+000, 11+000 and others)
Road Surfacing/gravelling work	<ul style="list-style-type: none"> <li>• Sprinkle water particularly nearby settlements to control dust pollution,</li> <li>• maintain equipment and vehicles</li> </ul>	Along the road corridors, specifically near the settlements from chainage 0+000 - 4+000, 5+000 – 7+000 and 10+000 – 11+000
Air Pollution	Adopt mitigation measures as suggested in earthwork excavation, spoil disposal, quarrying and stock piling	Along the road corridors
Water Quality	Adopt mitigation measures as suggested in earthwork excavation, spoil disposal, quarrying and stock piling	Along the road corridors, specifically at 0+450 – 0+750 (Pakachhu), 4+520 (Rotpachhu) and 5+780 (Budachhu)
Noise Pollution	Adopt mitigation measures as suggested in earthwork excavation, spoil disposal, quarrying and stock piling	Along the road corridors
Pressure on Community Infrastructures	Make separate water supply arrangement if required	Construction Camp site, etc
Adoption of Occupational Health and Safety	Adoption of OHS	Construction site
Disruption of Religious and Cultural Resources ( Note: Two culturally and historically sites are located beyond 15 km) hence no specific mitigations are provided in this EMP.	<ul style="list-style-type: none"> <li>• Change the road alignment, restore the sites. For details refer 6.3.3.5 of EA main report</li> </ul>	Construction Site Beyond 15+000 km
<b>C. Operation Stage</b>		
Slope Instability	correct maintenance of the slope protection measures and drainage works should be adopted, minor landslides, erosion, and mass wasting should be immediately cleared and slope restored with appropriate technology ( preferably bioengineering), promote and support soil conservation activities in the right of way and beyond, organize environmental awareness programmes for local communities, road users, and decision makers.	Landslide prone area
Road Accident	Adoption of Road safety measures, road signals to be places,	Along the road
Development of Ribbon Settlement	Restriction of development of ribbon settlement through enforcement of Road Act 2004	Along the road corridors
Depletion of Forest Area	Protection of forest resources by imposing strict rules	Along the road corridors
Maintenance of Road	Adoption of regular maintenance practices	Along the road

In order to implement the mitigation measures, comprehensive Environmental Management Plan covering mitigation measures, responsible person for adoption of mitigation measures, monitoring indicators, monitoring agencies, and frequency of monitoring have been prepared and presented in chapter 7 and Appendix 2.

The conclusions of the present EA study mainly include:

- Based on the exercise during the course of the EA studies, the proposed road sub-project will have no detrimental impacts to physical, biological and socio-economic and cultural resources, as the predicted negative impacts could be mitigated through the adoption of an appropriate mitigation measures.
- The forest within the first 15 km of the Drujegang – Balung road is fragmented and disturbed due to human activity; hence it is not a significant wildlife habitat. However, forest beyond Tsangkha village till Balung is mostly intact and it is a significant wildlife habitat.
- This road mainly passes through gentle to moderately inclined colluvium soil in general. The alignment is safe and stable, provided minimizations in slope disturbances by using the concept of cut and fill balance. The bridge sites are stable. The slopes near the bridge approaches are moist, steep and the concept of cut and fill balance is hardly possible which may cause slope stability problem. The spoil disposal site after 10+000 km is very difficult to find as the road passes mostly through orchard and dry land agriculture.
- About 558 households of three Geogs of *Drujegang*, *Tsangkha* and *Lajab* with an estimated population of 6000 people would directly or indirectly benefit from this sub-project by increasing access to market, education, health facility and other service centers.

Hence the proposed project is recommended for implementation. The specific recommendations are also presented hereunder:

- Considering the emergence of integration of environmental conservation into development process, the proposed project should be designed and implemented in line with the Environmental Friendly Road Construction Technique being adopted in Bhutan,
- The mitigation measures suggested should be integrated in planning and design stage of the project in terms of selection or appropriate alignment, incorporation of mitigation measures in detailed engineering design, cost estimate, bid document including technical specification as preventive measures.
- The John Howell's Bioengineering in Bhutan for Road Sector 1999 should be consulted and used while designing for slope protection and stabilization. The manual provides a detail bioengineering methods and techniques particularly relevant to the Bhutanese environmental conditions.

As a way forward, the RAP shall carryout the following activities:

- The mitigation measures proposed in the EMP will be included into contract conditions or technical specifications and cost estimations to be incorporated into Bill of Quantity (BOQ).
- The Contractor/Bidder shall prepare site specific EMP as per EFRC/DOR's "Guidelines for Bid Preparation, July 2005" which has to be along with bidding document.
- During construction, the contractor, Project officials (RAP at center as well as in Project level) will ensure the implementation of mitigation measures, monitoring activities in specified time as recommended by EMP. In addition, the project officials will facilitate the monitoring process to be carried out by other stakeholders such as communities, MOWHS, NEC.